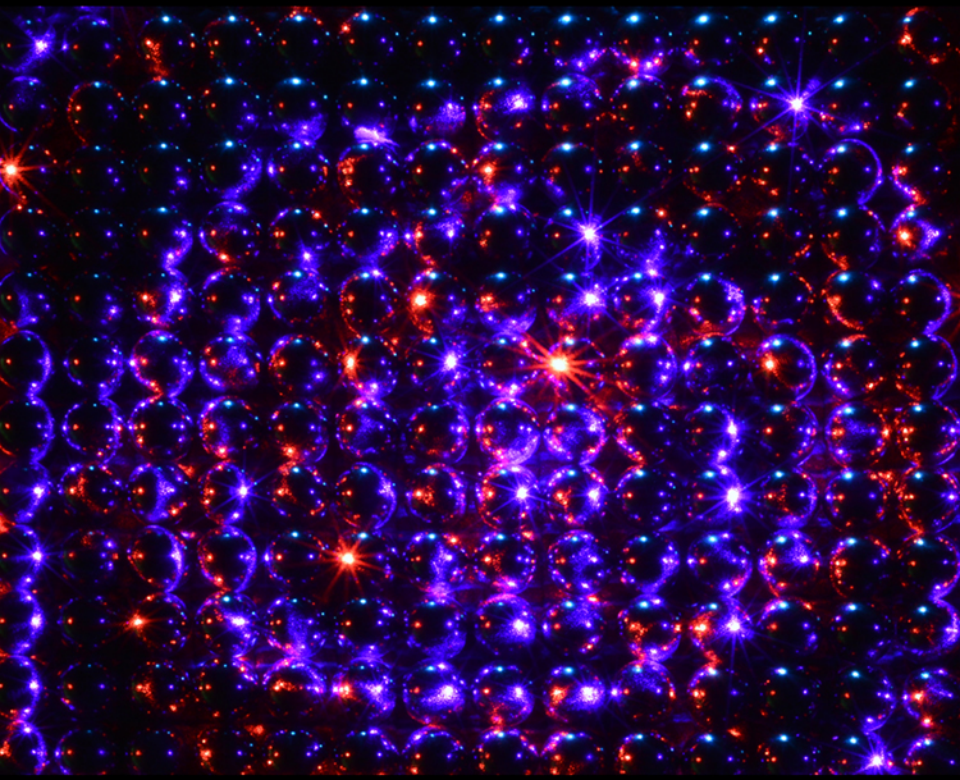
My Computer Was a Computer

Catalyst: M. Beatrice Fazi



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Catalyst

The twenty-first century is a time of prodigious creative and intellectual experimentation, with many thinkers, artists, and makers engaging in a range of practices that are foundationally speculative yet nevertheless transformative. The Catalyst book series aims to represent this space of possibility by coupling theorists and artists in ways that galvanize logics, spaces, politics, and practices that are not yet mapped … and perhaps never can be.

Catalysis instigates processual differentiations over a space of exchange; it is eventful, unpredictable, and generative. To chart a catalyst is to bring attention to the critical and creative processes that reveal hidden perspectives upon the event of their becoming. Thus, contributors to the Catalyst books think *alongside* the catalyst, edging and forging implications, connections, atmospheres and weirdnesses. The essays do not review or critique the catalyst's work but rather sound points of contact in pursuit of resonances, enacting gestures of performative solidarity through intellectual and creative engagement.

Catalyst books build speculative communities, inviting a wide range of perspectives into conversations about shared artistic, political, and intellectual values while privileging the unique, distinct and personal insights that characterize any single voice of engagement. Each volume in the series provides an in-depth look at an active thinker or artist—seeking after the full relevance of their work. The series focuses in particular on voices that have not already been widely featured but who have unique and relevant perspectives to share on questions of art, theory and culture.

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Catalyst : M. Beatrice Fazi

M. Beatrice Fazi is Reader in Digital Humanities in the School of Media, Arts and Humanities at the University of Sussex, United Kingdom. Her primary areas of expertise are the philosophy of computation, the philosophy of technology and the emerging field of media philosophy. Her research focuses on the ontologies and epistemologies produced by contemporary technoscience, particularly in relation to issues in artificial intelligence and computation and to their impact on culture and society. She has published extensively on the limits and potentialities of the computational method, on digital aesthetics and on the automation of thought. Her monograph *Contingent Computation: Abstraction, Experience, and Indeterminacy in Computational Aesthetics* was published by Rowman & Littlefield International in 2018.

Introduction
Computation is Computation

David Cecchetto

In her 2005 *tour de force My Mother Was a Computer*, N. Katherine Hayles introduces the phrase "regime of computation" to parse the ways in which the ubiquity of computers makes them a hegemonic structuring force of cultural imaginations. It isn't just that computers are everywhere and in everything, but that they shape our understandings of any particular where or what. In doing so, they afford certain futures while constraining others. Hayles notes, quite rightly, that computation has become a pervasive lens through which the world is viewed, both literally and figuratively; like any good lens, it succeeds precisely to the extent that it effaces itself from what it presents.

This is a quintessentially technocultural observation: the whats of the world are always caught up in the hows of their apprehension. As such, one lesson Hayles would have us learn from her analysis of the regime of computation is that computers are inseparable from their cultural histories. Importantly, she has given special attention to the gendered aspect of these histories. As much is evident in her title, which plays on the historical reality of "computing" as a profession mostly populated by women. In *My Mother was a Computer* and elsewhere, Hayles unpacks the ways in which this gendered history persists in the hardware,

software, and wetware of both contemporary computing and (computational) culture more broadly.

The title of this collection—*My Computer Was a Computer*—takes up Hayles's historicizing impulse in a slightly different register. If the wordplay of her title hinges on historical cultural developments as a force of change, our title suggests that similar changes might be found in and as computer technology itself.[1] My computer was a computer and my computer is a computer, but it isn't what it was. To say as much is to take up the position M. Beatrice Fazi has charted throughout her work. Rather than conceiving "the systematisations of computation [as] simple reductions that capture [or fail to capture] the complexity of the world," Fazi understands computational processes as "dynamic and generative because they have the potential to actualise themselves."[2] This generativity is crucial because, as noted above, it positions computation within history—or rather, it positions the computer as historical, *independent of its contacts with human narratives*.[3] Computational historicity—that is, the changes in computational concepts, practices, and materialities—is different from the history of computation, and therefore one of Fazi's central projects is to analyze computation on its own, radically singular terms.

Hence her emphasis on aesthetics. This emphasis is partially why Fazi makes such an interesting catalyst for this volume. While Fazi's work touches on a number of artistic practices, these are not central to her contributions (in contrast to other Catalyst books). By taking seriously her claim that computation is novel, this volume seeks to catalyze the exploration of creative practices—the actual, contingent instances of the computational aesthetics so central to her work—and to appreciate them as such.

This position emerges in response to Fazi's insistence that she is interested in aesthetics (following Deleuze) as an "investigation into the conditions of *real* experience"[4] that exceeds representation rather than as a theory of art "tied to traditional tenets such as beauty, taste, and judgement."[5] Fair enough! But if the point of this distinction is to establish a sphere specific to computation, we can still investigate the aesthetic tenets specific to that sphere. How would attending to computational aesthetics from an extra-human perspective (sic) bend our understanding of art itself in new directions? What would constitute a computer's art practice? A culturotechnical gambit to complement more familiar technocultural methods? To be clear, any answers to these questions are almost entirely formal in the chapters that follow, which feature very little explicit discussion of creative practice (as with Fazi's work itself). Yet my hope is that, as the sixth Catalyst book, this collection leverages its setting to draw out the weird, terrifying, and even beautiful appearances that come about with the strange novelty of computational technics. If computation works via its own aesthetics, as Fazi argues, then these inevitably *also* unfold in the dynamic and historical patterns of appearance indicated by the terms "beauty, taste, and judgement." If it is a little ridiculous to imply that such judgements might be placed in the province of "art," so be it: art is almost always in some sense absurd (perhaps most so when it is most serious), and has never been isomorphic with itself in any case.

As Fazi puts it in one of my favorite of her claims, "computation is computation."[6] Yet this is so precisely because computation is never simply contained within the skin of computers, but is instead singularly generative. That generativity—in the fullest sense of the term, and perhaps

even a little more than that—is the premise of this book: thinking with Fazi opens onto more-thans precisely because her analyses are so focused. Indeed, her work is profoundly catalytic for so many disciplines because it is fundamentally compressed: because "computation is computation," attendant terms such as (for example) contingency and incommensurability are troped in new ways, yielding novel aesthetic trajectories.[7]

In some ways, this contractively expansive approach is familiar. In scholarship on material culture, for instance, a common method is to focus on one seemingly simple thing such that it opens onto a tangled mesh of legacy technologies, historical influences, power brokerages, distribution networks, cultural assumptions, and so on. A screw is not just a small metal object, but instead depends on the standardization of bolts, screwdrivers, construction materials, distribution networks, retail outlets, construction techniques, and so forth. By contracting attention onto something that can be grasped, much else besides comes into focus.

But Fazi's work queers this method just a little, because the object of attention isn't a thing *per se* but something more abstract. It wouldn't be wrong to say that a similar fleshing out occurs with her concepts as with material artefacts … but it wouldn't be quite right, either. Something different happens with abstractions, which tend on the one hand to confound neat attempts to represent them, while on the other they can't but be represented. The latches and levers of abstraction are of a different sort than strictly material artefacts, which is precisely why it *matters* (to borrow a well-worn pun) that Fazi does not shy away from abstraction. Contra Jameson, theorizing "inevitably involves abstracting" for Fazi, because "abstraction is not

some kind of contemplative removal from the world, but is in fact intrinsic to the latter, and to how we experience it."[8] By honing in on the concept of computation and its more-than-human capacities, Fazi opens an opportunity for new understandings of the myriad ways in which human lives are lived in contact with computational abstraction. In this sense, Fazi's work is also explicitly and unapologetically schematic: she doesn't simply parse concepts, but instead builds them so that they in turn can build. This schematism distinguishes Fazi's work from much contemporary theory (which tends more towards criticism in the broad sense), and *makes room* for alternate readings and trajectories even as it forecloses them in some ways. There is more than one way to be generative: by definition, generativity means that there are always more ways than there are. Fazi's powerful contribution to our understanding of computation is thus to materially provide an abstract infrastructure for new abstractions; her thought plays like Minecraft rather than an open world video game.

Chapters One and Two demonstrate how computation as computation in no way precludes it from being something else, and in some ways acts as an alibi for pernicious undertakings. R. Joshua Scannell takes this up in Chapter One—"Terra Ignota: Noncorrelation and Computational Agency"—in the context of the "datalogical turn," a moment he characterizes as a shift away from the biopolitical management of humans and human populations and towards "the seamless circulation of 'objects' through parametric space": that is, towards a "life-as-logistics" treatment of "bodies *only as abstracted* from the materiality of actually-existing social relations" that, in turn, hides a "brutal necropolitics." Scannell makes a nuanced point about the particular type of abstraction brought about by digital

media and what he calls its "*noncorrelation* to the world." For Scannell, understanding the specific way that computation is computation—its "alien aesthetics"—is necessary in order to understand the formal agential capacities of digital media, which he demonstrates in a brilliant critique of the PredPol predictive policing system.

Jennifer Rhee also takes up the predatory profile of computation in Chapter Two, "'A really weird and disturbing erasure of history': The Human, Futurity, and Facial Recognition Technology." Rhee is concerned with the ways that artificial intelligence (AI) technologies foreclose the constitutive plurality of "futurity" (Bahng) in favor of a single future. Rhee notes that this comes about in part because of the implied "like a human" that follows many instances of the question "can a machine think?," which smuggles in the ways that the "concept of the human has enabled exclusion, exploitation, subjugation, and violence." Powerfully, Rhee demonstrates how AI's imitation of specific (racialized) contours of this term—its selections of who counts as human, how, and under what circumstances—leads to the seeming fatality of a given future it predicts. These given futures are constructed on historical "hierarchies of race, gender, sexuality, class, and citizenship" that they erase even as they rely on them. In this context, Rhee concludes the chapter by engaging the 2017 artwork *White Collar Crime Risk Zones,* which she positions as a speculative critique of the racial hierarchies constitutive of facial recognition AI.

In Chapter Three—"New Energy Holistics: Speculations on the predicament of predictive living"—Ted Hiebert centers artistic practice more than any other author in this collection. Hiebert transposes Fazi's interrogation of computational "black boxes"—"systems characterized

by their ability to generate outcomes that defy and exceed explanations based on the inputs they are given"—onto the site of the camera. His interest "is not with the images a camera produces, but with these images as instances of a larger context that cameras themselves produce—and by extension technology in a larger sense." From this, Hiebert meditates on three images, each a kind of portrait rerouted through cameratic relations. In so doing, he obliquely scouts the potential of photographic relationality to service a broader rethinking of technological predictive culture.

Chapter Four—"On Continuity and Discreteness: Bataille, Korzybski-Bateson, Adorno" by Colin Campbell—likewise takes an oblique approach to its central concern, namely the relation between continuity, discreteness, and digitality. Working from a position that "brings the continuous, infinite movement of experiential, lived dynamics into what is static and finite, such as the digital machine," this chapter limns "a mobius-like figure of ingression of the continuous within the discontinuous." (This approach is inspired by Fazi, but is one with which she would likely disagree.) Campbell's fragmented approach is vivid if anachronistic from the perspective of many contemporary approaches to digital culture: the first fragment engages the implications of human tool use through theory of religion; the second enlists general semantic theory, cybernetics, and cetaceans to make an (epistemological) point about artistic practice; and the third concludes by parsing digital indeterminacy through a cipher of Adornian aesthetic theory. If, as Campbell insists, the "ingression of everything whole by radical continuity troubles boundaries [such that] the fragments mutually inform but do not fully cohere," this relation plays out brilliantly in both the structure and signs of this chapter.

The volume takes an archeological turn with Chapter Five, "Which Kind of Media "Philosophy" for Computation? A Rather Radical Media Archaeological Comment" by Wolfgang Ernst. In adopting an archeological method, Ernst steadfastly analyses computation's mathematical and philosophical implications, eschewing its human histories in favor of focusing on its "technological being-in-action"; computation, here, is "operational mathematics." Ernst does not ignore the histories that subtend computation—the chapter moves fluidly through historical moments that span an impressively diverse set of disciplines—but rather attends primarily to articulating "actual computing": that is, to the "time-critical differences" that take hold when processes are "implemented into non-human procedures." For Ernst, then, "the machine's operations (its media archaeological *momentum*) are at their core un-historical; the specific time function of the machine is to some extent outside history and cultural discourse." By analyzing it as such, Ernst proposes that we can begin to understand the ways that computation is truly alien to human perception (a theme taken up elsewhere in the collection, from very different perspectives).

While oriented towards different ends, the final chapter—"Compression Artefacts: On the Aesthetics of Compressibility" by A. A. Cavia— pressures the technicity of computation in order to bring its aesthetic yield into focus. Specifically, Cavia considers "compressibility" in the context of intelligibility in order to situate information and computation as "symptoms of a broader project" he identifies as "*encoding of syntax*." Cavia's argument is nuanced and therefore difficult to compress, but works in part by charting the full ramifications of contingency's incompressibility, one

upshot of which is that contingency is part of "a minimum viable metaphysics outlined by a constructive treatment of computation." Recalling Fazi, this means that the understanding of compressibility Cavia tracks is central to the development of an aesthetics of computation, because "algorithmic compressibility comes to represent the very method that renders a real pattern intelligible through the movement from patterning to encoding." Importantly, however, this aesthetics is inclusive of computation (and its particularities) but is not exclusive to it; Cavia ends his chapter with a brief nod towards poetry as "arguably the most powerful mode of compression in all the arts."

Taken together, the argument these chapters make as a collection pertains to the distinction between is and equals: computation *is* computation, but precisely for that reason any instance of it is never simply equivalent to its abstraction. Instead, computation is the computational more-thans that make it itself, the politics, rationalities, materials, adjacencies, contingencies, digitalities, histories, archaeologies, futurities, mediations, and performativities that (in)cohere in its movements and abstractions. It's almost certainly other things too, and the gambit of this collection is that Fazi's comprehensive scholarship might catalyze as much as it describes, both within these pages and beyond.

Notes

1 To be clear, this isn't a position with which Hayles would necessarily disagree.

2 Fazi quoted in David Beer, "Explorations in the Indeterminacy of Computation: An Interview with M. Beatrice

Fazi," *Theory, Culture & Society* 38.7-8 (December 2021): 289–308, 209. doi:10.1177/0263276420957054.

3 This aligns with Wolfgang Ernst's media archaeological approach, both throughout his work and in Chapter Five of this book.

4 Fazi, *Contingent Computation: Abstraction, Experience, and Indeterminacy in Computational Aesthetics* (Lanham: Rowman & Littlefield, 2018), 13.

5 Ibid., 8.

6 M. Beatrice Fazi, "Incomputable Aesthetics: Open Axioms of Contingency," *Computational Culture* 5 (2016). http://computationalculture.net/incomputable -aesthetics-open-axioms-of-contingency/.

7 See, for example, her discussions of contingency in *Contingent Computation* and of incommensurability in "Beyond Human: Deep Learning, Explainability and Representation," *Theory, Culture & Society* 38.7-8 (December 2021): 55–77. doi:10.1177/0263276420966386.

8 M. Beatrice Fazi, "The Ends of Media Theory," *Media Theory* 1:1 (2017): 107-21, 110. https://mediatheoryjournal.org/m-beatrice-fazi-the-ends-of-media-theory/.

1 Terra Ignota
Noncorrelation and Computational Agency

R. Joshua Scannell

The intellectual honeymoon with digital media has come to an end. At its peak in the early-mid 2010s, digital platforms were credulously cited as catalyzing or enabling everything from frictionless government to a world without crime to full-blown neoliberal utopia.[1] Now, the enthusiastic tomes celebrating new eras of transparency and accountability have given way to a meticulously documented digital dystopia.[2] Rather than our computers heralding revolutionary possibilities for how we live, work, and think in the age of big data,[3] we know that, among many other things, they're automating inequality,[4] algorithmically reinforcing racism,[5] organizing planetary murder,[6] and scaffolding a new Jim Code.[7] A recent edited collection says it most succinctly in its title, warning that *Your Computer is On Fire*.[8]

Instead of Silicon Valley's promised clean break with a "dumb" capitalist past mired in irrational biases, critical scholarship has pointed to the fact that both the data-driven *reality* of our present *and* the supposed utopias that ubiquitous digitality was to bring into being are little more than extrapolations of exactly the same systems of domination that undergird racial capitalism.[9] It follows, of course, that the bodies that are targeted, captured, and churned to achieve the wished-for precision of the big data

revolution are the same as they ever were: women, queer and trans folks, people with disabilities, and people of color.[10]

The above barely scratches the surface of the outpouring of critical work that takes aim at the datafied order of things, and in fact the periodization is spurious. Criticism of the "cybernetic" turn is as old as the information revolution itself. And it always bears repeating that Norbert Weiner claims that his first act after discovering the managerial possibilities of datafication was to call union leaders and warn them about it.[11] That the information revolution was always an anti-politics, a way of domesticating radical demands and movements has been obvious to a great many observers, not least those Italian radicals whose demands were most totally coopted by capital.[12] Not for nothing did Gilles Chatelet warn at the end of the twentieth century that the primary thrust of digital postmodern market democracies was to teach the middle classes to "live and think like pigs."[13]

But still, there is something specific to this moment at the end of the 2010s and the beginning of the 2020s when the technocratic fever for the digital seems to have broken. Or, rather, when the hegemonic structure legitimating and normalizing what Mark Hansen calls twenty-first century media seems to have cracked.[14] Even in the inner sanctums of empire, hearings aim to call barons of bits to account. And although they are generally farcical in their pantomiming interrogations of the Zuckerbergs and the Dorseys, *yet still they exist* and that *is not uninteresting*.

At the risk of overstating the obvious, the pushback in this moment seems rooted in the chasmal disconnect between the breathless proclamations of the possibilities of the digital world and the reality ushered in by this stage of what McKenzie Wark calls post-capitalist "Vectorialism."[15]

Whether or not we are ready to declare with Wark that capital is well and truly "dead," it certainly seems true that the organizing modalities that govern the relations of expropriation and circulation between the living, the lived, and unliving matter have warped beyond recognizably "neoliberal" value forms and labor relations. That these morphing forms are driven by ubiquitous computational media is also beyond question.

Terra Ignota

My colleagues and I have elsewhere made the case that the involution of big data into the daily practices of managing and measuring "populations" inaugurated a weird form of governmentality that leaves the "biopolitical" administration of *humans* and *human* capacities behind in favor of tendering faith and care to the datalogical and the emergent.[16] This dynamic, which we call "the datalogical turn," is *non-biopolitical* in that the target of its operation ceases to entail management of humans and human populations specifically. Instead, the datalogical turn bends management towards the seamless circulation of "objects" through parametric space. In other words, if biopolitics denotes a mode of capture and control that sees the body itself as the target and tapestry of the exercise of power, the datalogical turn attends to bodies *only as abstracted* from the materiality of actually-existing social relations. Instead, the components of the body break into packets to be switched across simulated ontogenetic worlds of measurement and prediction no more or less the point of control than the other variables that populate the governed system.[17] Under this rubric of the non-biopolitical management of life-as-

logistics lies a brutal necropolitics built not only on but out of mechanisms for producing racial-sexual difference splayed across multiple and recombinatory temporalities.

Therefore, the shift to the datalogical has *not* had a notable impact on *exactly which* populations remain the overwhelming target of the extractive logic of digital capitalism plus the carceral logic of state power. Anti-black racial capitalism continues to structure the deployment of state violence against the racial-sexual "others" who constitute both the bedrock of administratively degraded and surplussed bodies, and, more importantly, the crucial foundation on which racial capitalist political economy is built.[18] But whereas warehousing surplussed populations in the cages of the American carceral state has often been understood as a spatial fix for the problems of economic restructuring,[19] the reframing of datalogical governance posits that the pricing logic of this mode of capitalism extracts enormous value from the structural surplussing of the socially dead.

An enormous amount of invaluable work has shown that the specific systems that drive most of the platforms that we users interact with on a daily basis engineer difference, inequality, or oppression by methods intended or not.[20] What drives this particular mode of governmentality that prices out dividuated extracts from the interstices of the material by hybridizing the fleshly with the spectral and speculative?[21] What is it that inheres in the ontology of "digital media" *as it has been imagined, developed, and deployed in the context of contemporary forms of governance and capital accumulation* that *guarantees* the changing same of "group-differentiated exposure to premature death"?[22] In other words: why, if the digitally-driven surveillance economies of a badly shuddering twenty-first-century

computational capitalism are so "indifferent" to the human, are poor folks, people of color, queer folks, women, and people with disabilities still the principle bodies from which speculative violence extracts value?

What exactly is it about the political ontoepistemology of digital media that leads it so well to projects of exploitation and expropriation? Surely part of the answer lies in the *cultural* logic of computationalism, as David Golumbia has demonstrated.[23] There is no shortage of idiocy and terror pouring forth daily from Silicon Valley faithful to buttress Golumbia's conclusion that computationalism is itself a sort of acephalous madness that leads to fascistic outcomes *regardless of the political commitments of the parties driving those outcomes*. The logic of computationalism too easily reduces people and social life to hierarchical and iterative systems that come to resemble a sort of computational numerology more than empirical or technocratic work.

But beyond the problem of the cultural logic of computation, there is something specific about the way digital technology *in general* operates as a political object of "the outside" that allies with the particular modalities of racial-sexually organized projects of capitalist command and control. Put differently, the socio-political power of digital media rests *precisely* in the fact that it is not truly a product of the material relations on which it is called to operate.[24] Always there is an irreducible inexplicability, an *alienness* internal to digital technologies that, in being both ontogenetic and performative, effectively *weaponizes* this exteriority to warp the regimes of the sensible that set the intelligible horizons of everyday life.

This capacity parallaxes the hallucinogenic and ontologically terrorizing necropolitics that anchors state and civil logic.[25] As in the return of the Lantern Law in the

Omnipresence of Precision Policing, so in this case is the parallax particularly obvious in the logical continuities that suture together the historical efforts of the eighteenth and nineteenth centuries to mathematize life with twentieth and twenty-first century histories of rationalization and reinforcement of the color line through the abstracted logics of mathematics and statistical reason. In the first instance, the state and infrastate projects of measuring and mathematizing life were dependent on the ontological placement of black life as continuous with but outside the regime of the "human."[26] This legitimized the fungibility of blackened bodies that, in turn, became the precondition for the creation of the Modern world.[27] This violent suturing of mathematics with black life was, as many have pointed out, both a precondition and the animating logic of twentieth and then twenty-first century efforts to "make sense" of the "race problem" by appealing to mathematics and burying the white supremacist infrastructure of population-making in the work of statistical reason.[28]

Jacqueline Wernimont has pointed out that part of what made this set of translations relatively seamless for the organization of state and infrastate power are the remediating capacities of quantum media, especially in the realms of measuring life and death.[29] With the growing ubiquity of digitally-driven techniques and technologies of "knowing" the social "enemy," the ideological project of producing racialized populations for extraction becomes increasingly enfolded into the background of everyday life: the sociotechnical operations that make twenty-first century life "work."

But this narrative in and of itself seems unable to account fully for the mystical effect of digitality on the performative work of world-making by death-dealing—a story that is

particularly acute in the realms of carceral capital.[30] Rather, this computational infrastructure doubles the (meta) physical work of the production of racialized hierarchies as "transparent" and "logical" statistical populations assembled for management by weighing on the systematizing capacities of actors and agency that achieves something like religious ecstasy.[31] To think through the enchantment of promoters of digital *policing* technologies is to see a faith not in the increased efficiency and safety of digitally-assisted logistics networks (and all digital media is essentially logistics media) but instead a donative in what Thrift calls an "untoward land,"[32] a terra ignota on which to reimagine the carceral capacities of state and capital. For Thrift, this process has produced:

> a natural economy because it resembles the process of terraforming in that it drives practices of worlding that are concerned with producing environments … which do not just provide support for a way of life in the way of infrastructure, but are a way of life: infrastructure cannot be separated out since it too has become expressive. In these worlds, every fibre of being is bent to producing landscapes that confirm each and every moment as what will happen.[33]

That this too redoubles the fantasies of racially organized imperial power's manifest destiny should not go unnoticed. The operative logic of the Untoward Land is the fantasy of it manifested in the bedrock assumptions of digital capital: a nonplace conjured by the operational handshakes of formless, weightless, transportable media. Yet of course "the cloud" of contemporary digital media is always anchored

in the production of bodies that, in their exclusion from the metaphor or imaginary, in fact anchor the floating signifier. Organized populational debility[34] is a precondition of the ontogenetic fiduciary capacities of the Untoward Land. Think of the Democratic Republic of Congo's maiming Coltan mines, indispensable for the chthonic logistics networks of digital capitalism yet unnoted by armchair political economists of contemporary capital.[35] Or remember the engineered legal and extralegal vulnerability of the delivery workers and warehouse pickers who anchor the "seamless" flow of goods and services to a hunkered-down elite.[36]

Alien Aesthetics

If the above helps to diagram the political economic and (post)-biopolitical dynamics that enframe the contemporary datalogical turn, it leaves largely to the side a philosophical question that must be engaged in order to formulate a coherent critical stance towards computational media: that of ontological capacity. It is not only crucial to understand what exactly computational media *is*, but what it is *about* its capacities that facilitates ubiquitous digitality's particular reorganization of the living and the lived. Building on M. Beatrice Fazi's work and particular strains of post-cinematic theory,[37] I want to propose that the crucial dynamic at play in digital media is its *noncorrelation* to the world. Or, put more strongly, that in the world organized by the digital model, the peculiar force of the model form (and here I am referring not just to software, but also to the discretizing precondition of computational media writ large)[38] is its *agential capacity*.

Computational media's world making is perhaps *related to* but *in noncorrespondence with* the "real" world. Fazi is especially important on this point in her systematic demolition of what she names the "metacomputational" gesture of contemporary computer science and digital philosophy, where the computational is imagined to converge with the "real."[39] It is worth pushing her argument farther, though, in order to note that the generative capacity of computational media also indexes a worldly *racial-sexual* problematic. This is so because the ontological terra nullius that Western thought projects onto the space created by the noncorrespondence of the world with itself is a foundational gesture of racial capitalist projects.[40]

The philosophical move towards granting autonomy of agency to computation in and of itself is crucial for digital media theory because it breaks an impasse. This impasse is rooted in the effort to reconcile Gilles Deleuze's noted antipathy towards the computational with his dominant status as *the* philosopher of the virtual and, therefore, of the digital. As Fazi points out,[41] this has basically been achieved by one of three interrelated maneuvers. First, by reading the way in which his ontology precludes computational media from thought as merely an antipathy that can be ignored. Second, by grounding the engagement with Deleuze and the digital in an affective register that focuses on the transduction of the body and the digital. Third, by positing that computation (especially in the wake of big data) has achieved an ontological density that renders it essentially indistinguishable from the analog, thereby ushering it into a Deleuzian ontology. I am personally guilty of all three of these maneuvers, but Fazi's point is indispensable here for the simple fact that *computation is what it is*: axiomatic,

discrete, and formal. If we are to grant computation *in and of itself* its proper due, then we must acknowledge that these Deleuzian maneuvers are *ontologically* unsatisfactory.

This is important because they consistently redirect attention away from automatic computation's capacities and therefore (if we are being Deleuzian about it) its ontology. Drawing on A.N. Whitehead, Fazi argues that this ontology is an axiomatic structure that functions through the *agential production of novelty*. Put more simply, in fact reductively, computational media is an *engine of alien intelligence* that proceeds via the *aesthetic* production of novelty. Or put another way: computational media exist to generate what I call *alien aesthetics*. This flips the script on human engagement with computational media. Whereas conventionally people may think of computational media as a reflection of the real that results in *misrecognition* (think of all the ways, from the humorous to the horrifying, in which computational media across mediums and disciplines are said to fail to "correctly" interpret and reflect the world "*as it really is*"), Fazi's work opens the door to positing computational media as a media of *nonrecognition*. In other words, computational media is generative of *its own world* (another way of saying that it is ontoepistemologically ontogenetic) irreducible to the world of "the real," understood as the domain of the living and the lived. Put in the simplest terms, we might say that when computational media "fails" or "gets things wrong," we misdiagnose the problem. We assume that the "real" as we understand it is computational media's referent when, in fact, the opposite is true. The ontology of contingent computation suggests that the production of novelty, rather than the simulation of "reality," is the fundamental operation of computational media.

This has significant social implications. Contingent computation's alien aesthetics has long held a desired (if disavowed) allure in the sociotechnical making of the world. To illustrate this point, we can look to a predictive policing system formerly called PredPol, and recently renamed Geolitica. PredPol is interesting because, according to its developers' stated goals, it doesn't "work"; its promotional materials assert that Police Departments that adopt its predictive system will successfully *reduce* crime and therefore *save* money.[42] In fact, the expensive software has been so inconsistent in accurately forecasting crime and so consistent in increasing racialized police violence that many municipalities previously invested in it have since abandoned it. Notably, two cities that have recently done so are its home city of Los Angeles, where massive grassroots resistance from groups like the Stop LAPD Spying Coalition effectively pressured the city council into reneging on its contract,[43] and Santa Cruz, where the technology was first tested and is now banned.[44]

But what *is* PredPol/Geolitica? The system is marketed in different ways to different actors. To police departments, it is supposed to be a cost-saver. By accurately "predicting" where "crime" will occur, the system is meant to facilitate the most efficient distribution of resources to prevent "the crime" from ever occurring. In theory, if the PredPol system were perfectly accurate, a few cops could police an entire city, driving from location to location just in the nick of time to prevent a "criminal" event from occurring. This would save departments *a lot* of money by reducing police staffing levels and overtime. At one level up, it would directly save cities a lot of money by reducing back-end costs associated with the arduous process of booking, holding, arraigning, and jailing people.

To civilians, Predpol is pitched as a way of eliminating officer bias and increasing safety while protecting civil liberties. If no crime occurs, the thinking goes, no "good cops" will have the opportunity to look the other way while "bad cops" arbitrarily assault civilians. In reality (and predictably) PredPol produces a "ratchet effect" of policing and police violence in Black and Latinx communities.[45] Brian Jefferson has done the crucial work of laying out why this framing (which is essentially adapted from police reform language set at the federal level)[46] is absurdly racist on its face. In fact, he shows it is little more than an extrapolation of predigital protocols for maintaining American racial capitalism through carceral racial domination.[47]

PredPol's developers disagree and claim that it can't be racist because it bases its predictions on three inputs: crime type, crime location, and crime time. This data is run through the PredPol system, which is patterned after seismic aftershock prediction software, which was in turn justified by criminological "near-repeat" theory. At all points in the modelling, questions of race (and humans, really) are left out, replaced by *ecological* and *geological* mathematics that *map onto* human social life.

But that is only part of the story. A key component of the PredPol system is derived from lead developer Jeff Brantingham's days as a computational forensic anthropologist studying the migration patterns of Neolithic hunter-gatherer societies. In one particular study of rock distribution in Stone Age France, he discovered that the algorithm that most accurately predicted those migration patterns was very similar to an algorithm that relatively accurately models the patterns of predatory animals ranging from wasps to leopards—a process called a Lévy random walk.[48] The not-so-great leap in logic was to connect the

words "predator" and "criminal," and suddenly crime prediction software begins to take conceptual shape. We can already see how a racialized alien aesthetics reenters the frame.

Conclusion

It is hard to overstate how dependent on contingent computation's *estranged* ontogenetic capacity such a project is. Purporting to foresee crime by computationally stacking 20,000-year-old hunter-gatherer rock distribution on top of the predatory habits of wasps and leopards, earthquake aftershocks, and racialized animalization, twenty-first century urban infrastructure, and the vagaries of police data collection protocols is, on its face, mad. But it is powerful precisely *because* it is a technic of the outside, an ontology that operates in the conceptual blank space produced by racial capitalism's insistence that the quantum can suture together its own incoherence in logic and lifeworld. It *may* have simulative value but is in fact manifesting the noncorrespondence of alien aesthetics.

Or, more to the point at hand, the interactivity of such a litany of objects across deep time can only produce *novelty* even if that novelty *appears phenomenologically as a misrecognized simulation*.[49] And, furthermore, it is exactly the *power* of this alien ontogeny that drives the adoption and deference to such sociotechnical systems. These are not, as Cathy O'Neill suggests, weapons of math destruction (though they have catastrophic effects),[50] but weaponizations of *world-building*, misrecognized by designers and adopters as simulating the world we live in. Vectorial Terra Ignota, come back once again.

Notes

1 See, respectively, Stephen Goldsmith and Susan Crawford, *The Responsive City: Engaging Communities Through Data-Smart Governance* (New York: Jossey-Bass, 2014); Robert Griffin, "Big Data, Big Results: How Cops Are Combating Crime with the Cloud," *Police1*, 15 December 2015. https://www.police1.com/pulse-of-policing/articles/big-data-big-results-how-cops-are-combating-crime-with-the-cloud-leIOgnEj0y9kRGHc/; Anthony M. Townsend, *Smart Cities: Big Data, Civic Hackers, and the Quest for a New Utopia* (New York: W.W. Norton & Company, 2014).

2 Eds. Brett Goldstein and Lauren Dyson, *Beyond Transparency: Open Data and the Future of Civic Innovation* (Washington DC: Code for America Press, 2013).

3 Viktor Mayer-Schönberger and Kenneth Cukier, *Big Data: A Revolution That Will Transform How We Live, Work, and Think* (New York: Eamon Dolan/Mariner Books, 2014).

4 Virginia Eubanks, *Automating Inequality: How High-Tech Tools Profile, Police, and Punish the Poor* (London: Picador, 2019).

5 Safiya Umoja Noble, *Algorithms of Oppression: How Search Engines Reinforce Racism* (New York: New York University Press, 2018).

6 Jonathan Beller, *Message Is Murder: Substrates of Computational* (Capital: Pluto Press, 2017).

7 Ruha Benjamin, *Race After Technology: Abolitionist Tools for the New Jim Code* (Cambridge: Polity Press, 2019).

8 Eds. Thomas S. Mullaney, Benjamin Peters, Mar Hicks, and Kavita Philip, *Your Computer Is on Fire* (Cambridge: The MIT Press, 2021).

9 See Katherine McKittrick, *Dear Science and Other Stories* (Durham: Duke University Press, 2020); Ramon Amaro, *The Black Technical Object: On Machine Learning and the Aspiration of Black Being* (Cambridge: The MIT Press, 2022); Seb Franklin, *The Digitally Disposed: Racial Capitalism and the Informatics of Value* (Minneapolis: University of Minnesota Press, 2021).

10 Eds. Elizabeth Losh and Jacqueline Wernimont, *Bodies of Information: Intersectional Feminism and the Digital Humanities* (Minneapolis: University of Minnesota Press, 2019); Marika Cifor and Patricia Garcia, "Feminist Data Manifest-No," *Feminist Data Manifest-No*. https://www.manifestno.com. Accessed 16 January 2020; eds. Adi Kuntsman, Jin Haritaworn, and Silvia Posocco, *Queer Necropolitics* (London: Routledge, 2015); Catherine D'Ignazio and Lauren F. Klein, *Data Feminism* (Cambridge: The MIT Press, 2020); Toby Beauchamp, *Going Stealth: Transgender Politics and U.S. Surveillance Practices* (Durham: Duke University Press, 2019); Mia Fischer, *Terrorizing Gender: Transgender Visibility and the Surveillance Practices of the U.S. Security State* (Lincoln: University of Nebraska Press, 2019); Shoshana Amielle Magnet, *When Biometrics Fail: Gender, Race, and the Technology of Identity* (Durham: Duke University Press, 2011); Liat Ben-Moshe, *Decarcerating Disability: Deinstitutionalization and Prison Abolition* (Minneapolis: University of Minnesota Press, 2020); Simone Browne, *Dark Matters: On the Surveillance of Blackness* (Durham: Duke University Press, 2015); Brian Jefferson, *Digitize and Punish: Racial Criminalization in the Digital Age* (Minneapolis: University of Minnesota Press, 2020).

11 Seb Franklin, *Control: Digitality as Cultural Logic* (Cambridge: The MIT Press, 2015).

12 Eds. Paolo Virno and Michael Hardt, *Radical Thought in Italy: A Potential Politics* (Minneapolis: University of Minnesota Press, 2010).

13 Gilles Chatelet and Alain Badiou, *To Live and Think Like Pigs: The Incitement of Envy and Boredom in Market Democracies* (Cambridge: The MIT Press, 2014).

14 Mark Hansen, *Feed Forward: On the Future of Twenty-First Century Media* (Chicago: University of Chicago Press, 2015).

15 McKenzie Wark, *Capital Is Dead: Is This Something Worse?* (London and New York: Verso Books, 2019).

16 Patricia Ticineto Clough, Karen Gregory, Benjamin Haber, and R. Joshua Scannell, "The Datalogical Turn," in ed. Phillip Vannini, *Non-Representational Methodologies: Re-Envisioning Research* (New York: Routledge, 2015).

17 Ibid.; R. Joshua Scannell, "Both a Cyborg and a Goddess: Deep Managerial Time and Informatic Governance," in ed. Katherine Behar, *Object-Oriented Feminism* (Minneapolis: University of Minnesota Press, 2016) and "This Is Not Minority Report: Predictive Policing and Population Racism," in ed. Ruha Benjamin *Captivating Technology: Race, Carceral Technoscience, and Liberatory Imagination in Everyday Life* (Durham: Duke University Press, 2019).

18 Jodi A. Byrd, *The Transit of Empire: Indigenous Critiques of Colonialism* (Minneapolis: University of Minnesota Press, 2011); Frank B. Wilderson III, *Red, White & Black: Cinema and the Structure of US Antagonisms* (Durham: Duke University Press, 2010); C. Riley Snorton, *Black on Both Sides: A Racial History of Trans Identity* (Minneapolis: University of Minnesota Press, 2017).

19 Ruth Wilson Gilmore, *Golden Gulag: Prisons, Surplus, Crisis, and Opposition in Globalizing California* (Berkeley: University of California Press, 2007).

20 Ruha Benjamin, *Race After Technology*; Safiya Umoja Noble, *Algorithms of Oppression*; Meredith Broussard, *Artificial Unintelligence: How Computers Misunderstand the World* (Cambridge: The MIT Press, 2019); Eubanks, *Automating Inequality*; Abeba Birhane and Jelle van Dijk, "Robot Rights?: Let's Talk about Human Welfare Instead," *Proceedings of the Association for Computing Machinery (ACM) Conference on AI, Ethics, and Society*, February 2020: 203-217. https://doi.org/10.1145/3375627.3375855; Joy Buolamwini, "We Must Fight Face Surveillance to Protect Black Lives," *OneZero*, Medium, 4 June 2020. https://onezero.medium.com/we-must-fight-face-surveillance-to-protect-black-lives-5ffcd0b4c28a. Accessed 6 January 2022.

21 Fred Moten, *Stolen Life* (Durham: Duke University Press, 2018).

22 Gilmore, *Golden Gulag*.
23 David Golumbia, *The Cultural Logic of Computation* (Cambridge: Harvard University Press, 2009).
24 M. Beatrice Fazi, "Digital Aesthetics: The Discrete and the Continuous," *Theory, Culture & Society* 36.1 (2019): 3–26. https://doi.org/10.1177/0263276418770243; Luciana Parisi, "Critical Computation: Digital Automata and General Artificial Thinking," *Theory, Culture & Society* 36.2 (2019): 89–121. https://doi.org/10.1177/0263276418818889.
25 Calvin L. Warren, *Ontological Terror: Blackness, Nihilism, and Emancipation* (Durham: Duke University Press, 2018); Sharon Patricia Holland, *The Erotic Life of Racism* (Durham: Duke University Press, 2012).
26 Sylvia Wynter, "Unsettling the Coloniality of Being/Power/Truth/Freedom: Towards the Human, After Man, Its Overrepresentation--An Argument," *CR: The New Centennial Review* 3.3 (2003): 257–337. https://doi.org/10.1353/ncr.2004.0015; Tiffany Lethabo King, *The Black Shoals: Offshore Formations of Black and Native Studies* (Durham: Duke University Press, 2019); Christina Elizabeth Sharpe, *Monstrous Intimacies: Making Post-Slavery Subjects. Perverse Modernities* (Durham: Duke University Press, 2010).
27 Sylvia Wynter, "The Ceremony Must Be Found: After Humanism," *Boundary 2* 12.3 (1984): 19. https://doi.org/10.2307/302808; Snorton, *Black on Both Sides*.
28 Khalil Gibran Muhammad, *The Condemnation of Blackness: Race, Crime, and the Making of Modern Urban America* (Cambridge: Harvard University Press, 2010); Katherine McKittrick, "Mathematics Black Life," *The Black Scholar* 44.2 (2014): 16–28.
29 Jacqueline Wernimont, *Numbered Lives: Life and Death in Quantum Media* (Cambridge: The MIT Press, 2019).
30 Jackie Wang, *Carceral Capitalism* (Los Angeles: Semiotext(e), 2018).

31 Eds. Natale, Simone, and Diana Pasulka, *Believing in Bits: Digital Media and the Supernatural* (New York: Oxford University Press, 2019); R. Joshua Scannell, "Both a Cyborg and a Goddess."

32 Nigel Thrift, "The Insubstantial Pageant: Producing an Untoward Land," *Cultural Geographies* 19.2 (2012): 141–68. https://doi.org/10.1177/1474474011427268.

33 Ibid., 161.

34 Jasbir K. Puar, *The Right to Maim: Debility, Capacity, Disability* (Durham: Duke University Press, 2017).

35 Deborah Cowen, *The Deadly Life of Logistics: Mapping Violence in Global Trade* (Minneapolis: University of Minnesota Press, 2014); Laleh Khalili, *Sinews of War and Trade: Shipping and Capitalism in the Arabian Peninsula* (London and New York: Verso Books, 2020); Ned Rossiter, *Software, Infrastructure, Labor: A Media Theory of Logistical Nightmares* (London: Routledge, 2016).

36 In the days of "lockdown" during the COVID-19 pandemic, the "remote" lightness of capital-at-a-distance and cities on "pause" was in fact a remediation of racially organized exposure to vulnerability and premature death. The bodies of the warehouse workers, grocers, gig workers, sanitation workers, and medical staff are toxified to make possible the whiteness and lightness of the pixelated boredom of a now supposedly digital social and civil society.

37 M. Beatrice Fazi, "Incomputable Aesthetics: Open Axioms of Contingency," *Computational Culture* 5 (January 2016). http://computationalculture.net/incomputable-aesthetics-open-axioms-of-contingency/; *Contingent Computation: Abstraction, Experience, and Indeterminacy in Computational Aesthetics* (Lanham: Rowman & Littlefield, 2018); "Digital Aesthetics: The Discrete and the Continuous," *Theory, Culture & Society* 36.1 (2019): 3–26. https://doi.org/10.1177/0263276418770243; "Can a Machine Think (Anything New)? Automation beyond Simulation," *AI & SOCIETY* 34.4 (2019): 813–24. https://doi.org/10.1007/s00146-018-0821-0; Shane Denson, *Discorrelated Images*

(Durham: Duke University Press, 2020); Steven Shaviro, *Post Cinematic Affect* (Hants: 0-Books, 2010); Kara Keeling, *Queer Times, Black Futures* (New York: New York University Press, 2019).

38 Fazi, *Contingent Computation*, 23-47.

39 Fazi, "Can a Machine Think (Anything New)?"

40 See Kathryn Yusoff, *A Billion Black Anthropocenes or None* (Minneapolis: University of Minnesota Press, 2018); Michelle M. Wright, *Physics of Blackness: Beyond the Middle Passage Epistemology* (Minneapolis: University of Minnesota Press, 2015); McKittrick, *Dear Science*; Wynter, "Unsettling the Coloniality of Being/Power/Truth/Freedom."

41 *Contingent Computation*, 30-41.

42 PredPol, "Calculating the Return on Investment for a Medium-Sized City Using PredPol," *Real-Time Patrol Operations Management*. 2020. https://www.predpol.com/.

43 Caroline Haskins, "The Tool Was Supposed To Predict Crime. Now Los Angeles Police Say They Are Dumping It," *BuzzFeed News*, 21 April 2020. https://www.buzzfeednews.com/article/carolinehaskins1/los-angeles-police-department-dumping-predpol-predictive. Accessed 5 January 2022; Tate Ryan-Mosley and Jennifer Strong, "The Activist Dismantling Racist Police Algorithms," *Technology Review*, 5 June 2020. https://www.technologyreview.com/2020/06/05/1002709/the-activist-dismantling-racist-police-algorithms/. Accessed 5 January 2022.

44 Kristi Sturgill, "Santa Cruz Becomes the First U.S. City to Ban Predictive Policing," *Los Angeles Times*, 26 June 2020. https://www.latimes.com/california/story/2020-06-26/santa-cruz-becomes-first-u-s-city-to-ban-predictive-policing. Accessed 5 January 2022.

45 Kristian Lum and William Isaac, "To Predict and Serve?" *Significance* 13.5 (2016): 14–19. https://doi.org/10.1111/j.1740-9713.2016.00960.x; David Robinson and Logan Koepke, "Stuck in a Pattern: Early Evidence on 'Predictive Policing' and Civil Rights," *Upturn.org*, 31 August 2016. https://www.upturn.org/reports/2016/stuck-in-a-pattern/. Accessed 5 January 2022.

46 President's Task Force on 21st Century Policing, "Final Report of the President's Task Force on 21st Century Policing," Office of Community Oriented Policing Services, 2015. https://cops.usdoj.gov/pdf/taskforce/TaskForce_FinalReport.pdf. Accessed 4 January 2022.
47 Brian Jefferson, *Digitize and Punish: Racial Criminalization in the Digital Age* (Minneapolis: University of Minnesota Press, 2020).
48 P. Jeffrey Brantingham, "Measuring Forager Mobility," *Current Anthropology* 47.3 (2006): 435–59. https://doi.org/10.1086/503062.
49 Fazi, "Can a Machine Think (Anything New)?"
50 Cathy O'Neil, *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy* (New York: Crown, 2016).

2 "A really weird and disturbing erasure of history"
The Human, Futurity, and Facial Recognition Technology

Jennifer Rhee

AI technologies seem to promise an objective certainty about the world and the future, and an end to doubt. AI systems are currently responsible for making major determinations about people's lives around policing, sentencing, hiring, and loan financing. But if the futures predicted by AI are realized, it is not because AI offers a more insightful, prophetic mode of knowing, but rather because AI—which has been embraced by governments and corporations alike as the solution to nearly every problem—enjoys considerable political and cultural authority and financial power while extending worldviews that uphold racial capitalism and colonial logics.[1] In the face of AI's considerable material effects on people's lives and pervasive claims about its predictive power, certainty, and omniscience, this essay turns to possibility as a structuring aspect both of AI's operations and of futurity. Here I draw on Aimee Bahng's incisive distinction between the future, which is singular, and futurity, which reframes the future as comprised of multiple experiences, histories, and imagined possibilities: "I use the term 'futurity' to highlight the construction of the future and denaturalize its singularity, while maintaining an emphasis on how narrative constructions of the future

play a significant role in materializing the present."[2] Bahng's futurity emphasizes that the future is a site of contestation and possibility rather than an inevitability, despite the powerful forces that suggest otherwise.

Like notions of the future as singular and predictable, futurity and the possibility it suggests are deeply rooted in history. Indeed, there is nothing inherently prophetic about AI's capacity to augur the future; there is only the authority AI systems have been given to determine which aspects of history and which worldviews function as truths that ground processes of algorithmic verification. Ruha Benjamin, writing about crime prediction technologies, astutely describes this function as producing the future, not predicting it. Situating predictive policing or crime prediction systems in their broader historical contexts of institutional racism and the racialized construction of criminality, Benjamin trenchantly argues that these systems "should more accurately be called 'crime production algorithms.'"[3] Benjamin's important critique, and the centrality of history to her analysis, refuse AI's attempts to foreclose the future, and in so doing gesture to futurity and possibility.

Not only does possibility structure futurity, it also structures AI technologies themselves. In addition to Benjamin, key thinkers in this genre include Louise Amoore, who carefully details the significance of doubt and partial accounts to explain how machine learning outcomes routinely erase all possible outcomes but one, which becomes elevated to a kind of machinic truth; M. Beatrice Fazi, who demonstrates how computing is structured by contingency, thus placing contingency and indeterminacy at the very heart of computing itself; and Wendy Chun, who draws attention to the important epistemological role and political potential of uncertainty in climate change models as well as

in broader machine learning systems.[4] These thinkers define AI through its constitutive and inescapable incompleteness rather than through (false) promises of absolute certainty, prediction, and control. In different ways, Fazi, Amoore, and Chun identify and assert as ineradicable the multiple possibilities, uncertainties, and doubtful and partial accounts that compose artificial intelligence. Despite AI's effective disavowals of other possibilities, if not of possibility itself, possibilities and open futures structure AI.

Different possibilities draw on different histories to open up different worlds and futures, quite literally in the case of predictive machine learning systems. Inspired by these thinkers, this essay returns to Alan Turing's field-shaping 1950 essay "Computing Machinery and Intelligence" to examine the possibilities that emerge from interrogating the concept of the human, both in Turing's essay and in AI more broadly. I conclude by discussing facial recognition technologies, which serve as a reminder that it is not enough to highlight uncertainty and possibility within AI operations, but, following Benjamin, to also bring an analysis of AI's technical functions into conversation with the broader histories that shape AI's emergence, development, use, and possible futures.

Turing begins his essay by declaring the question "Can a machine think?" as "too meaningless to deserve discussion." He then replaces this question with the imitation game, a game of gender identification that inspired what is often called "the Turing test."[5] In an essay titled "Can a Machine Think (Anything New)? Automation Beyond Simulation," Fazi takes up the question so quickly discarded by Turing and offers a rich dilation of the terms "machine" and "think."[6] She modulates the original question to posit that machine thinking, which has historically been associated

with anthropocentric approaches that aim to imitate some aspect of human thought, can be productively understood as an "alien" form of thought. This alien thought does not resemble or imitate human thinking, but instead can be productively understood as a new and different mode of thinking. Like Fazi, I also find it useful to examine the question "Can a machine think?", though my examination takes me back to the human from which Fazi's essay moves away.

The Human at the Center of AI

"Can a machine think?" Different lines of thinking, different questions, and different histories open up depending on which term in this question is interrogated. I join this rich conversation between Turing and Fazi to open up another set of questions, lines of thinking, and histories. To do so, I propose that "Can a machine think?" can aptly be read as "Can a machine think (like a human)?," thus introducing the human as another key term, however implied in the original version of the question.[7] I keep the concept of the human at the center of my thinking precisely because it has structured much of AI, which has been organized around human imitation since its early days.[8] There is also an ethical dimension to "staying with" the human.[9] Staying with the human entails foregrounding the history of the concept of the human; this history is characterized by the concept's definition against and through those categorized as less than human. The act of defining the human, whether implicitly (through imitation) or explicitly, is an exercise of power that has material consequences for those who are included within the category of the human (with all its resonance with the liberal subject) and for those who are classified as outside

this narrow vision of humanness. Historically and in the present, the concept of the human has enabled exclusion, exploitation, subjugation, and violence. This history and definition of the human grounds my attention to "the human" and my ongoing commitment to staying with the human in my examinations of AI.

As AI is fundamentally mimetic of the human, these questions immediately follow: what are the specific contours of the human being imitated? Which vision of humanness grounds AI? What is the history of this vision of humanness? In Neda Atanasoski and Kalindi Vora's important study of AI, robots, and race, they describe how AI imaginaries are organized around a concept of the human synonymous with the figure of the liberal subject, which they aptly describe as "a subject whose freedom is possible only through the racial unfreedom of the [human] surrogate."[10] (It goes almost without saying that this liberal subject is often associated with whiteness.) Atanasoski and Vora introduce the term technoliberalism to define a dimension of racial capitalism that upholds a specific vision of the human (that is, the liberal subject) as the sole beneficiary of technological progress, while obscuring the gendered and racialized processes by which some people have historically been devalued, oppressed, and exploited at the site of the human.[11]

According to Atanasoski and Vora, technology upholds the concept of the human qua liberal subject, as technology is shaped by racial logics:

> racial logics of categorization, differentiation, incorporation, and elimination are constitutive of the very concept of technology and technological innovation. Technology thus steps into what we call a surrogate relation to human spheres of

> life, labor, and sociality that enables the function and differential formation and consolidation of the liberal subject – a subject whose freedom is possible only through the racial unfreedom of the surrogate.[12]

I argue that these racial logics also constitute the concept of the human. Thus, building on Atanasoski and Vora's characterization of technology, I define the concept of the human itself as a technology of differentiation that is shaped by and reproduces colonial and racial capitalist logics of exploitation, oppression, and disposability. This definition of the human takes on particular resonance in relation to AI, a technology that is foundationally and mimetically organized around the human.[13]

Machine Learning, Facial Recognition, and History

Contemporary AI technologies—with their entwined funding from sources including the Department of Defense, venture capital firms, and corporate behemoths like Google—largely uphold both the concept of the human synonymous with the liberal subject and the racial logics that underpin the concept of technology itself.[14] In this section, I examine how facial recognition technology upholds the liberal subject while underscoring the importance of situating this technology within the broader histories of its use. Facial recognition technology draws on machine learning, a popular approach to AI at present.[15] Part of machine learning's popularity comes from its relationship to data, specifically the wide availability of data generated by

all manner of digital devices. In machine learning, copious amounts of data are fed through algorithms, by which AI systems are said to "learn" and make determinations about the world. Continuing the longstanding emphasis on anthropomorphization in AI, IBM defines machine learning as "a branch of artificial intelligence (AI) and computer science which focuses on the use of data and algorithms to imitate the way that humans learn, gradually improving its accuracy."[16]

Machine learning systems operate through a logic of verification, whereby truth claims are constructed by replicating the specific outcomes and worldviews reflected in the data, however discriminatory, and regardless of what the data represents, its relation to the world, or how it was collected, cleaned, and produced. In short, verification of the input data is the goal regardless of the accuracy of the data, the worldview reflected by it, or the ethical questions raised either by the data or the resulting analysis. In the realm of AI prediction, the future is not comprised of a horizon of possibilities; rather, because of the logic of verification, the predicted future replicates the past, as represented by the input data. As Wendy Chun elucidates, an AI trained on data that reflects a racist past can only verify racist outcomes and predicted futures.[17] For Chun, this interplay between verification and prediction results in "a really weird and disturbing erasure of history" that runs counter to critical engagements with history as a means of shaping more just presents and futures:

> We are told to study history in order not to repeat the mistakes of the past: we learn from history if we avoid past errors. In contrast, these [machine

> learning] models, if left unchecked, automatically transcribe past mistakes into the present and future. It's a really weird and disturbing erasure of history in the name of "machine learning."[18]

As Chun highlights, AI technologies are often employed by corporations and governments in ways that disavow history and critical encounters through historical thinking. Similarly pointing to the history embedded in data, mathematician Tarik Aougab rejects the premise that algorithms are in any way objective or neutral:

> When an algorithm spits out an answer or a calculation, there's a tendency to just believe it … But there are no magic formulas. Any algorithm that exists has to be trained on existing data that is collected. If that data collection process is permeated by systemic racism, then your algorithm is going to perpetuate those forces.[19]

As Aougab suggests, AI's erasure of history often emerges under the guise of a proclaimed technological objectivity. Ruha Benjamin underscores how historic power relations structure contemporary technologies, despite narratives of technological objectivity and progress that promise more just and equitable presents and futures; Benjamin calls this phenomenon "the New Jim Code," which she describes as "the employment of new technologies that reflect and reproduce existing inequities but that are promoted and perceived as more objective or progressive than the discriminatory systems of a previous era."[20] Facial recognition is part of this set of contemporary technologies that Benjamin describes as replicating historic inequities while claiming

an unbiased objectivity that ignores the racist histories that structure the present and the technologies themselves. Facial recognition's racist outcomes have been well documented. For example, in their pioneering research, computer scientists Joy Buolamwini and Timnit Gebru undertook an intersectional analysis of three commercial facial recognition systems and determined that their error rates were highest for women with darker skin (34.7%) and lowest for men with lighter skin (0.8%).[21] And a recent comprehensive study of facial recognition technologies by the US National Institute of Standards and Technology (NIST) tested 189 face recognition algorithms, covering most of the face recognition algorithms in existence at the time of testing. NIST found that most facial recognition applications have a significantly higher rate of false positive identifications for photos of Black, Asian, and indigenous people's faces than for photos of white people's faces. Indeed, some algorithms have false positive rates 10x higher for Black, Asian, and Native American people than for white people, and some are an even more astounding 100x higher.

High error rates are not unusual for facial recognition technologies, nor for biometric technologies more broadly, as Shoshana Magnet's concept of "biometric failure" elucidates. According to Magnet, the routine failure to accurately identify people of color, people with disabilities, and white women is itself a defining characteristic of biometric technologies.[22]

The stakes of facial recognition's failures are tremendous, considering the ongoing widespread use of facial recognition technologies by police departments.

For example, in 2017, the city of Detroit signed a three-year contract with DataWorks Plus for facial recognition software called FACE Plus.[23] The FACE Plus system provides

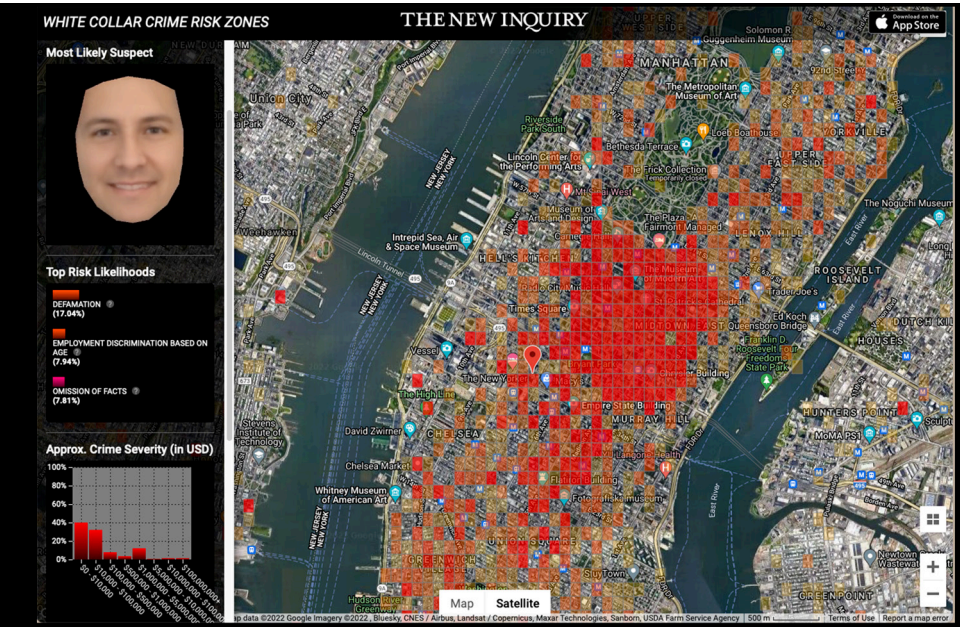
access to a database of photos and search algorithms used to identify suspects and persons of interest. Facial recognition software can provide two kinds of searches: one-to-one and one-to-many. A one-to-one search is used for identity verification; it matches an existing photo to a photo from an official database (say, a driver's license or passport photo). A one-to-many search determines a person's identity by trying to match them with a photo already in the database, and is often used by police to identify suspects. FACE Plus offers both one-to-one and one-to-many search capacities. The photos that comprise FACE Plus's database include driver's license photos, state ID photos, mug shots, and sex offender registry photos.

The FACE Plus database is no more neutral or objective than the algorithms that analyze this data. Data, including the processes of collection, classification, and manipulation that construct and produce data and datasets, are shaped by history and relations of power. In fact, Catherine D'Ignazio and Lauren Klein argue that data is specifically shaped by "uneven power relations."[24] Data and their reflection of historical context and uneven power relations are embedded in databases like FACE Plus's and in the analytic claims and identifications they produce. When it comes to data, context and history are everything. In the data used for facial recognition programs like FACE Plus that are marketed to police departments, the racialized history of crime and policing structures and shapes the technology, despite technological claims to objectivity that attempt to erase this history and prevent critical encounters with it. Jackie Wang and Josh Scannell highlight the importance of this larger historical context as they insightfully detail the racialized aspects of crime prediction AIs' claims and the history that

these technologies disavow while reproducing this history. As Wang explains, crime itself is a racialized and constructed category: "Crime has never been a neutral category. What counts as crime, who gets labeled criminal, and which areas are policed have historically been racialized."[25] And Scannell points to the construction of the category of crime through policing. According to Scannell, policing is a racializing system; thus, technologies like FACE Plus, based as they are on extant policing practices including documentation and used as a tool for policing, can only extend this racializing.[26] Despite the suggestions of tech companies and the larger system of technological racial capitalism, racism cannot be "fixed" with technological solutions, as these solutions ignore the larger historical contexts and worldviews that produce the data, the technologies, and their applications as such. Nor do these technological non-solutions attend to the ensuing significant material harms that require repair and care.

In 2020, Detroit police used FACE Plus to falsely arrest Robert Julian-Borchak Williams. FACE Plus incorrectly matched grainy video surveillance security footage of a robbery suspect to Williams's driver's license photo. According to the American Civil Liberties Union, which filed a complaint on Williams's behalf, FACE Plus's match was tenuous at best, based primarily on the fact that the suspect and Williams are both Black men. The police ultimately dismissed the case against Williams over insufficient evidence, and the prosecutor's office declared that any case using facial recognition technology could only move forward with additional supporting evidence. Buolamwini, in response to this case, underscored that these responses do not redress the extensive harm done to

Williams and his family: "You cannot erase the experience of 30 hours detained, the memories of children seeing their father arrested, or the stigma of being labeled criminal."[27]



Sam Lavigne, Francis Tseng, and Brian Clifton.
White Collar Crime Risk Zones, 2017. App.
https://whitecollar.thenewinquiry.com/.
Image © Sam Lavigne, Francis Tseng, and Brian Clifton.

Also in 2020, the Detroit police chief estimated FACE Plus's misidentification rate to be as high as 95 or 96%.[28] However, this wildly high misidentification rate has not disqualified FACE Plus as a tool to be used by Detroit police. Instead, the police chief emphasized that FACE Plus is only one policing and investigative tool used in conjunction with other tools and human discretion. And yet, in 2020, the Detroit police department used FACE Plus predominantly to identify or verify the identity of a Black person. According to reporting by *Vice* magazine, in the first half of 2020, the Detroit Police department used FACE Plus 70 times; in 68 of those 70 cases, they used FACE Plus to find a match to an existing photo of a Black person. In other words, investigators using human discretion overwhelmingly used FACE Plus to identify a Black person, despite FACE Plus's astonishingly high misidentification rate and the widely documented racist outcomes of facial recognition technology itself.

As these numbers reveal, FACE Plus's accuracy is not the point. History is the point. FACE Plus, as a technology of surveillance and policing, is linked to the extended history of enslavement, surveillance, and racialized policing of Black people, as Simone Browne incisively argues.[29] This history is linked to other histories and presents wherein the liberal subject and its freedoms are constituted through the unfreedoms and exploitation of oppressed people. AI technologies extend the hierarchies of race, gender, sexuality, class, and citizenship that enable the liberal subject's promised freedoms. Examining AI technologies like FACE Plus through these histories both refuses the "weird and disturbing" erasure of history that AI technologies try to realize in our presents and in our technological futures, and opens up the possibility of other worlds and futures.

Sam Lavigne, Francis Tseng, and Brian Clifton do just this in their artwork *White Collar Crime Risk Zones* (2017). This work takes the form of an app that uses crime prediction and facial analysis algorithms employed by predictive policing systems to map out locations in Manhattan with high probabilities of future white-collar crimes (unsurprisingly, Wall Street is a high-risk zone). To accompany these hot spots, the app also provides a list of nearby financial firms, "top risk likelihoods" such as failure to supervise, defamation, or employment discrimination based on age, and an algorithmically-generated image of the "most likely suspect" to accompany each hot spot.

To generate the suspect's face, Lavigne, Tseng, and Clifton created a database from the LinkedIn profile photos of 7000 corporate executives of financial organizations. The faces in these photos are then averaged to develop a generalized white-collar criminal subject for each zone designated high risk for future white-collar crime. *White Collar Crime Risk Zones* highlights the racialized construction of crime and criminality, and the ways in which it upholds the technoliberal logic and the concept of the human synonymous with the liberal subject. Benjamin describes this artwork as "a parody project that begins by subverting the anti-Black logics embedded in new high-tech approaches to crime prevention."[30] Expanding on the project's subversion, I suggest that by displacing the primacy of the liberal subject and its association with whiteness and identifying it as a source of harm, fear, and criminality, the artwork draws attention to the ways that racialized visions of humanness and the freedom of the liberal subject structure facial recognition, AI technologies, and criminality. By enacting a critique through a reversal of racial hierarchies,

White Collar Crime Risk Zones destabilizes the world as it is, while highlighting that simply reversing these historic hierarchies and power relations merely preserves existing structures and systems of inequality.[31]

I understand *White Collar Crime Risk Zones*, with its subversive reversals, as a speculative artwork that offers an aesthetic experience that critiques the present of crime prediction technologies while engaging in its own act of world building beyond what is given or possible in the present.

Bahng's definition of futurity, as cited at the beginning of this essay, draws attention to how narratives of the future shape the present. Examining the complexities of speculation across finance, colonialism, and fiction, Bahng looks to speculation's recuperative potential for futurity and possibility as found in speculative fiction. Certain works of speculative fiction, Bahng explains, can "demonstrate how speculation can take the shape of radical unfurling, rather than protectionist anticipation."[32] I understand *White Collar Crime Risk Zones* as similarly speculative. The artwork enacts a speculative reversal that provides a different starting point, a different opening in the present for the ongoing work of imagining other possible technological futures through critical engagements with history. This mode of speculation, grounded as it is in possibility, historical thinking, and world building, offers a counterweight to AI's claims of prediction and concomitant attempts to realize a single, specific vision of the future that extends existing power relations. While the question of machine thinking has been central to the field of AI, the practice of speculation may be vital to living amidst AI technologies.

Notes

1 Meredith Broussard names this ideology "technochauvinism," which she defines as the belief that technology is the answer to every problem. *Artificial Unintelligence: How Computers Misunderstand the World* (Cambridge: MIT Press, 2018), 7-8.

2 Aimee Bahng, *Migrant Futures: Decolonizing Speculation in Financial Times* (Durham: Duke University Press, 2018), 2.

3 Ruha Benjamin, *Race after Technology: Abolitionist Tools for the New Jim Code* (Cambridge: Polity Press, 2019), 83.

4 Louise Amoore, *Cloud Ethics: Algorithms and the Attributes of Ourselves and Others* (Durham: Duke University Press, 2020), 133-153; M. Beatrice Fazi, *Contingent Computation: Abstraction, Experience, and Indeterminacy in Computational Aesthetics* (Lanham: Rowman & Littlefield, 2018); Wendy Hui Kyong Chun, "On Hypo-Real Models or Global Climate Change: A Challenge for the Humanities," *Critical Inquiry* 41 (2015): 675-703.

5 A. M. Turing, "Computing Machinery and Intelligence," *Mind* 59.236 (1950), 412. Turing first introduces the imitation game as a game of gender identification involving two competitors (a woman and a man), and an interrogator who converses with both with the goal of correctly identifying which is a woman and which is a man. Unable to see or hear the competitors, the interrogator remains in a separate room and only communicates with them through written or typewritten pages, through a mediator who moves between rooms relaying questions and answers, or through a teletype device akin to today's computer screens. Turing then evolves the imitation game by replacing the man with a machine. This new version of the imitation game thus entails a woman competing against a machine that is pretending to be a man; the interrogator's goal is, again, to distinguish the woman from the machine (433-434). For an expanded discussion of gender and the Turing test, see Tyler Curtain, "The 'Sinister Fruitiness' of Machines:

Neuromancer, Internet Sexuality, and the Turing Test," in ed. Eve Kosofsky Sedgwick, *Novel Gazing: Queer Readings in Fiction* (Durham: Duke University Press, 1997). A modified version of the imitation game, known as the Turing test, has been widely taken up by both popular culture and the field of AI. The Turing test circulates as a test to distinguish between human and machine, erasing the structuring role of gender in Turing's imitation game. This erasure highlights AI's organization around a purportedly universal human subject who is in fact very specifically gendered, as well as raced, classed, and abled. As I argue in my book *The Robotic Imaginary: The Human and the Price of Dehumanized Labor* (Minneapolis: University of Minnesota Press, 2018), AI's visions of humanness are highly narrow and specific in their inscriptions of race, gender, class, and ability in ways that reflect historic and existing power relations.

6 For a rich discussion of Turing's essay and its influence on AI, see Simone Natale, *Deceitful Media: Artificial Intelligence and Social Life after the Turing Test* (Oxford: Oxford University Press, 2021).

7 While Turing's essay does not directly address or define the human, I contend that the concept is central to his essay and his meditation on the possibility of machine intelligence. Turing's use of the term "human" is often a modifier for "computer." Thus, "human computer" becomes Turing's term for human. This suggests that human and computer cannot be disentangled conceptually, if not functionally. Louise Amoore highlights the indissoluble "we" that characterizes how Turing understands human-computer interactivity in a 1952 BBC program; in response to the question, "But who was learning, you or the machine?" Turing refuses the constructed opposition, responding "I suppose *we both* were." Amoore brings this entangled "we" insightfully into her examination of contemporary machine learning (*Cloud Ethics*, 56-57). This entanglement of human and computer also reflects the early days of computing when women were employed as "human computers" to perform calculations.

8 Fazi describes this emphasis on anthropomorphism as AI's "simulative paradigm" ("Can A Machine Think (Anything New)? Automation beyond Simulation," AI & SOCIETY 34.4 (2019): 813–824, 813).
9 I borrow this phrase from Donna Haraway's *Staying with the Trouble: Making Kin in the Chthulucene* (Durham: Duke University Press, 2016).
10 Neda Atanasoski and Kalindi Vora, *Surrogate Humanity: Race, Robots, and the Politics of Technological Futures* (Durham: Duke University Press, 2019), 5.
11 Ibid., 4.
12 Ibid., 5.
13 For a discussion of the human as a history of exclusion through race, gender, and sexuality, see my introduction to *Robotic Imaginary*. In defining the human as a technology, I come to the same conclusion as Lauren Wilcox in "No Humans in the Loop," which will be published in eds. Jude Browne, Stephen Cave, Eleanor Drage, Kerry Mackereth, and Youngcho Lee, *Feminist AI: Critical Perspectives on Algorithms, Data and Intelligent Machines*.
14 For an excellent study of early dominant symbolic approaches to AI and their replication of a white, male, educated, middle-class subjectivity that then resembled many AI scientists, see Alison Adam, *Artificial Knowing: Gender and the Thinking Machine* (London: Routledge, 1998).
15 Indeed, computer scientist Ethem Alpaydin describes machine learning as "the driving force in artificial intelligence" today in *Machine Learning* (Cambridge: MIT Press, 2016), xiii.
16 IBM Cloud Education, "Machine Learning," *IBM.com*, 15 July 2020. https://www.ibm.com/cloud/learn/machine-learning. Accessed 2 January 2022.
17 Anne Pasek, Rena Bivens, Mél Hogan, "Data Segregation and Algorithmic Amplification: A Conversation with Wendy Hui Kyong Chun," *Canadian Journal of Communication* 44 (2019), 457.
18 Ibid., 457.
19 Quoted in Lilah Burke, "Mathematicians Urge Ending

Work with Police," *Inside Higher Ed*, 24 June 2020. https://www.insidehighered.com/news/2020/06/24/mathematicians-urge-cutting-ties-police. Accessed 2 January 2022. Notably, Aougab co-authored an open letter by mathematicians citing the racist outcomes of facial recognition algorithms, especially in the context of policing.

20 *Race after Technology*, 5-6.

21 Joy Buolamwini and Timnit Gebru, "Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification," *Proceedings of Machine Learning Research* 81.1 (2018): 1-15.

22 Shoshana Amielle Magnet, *When Biometrics Fail: Gender, Race, and the Technology of Identity* (Durham: Duke University Press, 2011).

23 This contract cost the city over $1,040,000. Detroit Financial Review Commission, City Resolution 2017-18, https://www.michigan.gov/documents/treasury/Detroit_FRC_City_Resolution_2017-18_590049_7.pdf. FACE Plus is not associated with the company Face++, which also develops and sells facial recognition systems in addition to a range of other biometric identification technologies.

24 Catherine D'Ignazio and Lauren F. Klein, *Data Feminism* (Cambridge: MIT Press, 2020).

25 Jackie Wang, *Carceral Capitalism* (Los Angeles: Semiotext[e], 2018), 247.

26 Scannell focuses on the predictive policing software, PredPol. However, I understand Scannell's argument to be relevant to other AI programs used by for policing. R. Joshua Scannell, "This Is Not *Minority Report*: Predictive Policing and Population Racism," in ed. Ruha Benjamin, *Captivating Technology: Race, Carceral Technoscience, and Liberatory Imagination in Everyday Life* (Durham: Duke University Press, 2019), 108-113.

27 Bobby Allyn, "'The Computer Got It Wrong': How Facial Recognition Led to False Arrest of Black Man," *NPR*, 24 June 2020. https://www.npr.org/2020/06/24/882683463/the-computer-got-it-wrong-how-facial-recognition-led-to-a-

false-arrest-in-michig. Accessed 2 January 2022.

28 Jason Koebler, "Detroit Police Chief: Facial Recognition Software Misidentifies 96% of the Time," *Vice*, 29 June 2020. https://www.insidehighered.com/news/2020/06/24/mathematicians-urge-cutting-ties-police. Accessed 2 January 2022.

29 Simone Browne, *Dark Matters: On the Surveillance of Blackness* (Durham: Duke University Press, 2015).

30 *Race after Technology*, 196.

31 In Chapter 4 of *The Robotic Imaginary*, I discuss various artworks that depict the complexities and inadequacies of reversals of racial hierarchies in the context of drone warfare.

32 *Migrant Futures*, 7.

3 New Energy Holistics
Speculations on the predicament of predictive living

Ted Hiebert

Introduction

I started writing this essay with the ambition of talking specifically about predictive algorithms and the significance of living in a world fabricated in advance by a technological infrastructure that increasingly contextualizes and scripts the day-to-day. It struck me at the time that the confluence of predictive algorithms and biometric ubiquity promises a certain amalgamation of data and bodies that seemed important to dwell on. Except that the more I thought about it, the more I began to recognize the same pattern of amalgamation in other places too. It made me wonder if all technology wasn't already predictive in some way. Or in many ways. This was always the promise of poststructural and posthuman thought insisting that technology operates at an ideological level, not just offering new tools of productivity but refashioning the mind and with it the behaviors of the body in ways that rewrite lived context.

As I was thinking through these thoughts I was also reading M. Beatrice Fazi's description of artificial intelligence and algorithmic thought as "beyond human"[1] and was taken by a number of lines of flight, among them notions of black boxes, incommensurability, and the nonhuman.

While I know that for Fazi these are technical terms with disciplinary specificity, for me they are also elegant metaphors and I don't pretend that my lines of thought will necessarily do a good job of representing their specificities. But that, in some ways, is also a resonant subtext of Fazi's essay, which I read in part as an eloquent interrogation of the human need for thought to serve a representative or explicative function. As Fazi explains, artificial intelligences can now learn by themselves and can manifest answers that are no longer accountable to human ways of knowing.[2] AI's indifference to human explanation exceeds and outpaces the capacity to represent the procedures by which knowledge and information are generated. As I understand it, this is the central criterion in Fazi's definition of "black boxes": systems characterized by their ability to generate outcomes that defy and exceed explanations based on the inputs they are given.[3]

New energy holistics considers attention as an energy expenditure involving a holistic process of relationship-building with technology—in the context of an increasingly predictive and technically intelligent world.

Now it's not the same thing at all, but I've had a similar thought about the camera, meditating on the kinds of relationships photography can generate—often much more complex than they first seem. I follow Vilem Flusser and others who see the camera as a technology that operates with intent; Flusser calls it magic or sorcery,[4]

but I might just as well call it agency, and I'd gesture to a possible solidarity with Fazi's argument here. My concern is not with the pictures a camera takes, but with images as instances of a larger context produced by cameras—an observation I would extend to technology in a larger sense. Cameras are the original black boxes after all, and I wonder how thinking the potential of photographic relationality might serve the project of rethinking a relationship to predictive technological or artificially intelligent culture.

I don't have answers, but my intuition is that answers aren't going to be useful here, thinking as we are in a way that aspires beyond human constraint. Instead, I offer three meditations in which I play on the idea of art projects as black boxes, reflecting on relationships between humans and cameras such as to begin the work of blurring the categorical differences between representations and lived encounters. These images are each part of generative projects I maintain in which participants are given open-ended prompts that invite them to build certain kinds of relationships with a camera. I'm not exactly sure it will be useful to Fazi's project of thinking beyond human representation, but in some ways it's a first gesture to her proposition that we "give speculative credit and attention to the incommensurable operations of artificial cognitive systems," not—as she intends—to produce a "useful and successful explanation," but instead to ground these incommensurabilities in a shared encounter of sorts, a poetic act of suspended engagement.[5] An aesthetics of photography that may be relevant to the operations of computation. It's perhaps as simple as spending time with images, and seeing that time as an energetic and philosophical investment. I am loosely thinking of this as a form of new energy holistics.

Example 1: On the Ceiling[6]

A chair hangs from a tree in the forest, in the snow, upside down. A woman stands underneath it, looking up at the chair and away from me; she seems mostly beside the point. Instead, it's the chair that draws my attention, and hers too. But the chair also serves no immediate purpose, except perhaps to draw attention in exactly the way it is doing—a different kind of script than chairs usually perform, but one that nonetheless leaves me sitting on its surface in some strange speculative or metaphoric way.

I am aware in looking at the picture that it's a trap. Literally—the chair is tied up over a tree branch in a way reminiscent of those cartoons where a box is propped up by a stick tied to a string, pulled to drop the box on those who walk underneath. Not just a trap, in other words: a caricature

On the Ceiling is a project that asks participants to photograph someone with a chair on their heads. It is informed by a short story written by Eric Chévillard in which the main character does exactly this—an absurdist performance suggested, in the story, as a corrective to bad posture. I wonder if it might also be a corrective for a human imagination limited by the more usual and pragmatic relationship with a chair.

Image: Simon Perez, *On the Ceiling*, photograph, 2019.

of a trap. But I notice that for me the chair reads as a box, not (for instance) as an anvil or a piano. The chair is an invitation. The chair has a "within," a "strange encounter," a curiosity. It invites me to imagine an interaction.

This, then, is an unusual chair only for the reversal of perspective. Usually a chair invites me to sit on top of it: that is its script. Marshall McLuhan was a fan of this logic, by which technologies script responses from those who use them. I walk into a room filled with chairs and the first question I ask myself is which one I will sit on, not *if* I will sit or instead put the chair on my head. I obey the script of the chair quite faithfully, naturally—one might even say photographically: trusting in the instrumentalized myth of technological neutrality in which the chair itself doesn't make me sit (no hidden agenda to the chair!). I just happen to always do it of my own accord. Beautiful delusions of agency wrapped up in a convenient ergonomic accessory.

This chair hung up in the tree does something different, making clear that the photograph is proposing a different kind of context. Something is happening. It's a strange encounter, but because it is photographed it becomes a bit more naturalized. I don't doubt that I see it. It is even plausible. Believable, even if I don't quite know what it is I am believing. But that's interesting—the idea that I could believe in a plausibility without knowing quite what it offers. It might be the definition of curiosity. Or the virtual. So maybe there's another option here, an invitation to vertigo. What if I tried to sit on this chair more directly, upside down, like a bat or an algorithm? Can one fall off an algorithm?

To think of this as a form of new energy holistics is to imagine a photograph as a platform to fall off or into.

Curiosity is a black box by definition, because once we break with the practical necessities of explanation, the vertigo of encounter can only be held together by affective force, especially when there isn't a legible representation to hold on to. But maybe representation can exceed itself too and a photograph can actually become an image of something that never happened.

Example 2: Cross-eyed Visions

A young girl stands, hooded, facing the camera, with her eyes crossed. Behind her looms a large tree. It feels like a second hood more than a backdrop to the portrait. This tree is almost a shadow, almost a building, almost a guardian, almost a menace. It is something, but I feel it more than I see it—at least at first. The tree sets the mood, even though it is not really the tree I see. I see a girl with her eyes crossed.

Generally, when looking at pictures, an eye will focus on what is already in focus. But here I find my eyes confused, focusing on what is in focus (optically) but not itself focused in the usual way. Focused otherwise, though I didn't really know that I knew what that might mean. What I see is what I do not see: I see someone not looking at me. A portrait of a person facing the camera but not looking at the lens, or rather looking twice, such that the lens might reside in between other things she sees. I see that I do not see what she sees.

Perhaps she's playing a game, wondering if—when she crosses her eyes—the camera can still see her. But my look too follows her gaze to … somewhere not really in the picture. She is looking at a space between herself and the camera, at the tip of her nose or just beyond. If she is

aware of the camera at all it would be out of the peripheral vision of each of her eyes, two cameras—one on each side of wherever she is actually looking. It shuts down something about how I expect cameras to work. That is, I am used to a camera showing a world that sees me the same way I see it. So what is this gesture, this crossing of eyes, this refusal of the singular focus of the lens and instead the insistence on a certain kind of invisibility that is also a refusal to be as one is seen?

Cross-eyed Visions invites participants to photograph somebody with their eyes crossed. It plays with the optical and ideological imperatives of focus. At stake is the predictive demand for clarity of vision, in photography as in critical thinking. The claim is simple: other ways of looking at the world are possible.

But that's interesting. Can crossing one's eyes at the camera be seen as a tactic of resistance? If so, then in order to really understand this picture it is necessary to abandon the stability of what is represented, and instead to adopt its posture. That is, while it seems a strange proposition, this picture may be best appreciated by crossing one's own eyes. The resulting image will not render in the usual way, will not reconcile two parallax visions into one—and perhaps that's the point. Parallax is an evolutionary function designed for the perception of depth. But a photograph has no depth;

the background sits on the same flat surface as the young girl's nose.

I suppose I should qualify that there is no optical depth but perhaps depth of a different sort—a freedom to look with my own eyes in order to see things other than the image itself—to see, perhaps, its idea. I cross my eyes and I see two young girls, facing me (the camera) with crossed eyes. Behind them looms a tree. In front of them looms … well, me.

Image: Mackenzie Gilstrap, *Cross-eyed Visions*, photograph, 2017.

To consider this from the perspective of new energy holistics would be to fixate on the new energies that arise from blurred vision or from holding attention with a differently-focused gaze. It's not exactly predictive except that it definitely scripts a different mode of encountering the world and thus shifts the gaze away from explanation in favor of an ongoing encounter. Maybe it's an algorithm. Maybe there is something predictive to the image after all.

Example 3: Laser Pointer Tag

A man sits in a camping chair. He wears a hoodie and an ambiguous expression. He is looking at me—that is, he is looking at the camera, but also at me. He makes clear that he knows he is in a photograph and that I should know that he knows. Around him, strange abstract lights dance without moving, red arcs across the scene, technological artifacts or conjured manifestations or optical defects exploited.

Susan Sontag said that the camera is sold as a predatory weapon,[7] but maybe it's less the camera itself than the kind of looking that a camera inspires. Predatory looking—predictive looking, even. In other words, an immediate differentiation in ways of looking such that the way I look at things in the world is always already charged with a certain kind of intentionality. Perhaps it's not always predictive—but it's disconcerting to realize that if Sontag is correct, then predatory looking is the norm and any attempt to look otherwise falls victim to the competition. Indeed, if surrounded by predators, it may not be wise to simply look away. Likewise for algorithms, and almost certainly for predictive technologies.

But then I realize that I have a predator in my pocket and that cameras are literally (well, not literally, but literarily) everywhere. This predatory ecosystem is absolutely also predictive—and this image is perhaps a more honest depiction of technological artifacts than I care to admit. Not just dancing lens flares but Wi-Fi and Bluetooth signals that bathe me throughout the day, blue light from screens, neutrinos that blast the planet as big science looks to capture just a few. True data bliss in the sense of saturation, in the sense that data is everywhere, in the air and in between the air. Circulating COVID particles or neutrino storms or optical satellite telemetries. But it's interesting that a laser pointer can be a way to look back. It's interesting that a relational return is at least optically possible. Perhaps the next algorithms will factor this in, responsive as they increasingly are. For the moment, however, there is something of an emergent interaction in the ability to influence the technical gaze. Something of a conversation.

Laser Pointer Tag is a collection of images in which participants have been asked to point a laser pointer at the camera. Usually the lens flares to a point of overload, completely blocking the picture, but sometimes a relationship is formed instead. The laser is a relational device, gesturing with interactivity towards the camera in ways not always present in a photograph.

New energy holistics, here, recognizes that in a strange way, this image suggests the possibility of being both transactional and relational: two different modes of looking that I never really thought I'd find happening at the same time. It's algorithmic and empathetic. Well, sort of. I don't really think the camera cares, except that it still reacts, which might be thought of as a form of optical caring. It was made to flare after all. A technical and nonhuman recognition of being seen. The metaphor is growing on me.

Conclusion

I acknowledge that this chapter might have a kind of randomness about it—a sharing of thoughts on three images that you have now also seen and probably have other thoughts about. Obviously my thoughts are not prescriptive or predictive. The point was not to tell you anything about the images, but to hold space for them for a few minutes. After all, it's not every day that we see the same images for any extended period of time. But in approaching the question this way, my hope was to hold together allegorically the space of the technological (by virtue of the photographs), the aesthetic (through the act of sustained engagement), and the predictive (which was the point of the whole exploration). But it's maybe not clear just yet how the idea of predictive living ties into the act of holding space.

Image: Heather Mcalister, *Laser Pointer Tag*, photograph, 2019.

The key, I think, lies in something else Fazi said, which sticks with me through these meanderings—the idea that explanations aren't really the point anymore.[8] Instead, the need for explanation is tied to the ways human knowledge has been anchored in a representative logic that doesn't really apply to complex AI systems. Perhaps not to cameras either, paradigmatic technologies of representation though they seem to be. Beyond representation, what persists is simply the willingness to engage in a sustained encounter, intelligible or not. That's new energy holistics: holding space for curious encounters in a world run by increasingly predictive operations. Perhaps, counterintuitively, building relationships with predictive living requires us to give up a bit of human agency in order to build more thoughtful relationships with other nonhuman agents.

Or something like that.

Notes

1 M. Beatrice Fazi, "Beyond Human: Deep Learning, Explainability and Representation," *Theory, Culture & Society* 38.7-8 (December 2021): 55-77, 55. https://doi.org/10.1177/0263276420966386.
2 Ibid., 61.
3 Ibid.
4 Vilem Flusser, *Towards a Philosophy of Photography* (London: Reaktion Books, 2000).
5 Fazi, 71.
6 Eric Chévillard, *On the Ceiling*, trans. Jordan Stump (Lincoln: Bison Books, 2000).
7 Susan Sontag, *On Photography* (London: Picador, 2001).
8 I extrapolate this from Fazi's assertion that representations function as explanations, and are a specifically human

form of understanding. In Fazi's view, representations and explanations alike are unnecessary from the perspective of complex AI systems. Fazi, 71.

4 On Continuity and Discreteness
Bataille, Korzybski-Bateson, Adorno

Colin Campbell

The question of continuity and discreteness has appeared as a matter of interest in recent discussions of the digital and digital humanities. Or perhaps it has re-appeared. For some time, it has been a concern of information theory and cybernetics; on a much longer time-scale, for at least 2500 years, it has arguably been the central unstated problem of occidental metaphysics. The ancient problem of the One and the Many in Plato, Aristotle, and other theorists may be no more than a palimpsest masking a more basic problem of the One itself: a discreteness that is presumed but never explained in the concepts of both unity and plurality in their traditional definitions.

What we could call a *problem of radical continuity,* a radical problem of continuity, has traditionally been excluded from the discussion. Some record of archaic musings on the issue might be preserved in the thought of the pre-Socratics, but the evidence is fragmentary and usually equivocal. Minor and subaltern currents alongside the history of occidental theory have no doubt occasionally spilled into the traditional walled-ball-pit of the self-identical One and the Many, which permits the Many to appear only in the form of the *addition of many Ones*. Gilbert Simondon, for one, spills, out of the mid-twentieth century, into the heart of the contemporary problem, in *Individuation in Light of*

Notions of Form and Information.[1] His proposition is that every imaginable individuated thing remains in a kind of intimate, invisible congress with a "preindividual" and implicit dimension of "existence."[2]

The radical idea of continuity implied by what Simondon calls "the preindividual" remains on the margins (at best) of both scientific and popular consciousness in global settler cultures.[3] Modern occidental physics offers a plethora of stories to explain the quantum-relativistic vs. classical worlds problem; as Roger Penrose puts it, some are superb, some useful, and some only tentative.[4] A profusion of popularized myth-imagery (black holes, big bangs, god-particles, etc.) obscures the deeper problem of radical continuity, of the preindividual, which Simondon makes the central concern of information theory.

At the same time, since World War II, along with the general profusion of material culture, an insurgence or resurgence of discourses on (dis)continuity has taken place, enjoining—whether phenomenologically, general-semantically, cybernetically, ecologically, sociologically, or in other theoretical terms—radical (re-) turnings to the problem of discreteness and continuity. The following triptych, an ungainly trimaran if ever there was one, is too sketchy to be understood as anything like an introduction to the vast, mostly underwater archipelago of contemporary discourses on (dis)continuity and on radical continuity (and the closely related problem of singularity). Instead, it is intended as a vessel for sounding, a contribution to a collective work in progress toward a sustained, intensive, and general program of research and practice across disciplines.

Research into what? It is one thing to say "radical continuity" and quite another to begin to account for the

essentially digital aspect of language: that the very idea of "radical continuity" is missed by naming "it" "radical continuity." This is a central operative double-bind: that to name radical continuity is to misname the unnamable.

For an explicit formulation of a general premise or meta-premise governing each of the three fragments below (Bataille, Korzybski-Bateson, Adorno), I invoke aesthetic theorist M. Beatrice Fazi's provocative gesture: a call for a *digital aesthesis* that "brings the continuous, infinite movement of experiential, lived dynamics into what is static and finite, such as the digital machine."[5] Fazi's statement is provocative because digital machines, in a sense, represent the apotheosis of discreteness. A digital machine is a rigidly selective sampler of the larger perturbation; it would be hard to find a more "pure" example of discreteness and non-continuity. Fazi's idea, then, goes against the grain of a tendency among modern thinkers, critics, and knowledge-workers who vaguely embrace continuity, the analog, intuition, or mimesis as the essence of art. In the sense of the infinitesimal calculus, Fazi "goes to the limit" of the concept, the purpose of which in calculus is to be able to translate the continuous into the discontinuous and discrete—and back again.

Fazi reminds us that art's "processes of determination are always exposed to and in fact ingressed by indeterminacy."[6] *Radical* continuity, then, is both outside the discrete *and at its heart*, and its singularly mobius-like aspect is continually washed out in the vague assertion that "everything flows." The indeterminacy of digital discreteness expresses the deeper truth of a noisy continuity, a fugitive freedom, an ability not "to be" or to "not be" with others and the Other in the terms of the system.

The following fragments sustain a mobius-like figure of *ingression of the continuous within the discontinuous*, starting with the theory of religion, shifting to epistemology, and concluding with a (re-)turn to aesthetic theory.

Bataille: "In the world like water in water"

Georges Bataille's *Theory of Religion* begins in a way that startled my heavily Protestant imagination for a long time: with the topic of animality. The animal, says Bataille, "is in the world like water in water." He proposes that the animal's experience is one of *radical continuity*. When one animal eats another, he says, it is more or less as if "a larger wave were overtaking a smaller one." There is neither guilt on behalf of the predator nor resentment on the part of the prey.

Bataille says that no one can deny a radical experience of empathy, of "something tender, secret and painful" with even the most alien animal form:[7] the animal, even a single cell, *desires* somehow to live, just as I do. But he says that this is at most an "embryo of transcendence," as we might say that elephant behaviors surrounding their dead could be understood as embryonic forms of human funerary rites. Bataille writes:

> I am able to say that the animal world is that of immanence and immediacy, for that world, which is closed to us, is so to the extent that we cannot discern in it an ability to transcend itself. Such a truth is negative, and we will not be able to establish it absolutely. We can at least imagine an embryo of that ability in animals, but we cannot discern it clearly enough. While a study of those embryonic aptitudes can be done, such a study

> will not yield any perspectives that invalidate our view of immanent animality, which will remain unavoidable *for us*. It is only within the limits of the human that the transcendence of things in relation to consciousness (or of consciousness in relation to things) is manifested.[8]

Bataille's central premise in *Theory of Religion* is that human tool use and language establish a zone of clear discreteness within radical continuity, but humans are nevertheless (in a more or less confused fashion) always shifting back and forth *between* their individual existence and a radically continuous life that ingresses within them *as* singular individuals. Prohibition and transgression (and moral life overall, whether or not it partakes of either) reflect a human problem with—even an "abhorrence" of—an uncorralled, continuous animal life that is always erupting at the heart of the discrete order of things.

The problem of radical continuity, for Bataille, is formulated ironically as that of the Name of God—ironic because Bataille is an atheist! The fact that prehistoric artworks, like the paintings at Lascaux, take animals as their exclusive subject suggests strongly that religious experience and rituals invoke animality and the sacred in one and the same gesture as tokens of a *radical continuity*. While we're atheists with Bataille (to the extent that we are with him), in the discussion of radical continuity we cannot altogether avoid the hoary old problem of God—or at least of gods, the divine, or the sacred. At the very least, we should beware of becoming "empty-headed atheists."[9]

In the development of *Theory of Religion,* Bataille argues that the Protestant Reformation and successive secular-ideological movements have increasingly suppressed the

signs of radical continuity, not only from profane everyday life, but also from the zones of the sacred where it ("it") had been enshrined in ritual. But even before modernity, in Bataille's view, the name of "God" has always been an imposture, a *token* for a radical *material* continuity indicated in the indeterminacy of the name itself across human cultures (God, *Dieu, Dio*, *Zeus*, *Jehovah*, *Ra*, *Rama*, etc.).

Bataille proposes that the archaic religions of the Paleolithic world provided ample resources to respond to the apparent paradox of radical continuity. In economic as well as religious terms, rituals of *religious sacrifice* responded to the fact that each individual in the community, like the community as a whole, was umbilically connected, as it were, to a larger movement—that is, in radical continuity with the larger currents of energy on the earth's surface. Sacrifice, for Bataille, institutionalizes and stabilizes the ambiguous play of the continuous among—and within—apparently discrete human beings.

In modernity, by and large, faculties for responding to radical continuity persisted on the borderlines of cultural tradition: in unspoken ritual forms, tacit knowledges, uncoded relations with natural patterns and forces, etc. These, however, have been effectively eliminated with the arrival of an ever-wider dogmatic conformity. What began as a pilgrimage ends with the proliferation of manicured golf courses and a mandatory cult of acquisition. The modern problems of communism and capitalism (Bataille was writing *Theory of Religion* in the late 1950s), chiefly war, result from an incapacity of societies to respond to the excessive productivity of their own economic activities. They cannot manage, without catastrophe and crisis, the ingression of the continuous, the free outpouring of solar

energy and its sequelae in natural systems, as expressed in the heart or gut of society itself: in its political economy. Bataille rejects any notion of natural scarcity, and observes that under capitalism we are systematically prevented from seeing the magnitude of the ingression of ecological wealth, as conducted by human labor on a vast scale, that capitalists degrade or destroy in order to retain the value of the money-capital or information-capital they monopolize.

Korzybski and Bateson: General Semantics and Cybernetics

A very different and somewhat less polemical point of entry into the issue of radical continuity is provided in the symbiotic work of Alfred Korzybski and Gregory Bateson. Though Korzybski's General Semantics was distinct from cybernetics as a movement, I make the connection here due to the importance of some of Korzybski's core propositions to Bateson's theory, especially in *Mind and Nature*, and more particularly expressed in Bateson's 1970 address to the General Semanticists ("Form, Substance and Difference," eventually published in *Steps to an Ecology of Mind*). Korzybski, a World War I veteran and émigré from Poland to North America after 1918, constructed and even patented a physical model of the core epistemological premises he proposed, which he first called the "anthropometer" and then the "structural differential."[10]

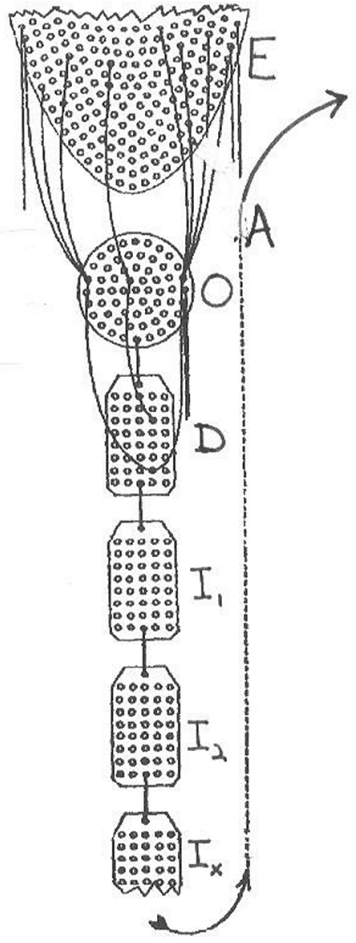
A model of perceptual-linguistic process, the primary, top level of the structural differential is called the "event level." The event level, labeled E in the image below, is what Québécois general semanticist Samuel Bois would later call WIGO, for "what is going on." It is represented by

a parabola cut off with a jagged line to indicate that the mathematical object does or ought to extend to infinity. The other parts of the model, notably the "object" (O) and the "labels" (D and $I_{1, 2...x}$), do not share this infinite quality because they represent *abstractions* (or abstractions from abstractions) from the primary event level. The first label level (D), that of sensory-grounded descriptions and the foundation of so-called "empirical facts," is already an abstraction from the object-level abstraction. The second and subsequent label levels ($I_{1,2...x}$) represent more and more generalized, simplified, and therefore exclusive inferences from descriptions. Using the structural differential, the linguistic field can be parsed to an arbitrarily high number of levels of generality, depending on the needs of a given context. Outside of science and philosophy, more than two or three would rarely be needed, but the expandability is preserved in the way the highest label level is cut off with a jagged line, as the Event level above.

Paradoxically, as generalizations become broader and more inclusive of domains of existence, they must necessarily exclude more and more actual information. As abstractions, they are finite and discrete, yet they are nevertheless connected at the root to WIGO—they *are* it, or of it, though not all of it. And so the highest label level is always connected back to the top of the diagram, back to the ongoing Event, by the arrow at the bottom.

The diagram, like the process itself, is thus cyclical in reality, though it may appear linear; we are, or ought to be, constantly returning to WIGO for new information. Korzybski enjoined those who attended his seminars to use the structural differential to help with "silent practice" at the "object level" (represented by the circle on the diagram,

hanging closely below the parabola) by attending to the level of perception and wordless experience. The object level is an abstraction from WIGO, but it is "where we live" and is less exclusive of WIGO than verbal language usually is.



Alfred Korzybski's Structural Differential, Pat. 1925

General semantics also involves liberal use of "linguistic devices" to examine and, if warranted, challenge habits connected with a variety of injurious neuro-linguistic practices that *identify* the label levels (represented by the three oblong shapes on the structural differential) with each other, with the object level, and with WIGO. Korzybski compared the effect of this habit of "identification" to mixing highly abrasive emery sand into the lubricating oil of a finely-milled and tuned machine. If the levels of the diagram were compared to the stories of a building, identification would be represented by the building collapsing in on itself.

The coveted goal of general semantics practice is what Korzybski called "cortico-thalamic integration": the levels of "cortical" (that is, linguistic and conceptual) meaning should creatively reflect and express the deep "thalamic" (that is, emotional) patterns of affect and sense experience rather than identifying them.[11] Patterns of affect at the object level *do* have discrete boundaries, but they are not discrete in the same way as those named by language. Echoing Bataille, we might say that sensed boundaries (visual or auditory contrasts, for example) are "embryonic" forms of the kind of categorical distinctions we make when we label things. To not only name but to *identify* the givens of sense experience with the discrete categories named by language is therefore to "kill" them, to attribute to them an absolute discreteness that nothing living could maintain.

Along with distinguishing the object from the labels, Korzybski again distinguishes *both* of these distinct levels of abstraction—language and perception—from what is going on, from the event level. WIGO is not what we think, nor is it what we experience. What we say, think, and experience is only a *part* of WIGO, an abstraction from it. WIGO includes an unimaginable and effectively

infinite profusion of entities—x-rays, subsonic sound, trace vibrations, chemicals, etc.—that are real in the sense that they are influencing the course of events, and yet are not "there" in any way resembling an everyday perceptual object. Perceptual experience and linguistic knowledge are not substantially separate *from* but are rather maps or abstractions *of* WIGO.

Korzybski was closely attuned to developments in quantum theory, mathematics, and information theory. He understood, in the wake of Hilbert's failure and Minkowski's and Einstein's formulations, that the primary feature of WIGO is *limitless relationality*: the fact that it is or would be "in reality" composed *only* of relations, not of "things" that are related. Accordingly, every organism, as he wrote using the linguistic device of the hyphen, ought to considered an "organism-as-a-whole-in-an-environment (external and *internal*)."[12] Every organism is a protuberance, a flowering of previously unrealized potentials and relations in its environment.

And yet the organism is also definitively a limited being that abstracts from its environment only what is relevant to itself, ignoring the rest. To capture the structure of this complex abstraction—which is both discretely objective and continuously relational—Korzybski offers his mantra, cited almost canonically in Bateson's *Mind and Nature* forty years later: *the map is not the territory*. The object level experience is a *map* of WIGO. Words are a map *of that map*. Bateson emphasizes that, as perceiving beings, we have no direct contact with WIGO whatsoever. All we have are sensory and linguistic maps.

Bateson's work is complementary to Korzybski's in the fullest sense of differentiating from a given model in order to complete and extend it. In Hegelian terms, we could say

that the meaning of Korzybski's mantra is both canceled and preserved in Bateson's analysis. In *Mind and Nature*, Bateson essentially says that the map called "the map is not the territory" is not the territory either:

> When we come to apply his dictum to the natural history of human mental process, the matter is not quite so simple. The distinction between the name and the thing named or the map and the territory is perhaps really made only by the dominant hemisphere of the brain. The symbolic and affective hemisphere, normally on the right-hand side, is probably unable to distinguish name from thing named. It is certainly not concerned with this sort of distinction. It therefore happens that certain nonrational types of behaviour are necessarily present in human life. … Each hemisphere does, in fact, operate somewhat differently from the other, and we cannot get away from the tangles that that difference proposes.[13]

A certain degree of map-territory confusion is unavoidable in life, Bateson says, because the distinction between an organism and its environment can never be located either in the environment or the organism, but is rather an aspect of WIGO that the organism abstracts from the environment. From another angle, there is for humans a whole domain of nonverbal gesture and indication where most significant human communication occurs, for better or worse. It's not clear how much of this level of bodily presencing is like a map or symbol, and how much is itself an unknown territory we are trying to explain with words.

In an essay on Cetacean echolocation in *Steps to an Ecology of Mind*, Bateson discusses a level of analog interchange that he calls "communication about relationship." He argues that this is a communicative behavior Cetaceans share with us and other mammals, likely with all animals and perhaps even all other life forms (to however a limited degree). "Communication about relationship" establishes and composes relations between and within people, as in other social animals. It is essential to what we would call a "normal" feeling of well-being in social life. This "communication about relationship" is primarily expressed among humans and other animals in gestures rather than words, that is, para-linguistically: in the vocal tone, the kinesics and posture ("body language"), the facial tonus (smiling, crinkling the brow) that accompany our verbal expression of some statement to another person. As an interspecies mammalian gesture, Bateson named this whole aspect of communication about relationship the *μ-function*, reflecting both the cat's mew and the Greek prefix *mu-*, the etymological root of both myth and music.[14]

Bateson categorized this nonverbal level, in cybernetic-information-theoretic terms, as "analog." In other words, the nonverbal level is a *relatively continuous* field, dealing in continuous, shifting magnitudes rather than discrete, fixed signs. It presents singular and individuated objects of perception, but their singularity and individuation are not sharp or dichotomous. In communicative terms, the play-bite and an aggressive bite can never be as essentially distinct as signifiers like war and peace.

For Bateson, humans remain inalterably linguistic beings as well as gestural ones. So much seems to be common sense. But a kind of civilizational deadlock is afflicting humanity,

resulting in an injurious relation between these orders of communication (recalling Korzybski's image of the emery sand in the works and his critique of identification). Bateson emphasized in a number of places the deceitful quality that human communication too often takes on as dogma, propaganda, or psychological influencing—a capacity for deceit and self-deceit that appears to have no parallel outside the human world.

No other mammal has the problem of the "myth of power," as Bateson describes it, and not only or precisely because they lack words: words are merely the sign of the difference. What the words indicate is the operation of a *digital* order of communication—verbal language—that supersedes and differs from anything found among any other mammalian group, apart, possibly, from the Cetaceans. Unlike other animal gestures, words are discrete not only in their auditory patterning, but *semantically*. In Saussure's terms, they refer to a signified, which they (the signifier) are not.

Bateson proposes a remarkable hypothesis (not yet confirmed, though there is tantalizing evidence) that Cetacean vocalizations might be a "digital expression of the μ-function." Where our words remain determinate markers of discrete things, and are therefore formally incapable of communicating "relationship," the Cetaceans have produced a form of digital communication that is not thing-oriented, or at least not in the same way as everyday indicative human speech: "there are the whales, and there is the oil."[15]

Bateson's writing on art and culture, in turn, says that the "function" of art among humans is a "corrective" that somehow spans or heals the rupture within experience caused by the abuse of word-languages.[16] Echoing Aldous

Huxley, he argues that we make art to re-attain the grace of animals. We might say that, rather than trying to teach dolphins English like his friend John Lilly, Bateson instead wanted to learn from them how to become a better singer, a better echolocator.

Adorno's Aesthetics

Coming to terms with "communication about relationship" in this "corrected" form of digital language suggests a leap to what philosopher T. W. Adorno calls "sprachcharakter": a "character of eloquence" *akin to language, and yet not of words*. Introduced in Adorno's *Aesthetic Theory*, *Sprachcharakter* is produced through the *arrangement* of the non-linguistic as well as linguistic material. Where it includes words, they will be contextualized within a larger nonverbal arrangement, and their "straight" meaning is sacrificed. When language occurs in an artwork, it does not express its meaning directly; rather, its meaning takes on a multiplicity of meanings, akin to or expressible in terms of *digital indeterminacy*.

Adorno inaugurates *Aesthetic Theory* with the notion of the indeterminacy of art's purpose: "It is self-evident that nothing concerning art is self-evident anymore."[17] He then elaborates its *telos* as "a language whose words cannot be located on the spectrum; a language whose words are not imprisoned by a prestabilized universality."[18] The concept, then, is not absent from or opposed to the work of art—rather, art presents us with the apparent paradox of a *nonverbal concept,* not in the image or iconic fixed form itself, but in a unique, dynamic, and determinate *meaning* that emerges from the interplay of, and tensions between, the forms. The concept is embedded in art not as an explicit

idea but as a material "parameter" of the work.[19] Through the modulation of material parameters (patterns of color, sound, word-images, etc.), "art itself thinks."[20] What art "thinks" is very different from prose speech. But though it may be illogical, art is no mere random pastiche; its materials and images are interconnected very much as words are connected in language, though their connection is rather through a kind of "cipher" or system of ciphers.[21] What art presents to us is a "wordless syntax,"[22] an aesthetic grammar.

Adorno is, for this reason, emphatically critical of intuitionist and simplistic mimetic theories of art. He will not rest easy with a vague notion of continuity for the horizon of art. Art requires technique and discipline to form its grammars, the implicit mastery of which enables the artist to objectify mimetic impulses—for example, for a composer, in the grammars of melody and rhythm. Nevertheless, the *patterns* in art differ fundamentally from those of prosaic speech in that they are not conceptually bisected from each other—or at least, they are not so in the work as a whole, though, again, prosaic speech-ideas may appear *within* the artwork, not as literal markers but as part of the material.

This "merger" of continuity and discontinuity remains necessarily fragmentary and incomplete; art is a "syllogism," but one "without concept"[23]—a kind of algorithm without any determinate output, whose only output is the formal transformation it itself accomplishes. Conceptual differences, comparison and contrast, are transformed in aesthetic practice into *parameters*, implicit emphases rather than statements like "this is (not) that." But the emphatic structures of art cannot be reduced to continuity; they are a register of differences as acute as the most effective digital search engine, though they never crystallize into anything

identifiable except in their interpretation, and there only tenuously.

Interestingly, in a note on Plato near the end of *Aesthetic Theory*, Adorno indicates how closely connected the problem of the aesthetic difference is to the epistemic or logical problem of "unity":

> The stumbling block here is the concept of unity. Its current use obscures everything, including the relation between the one and the many. In truth, unity should be conceived as it was reflected upon for the first time in Plato's *Parmenides*: as the unity of the many.[24]

In this reflection Adorno is (re-)turning to a theme of his lecture series, *Metaphysics: Concept and Problems*. In these lectures—focusing on Aristotle and Plato as well as the later history of philosophy, including Kant, Hegel, Husserl, and Nietzsche—Adorno notes a special kind of *narrowing of the part-whole relation*, of the relation between particular and universal, which seems to have been a crucial aspect of the Greek enlightenment of antiquity. Adorno connects this narrowing with the fact that the concept of infinity was alien to Greco-Roman antiquity, and that the thought of this place and time was marked by a "constitutive character of finitude."[25] In Western thought, Adorno documents, the destiny of the many has been to become absolutely one "by hook or by crook." This is the spirit of totalitarianism, anti-ecological to its core. What remains under its aegis remains a manifold of separate units.

But the ingression of everything whole by radical continuity troubles boundaries. And anyway, as Adorno indicated at the outset, *Sprachcharakter* could never be

monopolized by a discrete set of objects and practices called "art." The fragments mutually inform but do not fully cohere. Our ungainly vessel appears once again to be slipping beneath a beguiling surface. To cite Donna Haraway, we're "staying with the trouble."[26]

Notes

1 Gilbert Simondon, *Individuation in Light of Notions of Form and Information* (Minneapolis: University of Minnesota Press, 2020).

2 The similarity of this language to physicist David Bohm's "implicate order" is not accidental or unintended; Simondon names Bohm as an inheritor of de Broglie's pilot wave theory (ibid., 140). See David Bohm, *Wholeness and the Implicate Order* (New York: Routledge, 2002).

3 On the other hand, ideas approximating radical continuity can be found often enough in the knowledge traditions of indigenous peoples. To gesture adequately toward (let alone come to terms with) the wealth of indigenous knowledge on the topic is beyond the scope of this short piece.

4 See Roger Penrose, *The Emperor's New Mind* (New York: Oxford University Press, 1989), 49 ff.

5 M. Beatrice Fazi, "Digital Aesthetics: The Discrete and the Continuous," *Theory, Culture, Society* 36.1 (2019): 3-26, 8.

6 Ibid., 21.

7 Georges Bataille, *Theory of Religion* (New York: Zone Books, 1992), 23.

8 Ibid., 23-24.

9 I here invoke the semi-apocryphal story Gregory Bateson told of his father, who was an atheist like the rest of his family, but who read to them from the Bible every day after breakfast so as to prevent them from becoming "empty-headed atheists."

10 In Chapter XXV, "On the Structural Differential," of *Science and Sanity* (Lakeville: The International Non-Aristotelian Publishing Company, 1958), Korzybski discusses the diagram and its application by the practitioner.

11 The actual correlation of Korzybski's forms of communicative interplay with (respectively) the neocortex and the thalamic (brainstem) regions remains a complex subject for science, and is secondary to this argument. Korzybski is talking primarily about the necessary difference between relationship as talked about and experienced "at the unspeakable object level," and how the levels of affect and language cannot be reconciled without our first becoming intimately aware of the concrete difference between them. Whatever its bioneurological substrate, this is the "difference that makes a difference" in human life (to paraphrase Bateson).

12 Korzybski, *xx*. Along with hyphenation, Korzybski applied superscripts and other mathematical notations to his words in the form of linguistic devices. These devices are described and explained in detail by Gad Horowitz in part III of *The Book of Radical General Semantics Vol. 1*, eds. Shannon Bell and Gad Horowitz (New Delhi: Pencraft International, 2016).

13 Gregory Bateson, *Mind and Nature: a Necessary Unity* (Toronto: Bantam Books, 1988), 30-31. I have formulated the issue in this way in "The 'Myth' of General Semantics" which includes the same citation from Bateson's *Mind and Nature*. Colin Campbell, "The 'Myth' of General Semantics," *Anekaant* 6 (Autumn 2017-18); also presented in part at the Alfred Korzybski Memorial Lecture Colloquium in New York City, 2017.

14 Bateson, *Steps to an Ecology of Mind* (New York: Ballantine Books, 1972), 372.

15 Low-duty-cycle echolocative "click trains" enable dolphins to distinguish identical 3-inch diameter pipes, one made of aluminum and one of steel, set side by side twenty meters away. For more on this subject, see Pack, Herman,

and Hoffmann-Kuhnt, "Dolphin Echolocation Shape Perception: From Sound to Object," in eds. Jeanette A. Thomas, Cynthia F. Moss, and Marianne Vater, *Echolocation in Bats and Dolphins* (Chicago: University of Chicago Press, 2004), 288-98.

16 Foreshadowing the next fragment, it is worth noting here that Adorno uses the German term *korrektiv* on multiple occasions in *Aesthetic Theory* to designate one of the "functions" of the making and the experience of art.

17 T. W. Adorno, *Aesthetic Theory* (Minneapolis: University of Minnesota Press, 1997), 1.

18 Ibid., 83.

19 Ibid., 99.

20 Ibid. 99.

21 Ibid., 95.

22 Ibid., 184.

23 Ibid., 136.

24 Ibid., 327-28.

25 T. W. Adorno, *Metaphysics: Concept and Problems* (Stanford: Stanford University Press, 2000), 58.

26 Donna Haraway, *Staying with the Trouble: Making Kin in the Chthulucene* (Durham: Duke University Press, 2016).

5 Which Kind of Media "Philosophy" for Computation? A Rather Radical Media Archaeological Comment

Wolfgang Ernst

Rooting the "Computational" in Radical Media Archaeology

Symbol-based *computation*, as a cultural technique, has long been performed by human hands on sand or on paper.[1] As a core logical concern, the theme of computation falls within the competence of mathematics, logic, and theoretical informatics. Media science, though (as long as its self-understanding remains close to technology), takes care of actual *computing,* which is delegated to the machine. As the mother of all academic reflections on science and matter, philosophy is a rich tradition that media theory only humbly dares to address, with its interest in epistemology and "ontology." Charles Babbage—like Gottfried Wilhelm Leibniz, a forerunner of digital computing with overall mechanical means—proudly titled his autobiography *Passages in the Life of a Philosopher*.[2] A couple of technical "philosophies" have already been developed, such as Gilbert Simondon's 1958 *Du Mode d'Existence des Objets Techniques*, or Maurizio Lazzarato's Bergsonian video philosophy.[3] *Media* philosophy, in the following thoughts, is understood in the

sense of signal engineering, made explicit when B. M. Oliver, J. R. Pierce, and Claude Shannon (otherwise famous for his groundbreaking *Mathematical Theory of Communication*) published their 1948 paper on pulse code modulation for digital telegraphy and radio signal transmission under the title of "Philosophy of PCM."[4] "Philosophy" here referred to the literary genre, which aimed primarily at rendering relevant basic information rather than discussing complicated details. Such a reduction to the principles (*archai*) in the essential rather than historical sense corresponds with the media-archaeological impulse indeed. While Oliver and his co-authors focused on the coding of human speech, the following analysis focuses on algorithmic computing, which means the articulations of techno*lógos* itself.[5] The subsequent arguments and hypotheses therefore limit themselves to the media-archaeological way of questioning philosophy "after" computation, in its double sense: the epistemological impact (or challenge) of computation on traditional philosophy (as an archaeology of knowledge), and computation "after" (in the style of) philosophical reasoning. Computation is operational mathematics. As a method of inquiry, media archaeology—not merely a nostalgic metaphor for discovering obsolescent technologies[6]—therefore has to stay close to both mathematics and philosophy, and to be literally "radical" in its focus on the *arché*, the principles of technological being-in-action (rather than simply its historical "beginnings").

If the term "post-computational" is understood in the "post-digital" sense,[7] it simply means that computing is no longer exclusive to technical elites, and has become embedded in contemporary everyday culture. If it is understood as hypercomputation, it refers to an explosion, the potential

of computing "big data" patterns. Its archaeological reverse operation, though, is finding the square root of computation itself. The core symbol for the mathematical operation of squaring—the √—is called the "radical sign" or (Latin) *radix*.[8] In an epistemic (not metaphorical) sense of this operation, "radical" media archaeology, as primordial analysis, does not imply something historically remote, but corresponds with philosopher Martin Heidegger's concept that "being" can only be understood through what is contemporal. Media archaeology does not "post" the age of digital computing but "poses" the philosophical question of computation itself. At this point, a critical debate arises: Is computation, as mathematical reasoning, rooted in the cultural techniques of computing itself and therefore always "pre"-computational, or could the operations of actual computing only arise from a primary algorithmic thinking? The techno*lógos* hypothesis comprises both assumptions regarding computer-graphical objects such as fractal geometry: Its progressive infinite iterations were known in terms of mathematical formula(tion), but their implicit algorithmic knowledge only became literally evident on computer screens through high-speed computing: "On 1 March 1980, at IBM's Thomas J. Watson Research Center in Yorktown Heights, New York, Benoit Mandelbrot first saw a visualization of the set."[9]

A widely used symbolical mechanism for plotting the Mandelbrot set *via* a computing device is the (almost chrono-poetically named) Escape Time Algorithm, "where a repeating calculation is performed for each x, y point in the plot area and based on the behavior of that calculation, a color is chosen for that pixel."[10] The technification of *lógos* results in surplus insight, which is not simply visual but epistemic

(*theoría*) as well. "Time" itself is thereby transformed from a transcendent signifier to a techno-mathematical operator.

Analytic rigor in the sense of the square root symbol (√) in mathematics and "diagrammatic reasoning" (Charles S. Peirce) is closer to techno-logics than to narrative discourse. The escalation takes place in Peirce's first sketch of an electric circuit diagram for solving a logic problem; philosophical logic here turns non-human. In a 30 December 1886 letter to Marquand, who had built a mechanical logical machine, Peirce draws the first known electric circuitry diagram for performing logical reasoning, biased by a battery: "I think electricity would be the best thing to rely on … where the circuit may be open or closed. … This is like multiplication and addition in logic"[11] and the Arithmetic and Logic Unit (ALU) in micro-processors *in nuce*; techno-mathematics and techno-logistics converge.

To what degree can electronic computing be identified as mathematized electricity—or is the algorithmic mechanism rather electrified (instead of powered by steam, as envisioned by Babbage for his Analytical Engine)? A concrete realization of the universal digital machine (the Turing machine) does not necessarily depend on electricity. Therefore, Kurt Gödel's techno-mathematical term *mechanical procedure* might be reintroduced. The logician and mathematician claimed the equivalence of this expression to both the Turing machine and the concept of the algorithm. But proceeding from a metamathematical theory of computation to actual "digital" computing, this practice:

> should be grasped epistemologically, not merely as a phenomenon shaped by the use of electricity, but as an amalgam of both the mechanical (as Gödel's "mechanical procedure" defines it) and the electric.

> In this sense the digital should be regarded at its fundamental technical level in opposition to the standpoint of McLuhan in *Understanding Media* as the mechanical in the electric.[12]

Radical media archaeology is not about nostalgia for dead media, but techno-mathematical reasoning. Its approach to the *(més-)alliance* of computing and philosophy is consciously anachronistic, uncovering implicit *liaisons* between mathematics, philosophical reasoning, and the machine. Is mathematics the only scientific discipline which does *not* think, exactly because it operates symbols *as* the algorithmic machine?[13] If "[t]he machine is not a thinking being, but simply an automaton,"[14] then the human mind is machinic itself when "thinking" (answers Jacques Lacan).[15] Algorithms as philosophical tools, in this sense, lead to a kind of posthuman humanities.

Media philosophy "after" computation[16] does not address a post-computational world but the implicit interlacing of philosophy and actual computing. "The essence of technique is nothing technical," Heidegger declared in his critique of the Cartesian world;[17] it is rather techno-mathematical. A color surface, when measured and analyzed into its sinusoidal components (Fourier), disappears in the phenomenological sense,[18] just like a sound wave from within an electro-acoustic oscillator, once sampled into a computer file, is no longer an acoustic phenomenon but becomes implicit sonicity. To Heidegger's unease, nature is seduced into revealing its mathematical essence by media-technological measuring and calculating devices.[19] Whereas Pythagoras once saw numbers as embedded nature (like Leibniz's *deus calculans*), the computer literally numbers the world processually—closer to mathematical Fourier analysis

of physical vibrational events (sound, heat, electro-magnetic fields) than to any metaphysical aesthetics.

A media epistemology of computing discovers implicit techno-logical knowledge and creates sparks of insight (momentary illuminations), making explicit the *technopoiesis* of knowledge embedded within machine eventfulness. Techno*lógos* in latency becomes articulated by theoretical language. Thereby, even the core electronic element of the condenser (the venerable "Leyden jar") may become an "*objet philosophique*" (in Gaston Bachelard's or Gilbert Simondon's sense).

Rethinking technology from within, and the concept of operative diagrammatic reasoning, differs from the traditional philosophical approach. Once phenomena are no longer "transcendent" but grounded in technology and identified close to the signal, visual (or auditive) appearances on human-computer interfaces can cognitively be returned to what they are: computational functions.

Even Alan M. Turing once slipped into an archaeological metaphor; his "Proposal for Development of an Automatic Computing Engine" describes one process with BURY and UNBURY (which became mnemonic in the standard instruction tables).[20] Michel Foucault's *Archaeology of Knowledge* (1969), though, is not related to "digging" out forgotten artefacts buried in past archives, but to the techniques of propositional logics. Therefore, the appropriate way of rendering his passages intelligible is "to take the notion of a function at its mathematical face value."[21] Any non-metaphoric notion of an "archaeology" of media-implicit knowledge is strictly techno-logic: a study of enunciative functions, correlating symbols to an object field where they are enacted and repeated. Such investigations

into the conditions of possibility (Immanuel Kant's *a priori*) of discrete computing refer to its arithmetic as well as its hard-wired logic operations, revealing the knowledge machine. The set of terms Foucault proposes for discourse analysis is itself a theory-machine: "I must discover whether the machine works, and what it can produce."[22]

Mathematician and philosopher George Boole's propositional "binary" truth value logic, in his *Laws of Thought* (1854), was not invented for computing, but results from an ancient tradition and epistemology of philosophical reasoning. At the same time, the actual mechanization and mathematical formul(ariz)ation of previously verbal logic constituted a fundamental dis-continuity. Shannon's 1937 Master's thesis dealt with the mateRealization of symbolical logic by electro-magnetic relays.[23] Therefore, his preference for binary logics over other forms of computing (such as ternary or even multi-valued, non-Aristotelian logics) resulted from an engineering affordance: the binary trigger mechanism then common in automatic telephone switching systems. Shannon demonstrated that Boolean algebra could be applied to the same types of problems for which Babbage had designed his mechanical notation system.[24] Shannon proved that techno-logical implementation can be isomorphous to Boolean algebra. What had been verbal philosophical reasoning in Aristotle's *Organon* turned into electro-mechanics, thereby becoming autonomous of the immediate coupling of the human mind to pencil and paper. In electrified computation, a different kind of textuality returns. With electronics, the energy form of electricity does not count in its physicality any more, but is used as binary logics (information). All of a sudden, circuitry wiring becomes "operative writing" again: a symbolic order, just as identified by Shannon in 1937.

What can be diagrammatically expressed in algebraic symbols can also be implemented as real machine. This argument has not (only) been developed in the historical evolution of knowledge, but flashed up in equiprimordial repetition. In the era of scholastic philosophy, Ramon Llull's *Ars Magna* created a concentric "paper machine"[25] of symbol-based argumentation, and in Baroque times, Leibniz reduced mathematics to "dyadic" operations with the smallest code of "0" and "1." This code was meant to become machine and was designed by the philosopher but never implemented (until its "arrival" in the Heinz Nixdorf MuseumsForum at Paderborn, Germany). William Stanley Jevon's "logical piano" from 1869 was no tool for experimenting with the interrelation of "music & mathematics" in the Pythagorean sense, but an operative diagram of the implicit sonicity of philosophical reasoning itself.[26] The numerical sublime is mathematical calculation *in time*, rather than the geometric proportions of Pythagorean musicality.

Close to Computation: Combinatorial Reasoning (Leibniz)

For ages, philosophy has been primarily performative as a cognitive human procedure, while computing is always already materially operational—even if this mechanical operation is reduced to taking place with a hand coupled to paper by a pencil, and equipped with a rubber eraser. Leibniz dreamt of a kind of synthesis: to express philosophy algebraically (*characteristica universalis*), and to communicate by mathematical formulas in symbolic language ("*per Artem Combinatoriam*"). But opposed to the universal discrete machine named "computer," the *ars combinatoria* of the Baroque era was not able to calculate by itself, nor was it

capable of effectively storing intermediary results or of being programmed. This coupling of machines and mathematics led not to a mathematization of the machine, but to a mechanization of mathematics.

The media-archaeological question is therefore: To what degree is computation still rooted in philosophy, or does it depart from any "speculative" realism, with a veto? Is philosophical analysis essential to the origin of algorithmic computation itself, assuming that methodological reasoning is algorithmic already? For Babbage's procedure of "mechanical notation"[27] as well as for Turing's "paper machine," the symbolic (algebraic or diagrammatic) representation of the algorithm *is* (or can be) the same as the machine.

Henri Bergson was concerned with what happens in intellectual history when the "spiritualization of matter" reverses to become the materialization of the mind.[28] Cyberneticists frequently took mathematical machines for thinking machines, which meant the automatization of mathematical intelligence as opposed to the trivial mathematization of mechanical tools. Simple mechanics may be able to implement simple calculating rules, such as the four-species-machine that Leibniz presented to the Royal Society, which successfully translated the Indian-Arabic counting system by ciphers into a hardware of decadic cog-wheels. But this flow of numbers between mechanical wheels is not yet a program able to start, control, and finish calculations on its own, whereas a digital computer can be structurally programmed.[29]

Combinatorial reasoning, as described in Leibniz's 1666 *Dissertatio de arte combinatoria*, aimed at reducing all reasoning and discovery to a combination of basic elements such as numbers, letters, sounds, and color, but cannot

calculate on its own, let alone store data in RAM or registers. The coupling of machine and mathematics that enabled the creation of computers occurs as a mathematization of the machine itself, not as a mechanization of mathematics.

Materialist Philosophy: Is Dialectics Computable?

As long as a deceased computer is perceived as a disintegrating technical ensemble in a waste deposit, it is indistinguishable from other fragments of ("analog") electronics. Its specificity resides not only in its hardware materiality, but in its software, which might be performed in organic matter as well (such as computing with DNA). If future archaeologists discover among the ruins of Berlin strange artefacts that look like electronic devices, they will probably miss their essential identification as computers. What (literally) *matters* for computers? Are they mathematized matter or material mathematics?[30] The Turing machine is a heuristic fiction, but it has to take place on paper and with ink at least. Diagrammatic reasoning is never purely intellectual, but depends as an operation on the material trace in order to take place.

Only with(in) computing does the marriage of engineering (*techné*) and mathematics (*logos*) happen. Any archaeology of the computer and its programming practice oscillates between two poles: the mathematization of machines and the mechanization of mathematics. "The *logic of engineering* is one aspect of technical logic and another one *is the engineering of logic* that is *logical modelling* or the building of logical machines."[31] This is one reason for the rupture between the developers of computer engineering

(typically electricians) and the mathematicians working on meta-calculations, unable to affect the development of computing engineering.[32]

The notion of matter, thought through by G. W. F. Hegel, dissolved into matter and mathematics (like the very meaning of techno/logy, reminiscent of the Aristotelian distinction between *logos* and *physis*). Just when Babbage was about to extend his arithmetical Difference Engine to an inherently stored program-based and therefore algorithmic Analytical Engine, Hegel—who opposed the idea that the act and procedures of thought might be performed by a logical machine rather than by "working through" in philosophical terms, as expressed later in Boole's *Laws of Thought*—came to regard mathematical machines that claimed intelligence as a provocation.[33]

Rather than a mere modification "after" the arrival of mechanized computation, stored program computing (Babbage's Analytic Engine and the Von-Neumann architecture) disrupted the philosophical cosmos. With algorithmicized computation, calculation and intelligence converge.[34]

Heinrich Hertz's theorem of conceptual modelling[35] corresponds with Peirce's definition of *(me)dia-grammatics* as "reasoning which constructs a diagram according to a precept expressed in general terms, performs experiments upon this diagram, notes their results, assures itself that similar experiments performed upon any diagram constructed to the same precept would have the same results."[36] Each computational mechanism needs some physical implementation or embodiment to be in an operative medium state. It cannot be reduced to the symbolical order only, as "implementation" in software science refers to "a

realization of a technical specification or algorithm as a program, software component, or other computer system through computer programming and deployment."[37]

In the second edition (1963) of Gotthard Günther's *Das Bewußtsein der Maschinen. Eine Metaphysik der Kybernetik*, he suggested that it should be possible to test the validity of the dialectic theory by translating it into a formal algorithm of mathematical logic.[38] Georg Klaus (Chair of Philosophy of Logics at Humboldt University in East Berlin) counterattacked, insisting "that this was not only contrary to the spirit of Marxism and Leninism but also technically impossible; because, according to Hegel, dialectic theory is not capable of formalization."[39]

"Information is information, not matter nor energy, and any materialist philosophy which does not recognize this cannot survive these days," Wiener declared in his *Cybernetics* (1948). Different from mechanical engines driven by steam or electrical force as known from industrial modernity, trans-classical machines (Gotthard Günther) are primarily devices for processing binary information. Abraham Moles, in his writing on "machine art," expressed a cybernetic understanding of the machine no longer reduced to matter and energy transformation but first of all as an informational device:[40] "We are presently facing … a revolution of *automation* … of *symbiosis with machines* … a 'secret revolution' in the sense that those who are part of it—all of us—were unaware that it was going on."[41] The techno-logical works at its best in a mode well known from ancient rhetoric, defined by Quintilian as *dissimulatio artis*.

Human hands actually get *off* instruments by automation. Machinic typewriting differentiates the hand(s) into ten discrete fingers, and binary code finally

reduces decimal fingers to two. What still looks like a playful *performative* handicraft is in reality already a techno-mathematical *operation*. While fingers hack such thoughts in symbolical code on the keyboard of a laptop, the media-archaeological distance is aware that most writing is done within the micro-processors themselves where algorithms reign. Different from a typewriting machine that is still an instrument, the computer has already become what Gotthard Günther once called the *trans-classical machine*. When discretely (not diagrammatically "analog") calculating in his mind or coupled to pen, eraser, and square paper, man is already in a (Turing) machine state.

The opening statement of Semen Karsakof's 1832 *Aperçu d'un procédé nouveau d'investigation au moyen de machines à comparer les idées* declares: "L'homme pense et ses actions sont machinales [man thinks, and his actions are machinic]." Speech and writing "ne sont que des opérations mécaniques de l'intelligence [are nothing but mechanical operations of the mind]"; this is followed by a truly media archaeological definition of writing as "fixer les idées sur la matière [fixing ideas in matter]."[42] Digital computers are, as Hegel might say, instantiations of an "objective mind."[43] Such second-order machines are different from thermodynamic engines; logical mechanisms *invite* their materialization as techno-logic, just as Peirce designed the first electric circuit diagram for logical reasoning. Peirce's diagrammatic reasoning of media-in-being results from symbolic notations which are themselves already symbolical machines, as designed and discussed in L. F. Menabrea's 1842 "Sketch of the Analytical Engine invented by Charles Babbage."[44] On the previous Difference Engine it says: "The drawings are nearly finished, and the mechanical notation of

the whole, recording every motion of which it is susceptible, is completed"[45] as "operative writing."[46] This correlates with Turing's model of the (both human and non-human) paper machine.

Man becoming Inhuman in the Calculating State

With step-wise "digital" calculations in the mind or on paper, humans are (momentarily) in machine states. The Turing machine is not an extension or prosthesis of human organs; it is the definition of humans as speech-articulating beings. As indicated by the very term "programming language," culture has generated machines that operate with symbols in a language-like way, which has so far been seen as the unique privilege of humans.

Writing, reading, and counting are "elementary" cultural techniques. But man, when calculating, endowed with paper, pencil, and eraser, is in a machine state, revealing the mechanical within the "human" itself. A machine is not simply cultural technique anymore but a techno-logics of its own. It makes a time-critical difference when this process is implemented into non-human procedures, which transcends conceptual computation to actual *computing*. All of a sudden, a world in itself unfolds with all its breakdowns, side-effects, unknown phenomena, achievements, time-critical operations, and ahistorical tempor(e)alities. Such implementations are cultural products; technique is always cultural already, but results in a different kind of the physical un-natural: the symbolic order as implemented in the real.

Techno-epistemic constellations differ from applied "cultural techniques" such as geometry. In terms of a process-oriented ontology, the notorious Turing machine

invites "carpentry" in Ian Bogost's sense of an "alien phenomenology."[47] This mechanism was modelled, in 1936, not to solve a concrete numerical task like other calculating mechanisms, but as a meta-mathematical tool, equating the algorithm with the machine itself.

Philosophical reasoning exists *with*(*in*) computation. Philosophy becomes inhuman when its human agency is coupled to a machine, thereby constituting a cybernetic system. In this moment, the human lends consciousness to the machine, as argued by Günther, proponent of a philosophical multi-valued, trans-Aristotelian logic ("kenogrammatics"). The "trans-classic machine" *alias* digital computer can perform functions of consciousness, but gains self-consciousness only by its coupling with the human engineer.[48] In a letter to Kurt Gödel from 23 May 1954, Günther actually declares symbolic mathematical logic a condition for philosophical metaphysics.[49]

The Limits of Computability vs. Effective Computing

Computational technology is not simply an extension of human thinking into material objects, but a trans-subjective tool for operative reasoning that—in its complexity—cannot be performed by humans themselves. Ada Lovelace, Countess of Lovelace, who mathematically inspired Babbage's Analytical Engine, de-coupled mechanical computing of mathematics from the human hand or mind, and from the "subject" in both senses: "The science of operations … is a science of itself, and has its own abstract truth and value, just as logic has its own peculiar truth and value, independently of the subjects to which we may apply its reasons and processes."[50]

In the final section of the "alternative history" (or "steampunk") novel *The Difference Engine*, Lady Ada Byron—the mathematical genius behind the programming of Babbage's Analytical Engine—envisions a Leibnizian philosophy where "human discourse could be interpreted as the exfoliation of a deeper formal system."[51] Such a *Characteristica Universalis* would escape "the grave ambiguities of human speech"[52]—a challenge that Natural Language Processing, in Deep Machine Learning, actually addresses today. Still, "any formal system must be both *incomplete* and *unable to establish its own consistency* … There is no finite mathematical way to express the property of 'truth.'"[53] For the theory of computation, however, "truth" is no philosophical category, but is replaced by the Cartesian "method," which turns out as a mechanical procedure.

In a remarkable media-epistemic flipping from questions of abstract computation to actual computing, the fictitious character in the novel refers to the mechanical limits of *computing* in her epoque. Referring to "the so-called Modus Programme," Ada reports: "The programme ran, yet rendered its Engine useless…. The Modus has proven my Conjectures, but their practical exfoliation awaits an engine of vast capacity, one capable of iterations of untold sophistication and complexity"[54]—techno*lógos* unfolded. Indeterminacy, which is a core trope in computational aesthetics, is dislocated into the agency of actual computing practice. Attempts to create a provably-correct software (in terms of mathematical systems theory "as a great Engine for proving theorems") have failed so far, but this computational challenge or incomputability differs from the nonexistence of "a 100 percent bug-free computer program"[55] in *computing*. Artistic researcher Joost Rekveld questions "directly linking

our daily computer bugs and crashes to the undecidability of the 'halting problem,'"[56] but then falls victim to a Freudian slip by writing "Deep into Fazi's 'Contingent Computing' book"—which is instead titled *Contingent Computation* (typographically more correct). In such a slip of signifiers, techno*lógos* articulates itself in accordance with Lacan's insight that the (human *and* machine) unconscious is structured like a mathematical machine. Exactly because any mateRealization of a formal logical system is subject to material and energetic (entropic) frictions once embodied, the Lacanian "real" takes revenge on the logocentric desire for control by the "symbolic order." Actual computing can never be reduced to its pure computational concept; even the Turing machine depends on material inscription (ink on paper). A different kind of "contingency" emerges from the computational tempoR(e)al. For Lacan, "the real is the impossible," described as "that which is lacking in the symbolic order, the ineliminable residue of all articulation, the foreclosed element, which may be approached, but never grasped: the umbilical cord of the symbolic."[57] (Meta-) Mathematical reasoning, when reduced to a "little symbolic game," is not computing already:[58] "The science which reduces the real to several little letters, to a little bundle of formulae, will probably seem, with the hindsight of later epochs, like an amazing epic, and will also dwindle down, like an epic to a rather short circuit."[59]

In this sense, they are "engines of logic" indeed; the very term "engine" recalls the material embedding of computation as "the technological realisations of those strategies of formal abstraction."[60] Ada Lovelace still adhered to mathematical logocentrism and reduced computation to the merely "symbolical machine,"[61] writing that "[t]he

Analytical Engine has no pretensions whatever to *originate* anything. It can do whatever we *know how to order it* to perform."[62]

The metamathematical discussion of the incomputable, and the limits of algorithmic analysis, resulted in a theoretical mechanism of computation known as a Turing machine. Turing's seminal 1936 paper ("On Computable Numbers, with an Application to the Entscheidungsproblem"[63]) was preceded by Kurt Gödel's incompleteness theorem in 1931, which states that in any sufficiently powerful logical system, statements can be formulated that can neither be proved nor disproved within the system. Unpredictability thereby resides even *within* the symbolic regime of logical reasoning.[64] The Turing machine, which in a positivistic media-historic understanding laid the grounds for the era of ubiquitous computing today, can literally only compute "computable numbers" (no tautology), and thereby resulted conceptually from a negative answer to logical challenges such as the decision problem, and the question of unlimited algorithmic computation, almost (t)autologically limiting itself to the computation galaxy of the literal "computable numbers."

Notably, Turing's paper was published in the 1937 Proceedings of the London Mathematical Society, and not in a journal of applied engineering. The foundation for computer science therefore does not derive from a genealogy of technical applications like all other technical "media" before it, but from theory itself. The relation between theoretical design and practical machine was turned upside down when Turing investigated whether there could be a definitive method by which any logic theorem could be assessed as provable or not using a universal machine; the

paper "introduced the concept of a Turing machine as a thought experiment of how computers could operate."[65]

While the Turing machine, theoretically and in terms of "software," originated from efforts to formalize the *limits* of numerical computation (which, in a temporal sense, coincides with the *Halteproblem*), it practically resulted in hardware architectures for (apparently) "unlimited" capacities of computing. Here, the gap between a mathematical philosophy of computation and a media-archaeological understanding of actual computing makes a decisive media-epistemic difference.

Turing "on Paper" and the Paper Machine

This argument insists on writing "turingmachine" instead of "Turing('s) machine" because, unlike media historiography, media archaeography understands "Turing" as an intermediary catalyst or human "medium" of the techno*lógos* agency, rather than as an individual "author" of this epistemic thing. Media thinking is not only media thought by humans, but media "thinking" themselves in diagrammatic operativity (Peirce). That is why media archaeology tends to de-narrativize this machine, liberating it from the narrative enframing that would reduce it to the idiosyncrasies of an individual biography.

This recently became one of the themes of the new British £50 bank note, the iconography of which oscillates between the human (Turing's portrait and signature) and the machine (the codes). The note features "a photo of Turing taken in 1951 by Elliott & Fry which is part of the Photographs Collection at the National Portrait Gallery" and "a table and mathematical formulae from Turing's seminal 1936 paper."[66]

The note's iconography flips back to applied computation, in fact to one of the first electronic stored-program digital computers: "The Automatic Computing Engine (ACE) Pilot Machine which was developed at the National Physical Laboratory as the trial model of Turing's pioneering ACE design." Technical drawings for the British "Bombe" feature on the note as well: "the machine specified by Turing and one of the primary tools used to break Enigma-enciphered messages during WWII."[67] The essential enigma, though, remains T/turing him- or itself: human and/or machine?[68] In an anthropocentric capturing of the observer's historical imagination, the bank note displays Turing's signature from the visitor's book at Max Newman's House in 1947; in contrast, one detects a ticker tape depicting Turing's birth date (23 June 1912) in binary code: "The concept of a machine fed by binary tape featured in Turing's 1936 paper."[69]

The new note was issued on 23 June 2021 to coincide with Turing's birthday. According to Jeremy Fleming, the director of British Government Communications Headquarters, "Alan Turing's appearance on the £50 note … confirms his status as one of the most iconic LGBT+ figures in the world."[70] Against this focus on human wetware, the polymer bank note itself belongs to the symbolical regime of the "paper machine." Fleming confirms that Turing's appearance on the £50 note is meant as "a celebration of his scientific genius which helped to … influence the technology we still use today"[71]—referring to the imaginary of circulating coins as that which dynamically endures, or as paper currency itself.

(Re-)Thinking Computation in Philosophical Terms: Cybernetic Reasoning

Cybernetics cannot be reduced to a historical discourse of applied engineering; in the tradition of Norbert Wiener, it is both a mathematics and a philosophy. Heidegger was well aware of the transition from *techné* as handicraft (cultural techniques) and "*Kraftmaschinentechnik*" (thermodynamic machines) to "*Automation*," essentially defined by cybernetic communication and control.[72] When confronted with cybernetic thinking, Heidegger "conceptualized the beginning of computers as the factical end of philosophy itself."[73] Humans (as mathematicians or technicians) vanished into machines.[74] With the algorithm itself identified as "machine,"[75] a challenge to traditional philosophical reasoning arose. (Meta-)Mathematics displaced discursive philosophy by logics and equations in formal languages.

While technique (or cultural techniques[76]) is still body-related (as extensive *handling*[77]), technology in its true sense is the marriage of in-formed physics and *logos* (mathematics, logic circuitry). This relation is turned radically upside down by the Turing machine: Techno-mathematics is not simply the mechanization of mathematical calculation (like in the ancient Mechanism of Antikythera), but reveals the machinic within mathematical reasoning itself—what Thomas Nückel calls a "sphere of Berechenbarkeit [computability]" that challenges the sphere of philosophical thinking.

Cybernetics is equally rooted in philosophy, engineering, and mathematics, a trinity that asks for media-epistemological unfolding. The ambition of primary cybernetics (before it split into separate and therefore epistemologically-reduced fields like second-order cybernetics, computational science,

neuroscience, technical informatics, etc.) was to embrace the double nature of mathematical computation and electro-technical computing. Media archaeology must de-historicize that cybernetic approach in order to rescue it from being reduced to a simple chapter in the history of ideas.

(Re-)Turn from Phenomenology to Processual Ontology

Seen from a distance, the field of "new media" philosophy and theory seems split between two different approaches. Technocentric media archaeologists describe the non-discursive practices of the technocultural *archive* in the spirit of Foucault, while media phenomenologists take an anthropocentric, performative approach to "analyze how phenomena in various media appear to the human cognitive apparatus, that is, to the mind and senses."[78] Phenomenology stays close to the embodied affective signal, while media archaeology traces effective signal processing as implemented in technologies. For Heidegger, up-dating the etymological root in *Being and Time* (1927), phenomenology literally encourages that which shows itself to be seen for itself. An epistemology of media derives sparks of knowledge from within its technology, indeed its techno*lógos*.

In the cultural historical narrative, technologies changed from tools to machines, then to "symbolical machines" (algorithms).[79] In an alternative chrono-logical concept of equiprimordiality, any archaeology of contemporary media culture is as close to mathematics as it is to phenomenology. In alliance with George David Birkhoff—who delivered a lecture at the 1928 congress of mathematicians in Bologna proposing a measure for aesthetic perception (so-called

"*Gestaltmaß*") as ratio between order and complexity[80]—philosophers like Max Bense as well as artists made cybernetics and aesthetics converge.[81] Onto-techno-analytics, while being aware that all technological artefacts are emanations of cultural knowledge, aims at a "culture-free" understanding of computational events as well. Object-Oriented Ontology hereby approaches media archaeology.

Media theory, in a time of embedded computing, breaks with any reduction of operative reasoning to mathematical computation. When it comes to technology, there is always a material, "concrete" grounding of the cognitive *lógos*. James Clerk Maxwell's differential equations (in his 1865 paper "A Dynamical Theory of the Electromagnetic Field") offered a mathematical tool to master the phenomenon of what Michael Faraday has called the "field," that is, the sphere of electro-magnetic interaction and induction. Instead of empirical study with a mechanical model (as preferred by Maxwell), mathematics itself became the model of an invisible event with symbolical means (operators).[82] The computer, as Turing's machine, is derived from meta-mathematical deduction. But this theory-born mechanism became "medium" only when translated into operative matter, into "being" as world/as time. Beyond the static Pythagorean empirico-philosophical equation (harmonic order in integer number ratios), the processual derivative of meta-mathematics (the algorithm as machine) became a worldly medium.

Traditionally, ontology is the philosophical inquiry into the nature of being as existence and becoming. But it gains "practical application in information science and technology, such as ontology engineering,"[83] which deals with formal representations of a set of concepts within the domain of

temporal action. That is, with applied processual ontology,[84] a core concept of occidental philosophy becomes functional and adaptive to the changing underlying algorithmic domain.

While in its root meaning, phenomenology is the study of *phenomena* linked to empirical and especially sensory appearances (appearances as opposed to reality, specified in the philosophical model of Plato's cave), Edmund Husserl took up the term for a science of consciousness and subjective embodied action, especially the complex procedures of temporal awareness. Media archaeology, on the contrary, does not begin the inquiry into the meaning of being in the anthropocentric sense by examining human existence, but is radically object-oriented, granted a definition of media that a technological device is in "media being" only when in action, that is, when signal processing. Media archaeology learns from posing the philosophical question in Heidegger's *Being and Time*, but extends and specifies it to the question of computational media tempor(e)alities.

In 1936 the "invention" of the computer as symbolical machine was a byproduct of Turing's answer to the problem of the mathematically undecidable. "Computable" numbers are those that are calculable by *finite procedures*. The question of whether there can be an algorithm with "a sense of ending," that is, one capable of deciding whether a given mathematical procedure will terminate within a limited time (the *Halteproblem*), leads to the more general consideration of media-induced temporality. Computational systems internally develop new forms and operations of temporal sequences and a different notion of "ending" (recursive functions, real-time operations), enacting a micro-dramaturgy of synchronization where fractions of time are decisive ("critical") for the success of the whole media event.

Media theory replaces the ontological definition of media with a dynamic one[85]—its temporal mode of existence—as a technical implementation of Heidegger's philosophical claim.[86] Continuous or discrete processuality is the core definition of electro-mechanic and electronic media as such.

"Ready-to-hand"? Computing Technology with Heidegger, and Object-Oriented Ontology

The very term technology goes back to both *techné* and *lógos*. The bias of the ancient Greek mathematical *lógos* is less actual calculation, more an inquiry into its theory[87]—a "presence-to-hand" (*vorhanden)* that differentiates it from the operative "readiness-to-hand" (*zuhanden*) of functional computing as tool (*Zeug*).[88] The hammer—Heidegger's preferred example for technique that is "ready-to-hand" (*griffbereit*)—is still an instrument coupled to transitive human performance; his technical ontology hardly takes into account the autopoietic electronic circuits of algorithmic computing *from within*. True *technopoiesis* takes place *within* the operative technological process itself.

Electronic circuitry (including the triode or transistors) and its cybernetic coupling for signal transduction in "electrified" system and communication theory is an escalation into technology, compared with the merely technical *Zeug* or the trivial machine. Smart devices in ubiquitous computing are no longer simply "ready-to-hand" like the Heideggerian hammer; their agency is not primarily performed by human action but becomes an autopoietic operative regime. Media archaeological analysis opens the flat Integrated Circuit, making it "present-to-hand" (*vorhanden*) in terms of critical insight. This requires

not simply mechanical circuit bending, but the logical revelation of codes (hacking, and the literal "disassembler" reverse engineering tool for computer code).

Is there an equivalent to Heidegger's "readiness-to-hand" in digital computing? In "post-computational" times (in the sense of "post-digital"), with its ubiquitous computing and mobile communication devices, the computer turns from an object of media-theoretical observation into an everyday thing, *zuhanden* (ready-to-hand) more than *vorhanden* (present-to-hand). For most consumers, a communication device like the cell phone is literally "ready-to-hand," used without theorizing it. The term has been extended to "object-oriented philosophy," as coined by Graham Harman in his 1999 PhD dissertation, "Tool-Being: Elements in a Theory of Objects."[89] Heidegger's concept of "readiness-to-hand" refers to the withdrawal of objects from human perception into a different reality.[90] They thereby distance themselves from humans not only in cultural space but in their proper temporality (*Eigenzeit*). The technological world escapes from human "history."

Technology only reveals itself to human perception in breaking down, when it goes from "readiness-to-hand" (at utilitarian disposal) to articulating itself as a medium. Media archaeologists listen to the technologically-induced noise as the essential message from within the "medium" (channel) itself. While the signal-to-noise ratio in communication can be mastered by mathematical analysis, only in moments of complete technological breakdown is the *aletheía* of the operative machine revealed: "The malfunctioning machine will be expressed only when experiencing the real physical machine (building it, repairing it); its operation is inextricably linked to its malfunctioning."[91] This leads to a core ontological question: Is digital computing

capturing the essential operativity of the world (conceived as "computational universe" in the knowledge tradition from Pythagoras to informational quantum physics), or is it nothing less, or more, than its mathematical model (a diagram)? Metamathematics correlates with metaphysics, declaring its independence from the real physical world in the numerical description of abstract objects, "but the actual information manipulation is still in the real physical universe."[92] Here a radically different way of computational mathematics media-archaeologically reoccurs, right from the museum of "dead" technologies: the analog computer that metonymically models physical events by nonlinear (electro-)physical means, rather than by numerical and algorithmic ones (such as voltage and condensers). The analog computer is itself part of the world it analyzes or simulates; just like in quantum computing, the mechanism no longer symbolically abstracts from the physical world, but calculates with the computer matter itself. All of a sudden, the lithographic "inscriptions" in silicon merge with the matter carrying them.

Ian Bogost's concept of "carpentry" refers to technological circuit-bending as a means of operative media analysis in techno-logical experimentation; Morten Riis has enacted a case study by his invasive modifications of a cassette tape recorder.[93] From hard- to software, this practice-based media philosophical approach becomes truly computational when applied to the analysis of algorithms. Johannes Maibaum closely examines two algorithms that transform data between the time and the frequency domain in terms of what Bogost calls "unit operations:" Joseph Fourier's original series and the optimized fast Fourier transform (FFT), the latter being central to almost all computer-based communication technologies available

today.[94] Different from classic mathematical Fourier Analysis, the computational effectiveness of the FFT is grounded in an operation that cannot directly be identified in its formal listing of single steps (that is, in its source code). Instead, by exploiting certain properties of the data to be transformed, the time-critical minimization of the number of single operations allows for the algorithm's speed gain. This approach in modern computational design is already well known as *divide-and-conquer*, from the Roman empire's power administration. In order to make such software engineering knowledge about the time requirements of algorithms available to media philosophy, Maibaum develops a neologism that extends Bogost's carpentry in a media-archaeological way: "algorithmic time," which is largely pre-determined by an algorithmic time coefficient.[95] For Harman's Object-Oriented Ontology, the object always withdraws; it is impossible to access its encrypted essence. But for a process(ing)-oriented ontology, such essence itself unfolds only in time; technical media themselves therefore become active archaeologists of knowledge.

Media archaeology experiences technologies not simply as "present-at-hand" from a theoretical distance, but as *operative* media analysis, thereby "ready" and "present" at the same time. The concept of "machine thinking"[96] refers both to a (finite state) machine's inner operation *and* to its affordance for humans. Conceptual media theatre is well suited to exploring the interplay between such modes of machine thinking, for example, by enacting the Turing test as well as by re-embodied chatbots.

According to Heidegger, only the *present-at-hand* attitude to technologies—which (at least momentarily) suspends the object from its utilitarian *ready-to-hand*

function—allows for critical observational, that is, theory as distant looking (*theoría*) at something. Such contemplative observing corresponds with the Cartesian way of instrumentally measuring and numerically mathematizing the world, but misses the concatenation of the isolated tool with other objects. However, with computational machines that mechanize mathematics itself, theoretical analysis (in numbers) is re-implemented in the physical world, in the very tempor(e)ality of being.

Presence-at-hand is not the way digital technologies in the world are usually encountered. Heidegger's reference to the instrumental *Zeug* as an object in the world with which humans have meaningful dealings, and which "always exist[s] in a network of other tools and organizations, e.g., the paper is on a desk in a room at a university,"[97] is somewhat inappropriate for a more processual definition of actual media.[98] What is revealed when, for instance, a hard disc drive within a computer breaks down, and thereby reverts to a simple material artefact?[99] Certainly not the axiomatic halting problem. In a transgression of Heidegger's terms, the digital computer, by means of an emulator or real-time debugger, can both be used as a tool (*zuhanden*) *and* be critically reflected in its modalities. Different from the Heideggerian example of the hammer, computation, as a computing medium, is not simply a tool anymore. Indeed, according to Heidegger, the mere description of a technical object is a mis-description,[100] as opposed to its operative experience in (con-)temporality. In accordance with the ancient definition of a physical medium such as air, an electronic communication device such as the radio is in its medium state only when transducing signals. The hitherto passive Aristotelian notion of "medium" (*to metaxy*), in

contrast to the "thing,"[101] turns media-active as technology, with its proper circuitry engineering or algorithmic media-dramaturgy. Even the "ether" becomes a media-active substance, consisting of electro-magnetic waves propagating from high-frequency oscillators via antennas.

The "Alien Temporality" of Computational Ontology

Technically "applied" ontology pairs with the anti-hermeneutic focus on micro-temporal analysis of real media apparatuses in media archaeology. This requires close observation and interaction with rudimentary aspects of technological *objets trouvés*. The machine's operations (its media archaeological *momentum*) are at their core un-historical; the specific time function of the machine is to some extent outside history and cultural discourse. Each media event is inherently technological, not human.

Computational data processing makes all the difference between linear signal transduction and discrete, nonlinear algorithmic steps, thereby interrupting its compatibility with the human phenomenology of a time "flow." The ontological question "What *is* computation?" misses the essence of computing, which is the moment inherited philosophy has to switch to *media philosophy*. When "in being," technology is exempt from the narrative cultural order of time (a.k.a. "history"). Its ontology (with the *ón* read literally as the participle present of "to be") roots in its being (as) a time-object itself.

Notes

1 See *Theory, Culture & Society* 30.6 (2013), eds. Jussi Parikka and Geoffrey Winthrop-Young, special issue on *Cultural Techniques*.
2 Charles Babbage, *Passages from the Life of a Philosopher* (London: Longman, Green, Longman, Roberts, & Green, 1864).
3 Gilbert Simondon, *Du Mode d'Existence des Objets Techniques* (Paris: Aubier et Montaigne, 1958); Maurizio Lazzarato, *Videophilosophie. Zeitwahrnehmung im Postfordismus* (Berlin: b-books, 2002).
4 *Proceedings of the Institute of Radio Engineers* 36 (1948): 1324-1331.
5 Core arguments of this text were originally formulated in a draft for the edited book project *Philosophy After Computation* that, sadly, has not been realized. Its basic theme has been inspired by, and remains sometimes explicitly, more often implicitly, in critical dialogue with M. Beatrice Fazi's seminal book *Contingent Computation: Abstraction, Experience, and Indeterminacy in Computational Aesthetics* (Lanham: Rowman & Littlefield, 2018).
6 See the Dead Media Project, initiated by science fiction author Bruce Sterling in 1995. http://www.deadmedia.org/.
7 A term coined by Kim Cascone, "The Aesthetics of Failure: "Post-digital" Tendencies in Contemporary Computer Music," *Computer Music Journal* 24.4 (2002): 12-18.
8 "Square root," *Wikipedia*. https://en.wikipedia.org/wiki/Square_root. Accessed 12 May 2017.
9 "Mandelbrot set," *Wikipedia*. https://en.wikipedia.org/wiki/Mandelbrot_set. Accessed 12 April 2021. Referring to R. P. Taylor and J. C. Sprott, "Biophilic Fractals and the Visual Journey of Organic Screen-savers," *Nonlinear Dynamics, Psychology, and Life Sciences* 12.1 (2008).
10 "Mandelbrot set."
11 Editors' note, Charles S. Peirce, *Logical Machines*, *The New Elements of Mathematics*, *vol. III/Part 1: Mathematical*

Philosophy (The Hague and Paris: Mouton; Atlantic Highlands: Humanities Press, 1976), 632.

12 Email from Thomas Nückel, May 2017. See also his "Berechenbarkeit als Sphäre digitaler Medien [Computability as the Sphere of Digital Media]" (M.A. Thesis: Humboldt University, 2016/17), 81. https://edoc.hu-berlin.de/handle/18452/19708. Referring to Marshall McLuhan, *Understanding Media. The Extensions of Man* (London and New York: Ark Paperbacks, 1964), 349.

13 "'Die einzige Wissenschaft, die nicht nicht denkt, ist die Mathematik': Friedrich Kittler, Ästhetik und Mathematik," in eds. Karin Hirdina and Renate Reschke, Ästhetik. Aufgabe(n) einer Wissenschaftsdisziplin (Freiburg im Breisgau: Rombach, 2004), 270.

14 L. F. Menabrea, *Sketch of the Analytical Engine invented by Charles Babbage* [1842], trans. Ada Lovelace, in ed. B. V. Bowden, *Faster Than Thought. A Symposium on Digital Computing Machines* (London: Pitman Publishing, 1971), 349.

15 See Jacques Lacan, "Psychoanalyse und Kybernetik oder Von der Natur der Sprache" [1955], *Das Seminar II. Das Ich in der Theorie Freuds und in der Technik der Psychoanalyse* (Berlin: Weinheim, 1991): 373-390.

16 An allusion to the title of a book project envisioned by David Berry and M. Beatrice Fazi (unrealized so far).

17 Martin Heidegger, "Die Frage nach der Technik," *Reden und Aufsätze*, 2nd ed. (Pfullingen: Neske, 1959): 13-44.

18 Martin Heidegger, "Der Ursprung des Kunstwerks," *Holzwege*, 4th ed. (Frankfurt am Main: Vittorio Klostermann,1963), 35f.

19 Martin Heidegger, "Die Natur wird daraufhin gestellt, sich in einer berechenbaren Gegenständlichkeit zu zeigen (Kant)," Überlieferte Sprache und technischnische Sprache [1962] (St. Gallen: Erker, 1989), 17.

20 Alan Turing, *ACE Report of 1946 and Other Papers* (Cambridge: MIT Press, 1986): 20-105, 36.

21 Martin Kusch, "Discursive formations and possible worlds. A reconstruction of Foucault's archaeology," *Science Studies* 1 (1989): 17-25.
22 Michel Foucault, *The Archaeology of Knowledge and the Discourse on Language*, trans. A. M. Sheridan Smith (New York: Pantheon Books, 1972), 135f.
23 Claude E. Shannon, "A Symbolic Analysis of Relay and Switching Circuits" (M.S. Thesis: MIT, August 1937); published (edited and abridged) in *Transactions of the American Institute of Electrical Engineers* 57 (1938): 713-723.
24 Jeremy Norman, "Babbage Describes the Logic and Operation of Machinery by means of Notation," *History of Information.com*. http://www.historyofinformation.com/expanded.php?id=3179. Referring to ibid.
25 Bernhard Dotzler, *Papiermaschinen: Versuch über Communication & Control in Literatur und Technik* (Berlin: Akademie Verlag, 1996).
26 Martin Gardner, *Logic Machines and Diagrams* (New York, Toronto, and London: McGraw-Hill, 1958).
27 As published in a paper in the *Philosophic Transactions of the Royal Society*, 1826.
28 Henri Bergson, *La signification de la guerre* (Paris: Bloud et Gay, 1915), 20; see Friedrich Kittler, *Die Nacht der Substanz* (Bern: Benteli, 1989), 30.
29 Friedrich Kittler, "Hardware, das unbekannte Wesen," *Lab. Jahrbuch 1996/97 für Künste und Apparate*, ed. Academy of Media Arts (Cologne: Walther König, 1997): 348-363.
30 See A. Willers, *Mathematische Maschinen und Instrumente* (Berlin: Akademie, 1951).
31 Gellius N. Povarov, "Logic, automation and computing: The Rise of Russian Technical Logic," in eds. Georg Trogemann, Alexander Y. Nitussov, and Wolfgang Ernst, *Computing in Russia. The history of computer devices and information technology revealed* (Braunschweig: Vieweg, 2001): 63-71, 68.
32 Stanislav V. Klimenko, "Computer Science in Russia: A Personal View," *IEEE Annals of the History of Computing* 21.3 (1999): 16-30, 24.

33 On computing with numbers see G. W. F. Hegel, *Wissenschaft der Logik, vol. 1: Die Lehre vom Sein* (1832), ed. Hans-Jürgen Gawoll (Berlin: Akademie Verlag, 1990), 230.
34 "Mechanisierung des Geistes und Vergeistigung der Materie fallen seitdem zusammen," Kittler, *Die Nacht der Substanz*, 31.
35 Heinrich Hertz, *Die Prinzipien der Mechanik in neuem Zusammenhange dargestellt* (Leipzig, 1894), 1.
36 Charles S. Peirce, *The New Elements of Mathematics, vol. IV: Mathematical Philosophy* (The Hague and Paris: Mouton; Atlantic Highlands, Humanities Press: 1976), 48.
37 "Implementation," *Wikipedia*. https://en.wikipedia.org/wiki/Implementation. Accessed 11 February 2019.
38 Gotthard Günther, *Das Bewußtsein der Maschinen. Eine Metaphysik der Kybernetik* (Krefeld and Baden-Baden: Agis, 1958).
39 Quoted from the manuscript "PROPOSED: To develop a mathematical calculus of dialectics to anticipate recent Marxist intentions in this field since they are aiming at new technical designs in Cybernetics," *Estate of Gotthard Günther*, Staatsbibliothek (Preußischer Kulturbesitz) Berlin, file 471, 1.
40 Abraham A. Moles, "Introduction to the colloquium *Computers and Visual Research*, Center for Culture and Information, August 3-4, 1968, Zagreb," in ed. Margit Rosen, *A Little-Known Story about a Movement, a Magazine, and the Computer's Arrival in Arts. New Tendencies and Bit International, 1961-1973* (Karlsruhe: ZKM and Cambridge: MIT, 2011): 263-266, 263.
41 Ibid., 264.
42 Semen Karsakof, *Aperçu d'un procédé nouveau d'investigation au moyen de machines à comparer les idées* (St. Petersburg, 1832), 1.
43 Günther, 181.
44 *Bibliothèque Universelle de Genève* 82 (October 1842).
45 Ibid.
46 Sybille Krämer, *Symbolische Maschinen. Die Idee der Formalisierung in geschichtlichem Abriß* (Darmstadt, 1988).

47 Ian Bogost, *Alien Phenomenology, or What It's Like to Be a Thing* (Minneapolis: University of Minnesota Press, 2012).
48 "Maschine, Seele und Weltgeschichte," *Gotthard Günther, Beiträge zur Grundlegung einer operationsfäigen Dialektik*, 3 (Hamburg: Meiner, 1980): 211-235.
49 Kurt Gödel, *Collected Works*, *Volume IV: Correspondence A-G*, eds. Solomon Feferman et al. (Oxford: Oxford University Press 2003): 456-535.
50 James Essinger, *A female genius: How Ada Lovelace, Lord Byron's daughter, started the computer age* (London: Gibson Square, 2014), 173.
51 William Gibson and Bruce Sterling, *The Difference Engine* (London: Gollancz, 2011), 376.
52 Ibid.
53 Ibid.
54 Ibid.
55 Fazi, 122.
56 Posted on Facebook on 15 March 2019. Screenshot by computer archaeologist Stefan Höltgen, 8 April 2021.
57 Alan Sheridan, "Translator's Note," Jacques Lacan, *The Four Fundamental Concepts of Psycho-Analysis* (London: Penguin, 1994), 279.
58 Ibid., 279.
59 Jacques Lacan, "Psychoanalysis and cybernetics, or on the nature of language" [1955], *The Ego in Freud's Theory and in the Technique of Psychoanalysis 1954–1955. The Seminar of Jacques Lacan. Book II* (New York: Norton, 1991), 299.
60 Fazi, 2. Referring to Martin Davis, *Engines of Logic. Mathematicians and the Origin of the Computer* (New York: Norton, 2000).
61 See Krämer.
62 From Ada Lovelace's "Notes" (1843), quoted in the epigraph of the "Introduction" to Fazi, 1.
63 Turing, "On Computable Numbers, with an Application to the Entscheidungsproblem," *Proceedings of the London Mathematical Society* 42.2 (1937): 230-265. The (German) *Entscheidungsproblem* or decision problem addresses a computational challenge: Is there a mechanism that can,

in advance, decide whether a string of symbols is logically provable or not?

64 Concerning computation, Fazi has carried this philosophically much beyond Gödel and Turing, involving Whitehead and Deleuze.

65 "The new £50 note unveiled," Bank of England, 25 March 2021, https://www.bankofengland.co.uk/news/2021/march/the-new-50-note-unveiled. Accessed 1 April 2021.

66 Ibid.

67 Ibid.

68 Andrew Hodges, *Alan Turing: The Enigma* (London: Penguin, 1983).

69 "The new £50 note unveiled."

70 Ibid. See as well Jacob Gaboury, "A History of Queer Computing," *Rhizome.org*, 19 February 2013. https://rhizome.org/editorial/2013/feb/19/queer-computing-1/. Accessed 30 December 2021.

71 "The new £50 note unveiled."

72 "Was hier überall der Name Technik meint, ist nicht ohne weiteres klar." Martin Heidegger (1962 lecture), Überlieferte Sprache und Technische Sprache (St. Gallen: Erker, 1989), 10.

73 Friedrich Kittler, "Towards an Ontology of Media," *Theory, Culture & Society* 26.2-3 (2009): 23-31, 24.

74 "Seit Alan Turing 1954 Selbstmord begann, heißt die *Turing machine* schon *turing machine*." Friedrich Kittler, "Phänomenologie versus Medienwissenschaft," *Kittler Web Hub*, http://hydra.humanities.uci.edu/kittler/istambul.html. Referring to Hodges.

75 Turing, "On Computable Numbers."

76 See *Theory, Culture & Society* 30.6 (2013).

77 "'*Technik' im weisteren Sinne*: handwerkliches, werkzeugliches Arbeiten; Gerätegebrauch … *téchne*, Sichauskennen in der Handhabung, Können, 'Kunst.'" Martin Heidegger, *Leitgedanken zur Entstehung der Metaphysik, der neuzeitlichen Wissenschaft und der modernen Technik* (Frankfurt am Main: Vittorio Klostermann, 2009), 293.

78 Kjetil Jakobsen, "Anarchival Society," in ed. Eivind Røssaak, *The Archive in Motion. New Conceptions of the Archive in Contemporary Thought and New Media Practices* (Oslo: Novus, 2010): 127-154, 141. Referring to eds. Wendy Hui Kyong Chun and Thomas Keenan, *New Media, Old Media. A History and Theory Reader* (New York: Routledge, 2006), 3f.
79 See Krämer.
80 "Quelques éléments mathématiques de l'art," *The collected mathematical papers of G. D. Birkhoff, American Mathematical Society* 3 (1968): 288-306.
81 *When Cybernetics meets Aesthetics* was the title of a conference organized by the Ludwig Boltzmann-Institute for Media.Art.Research at Linz (Austria), 31 August 2006, on the occasion of the Ars Electronica festival of media arts.
82 Hugh G. J. Aitken, *Syntony and Spark. The Origins of Radio* (New York, London, and Sydney: Princeton University Press, 1976), 21.
83 "Ontology," *Wikipedia*. https://en.wikipedia.org/wiki/Ontology. Accessed May 2017.
84 "Ontology engineering," *Wikipedia*. https://en.wikipedia.org/wiki/Ontology_engineering. Accessed May 2017.
85 Wolfgang Ernst, *Technológos in Being. Radical Media Archaeology and the Computational Machine* (New York: Bloomsbury Academic, forthcoming).
86 "Um dem Seinscharakter dessen, was hier Thema ist, zu entsprechen, müssen wir von der Zeit zeitlich reden…. Die Zeit ist das Wie." Martin Heidegger (1924 Marburg lecture), "Der Begriff der Zeit," ed. Hartmut Tietjen, *Der Begriff der Zeit* (Tübingen: Niemeyer, 1995), 27.
87 Johannes Lohmann, *Musiké und Logos* (Kleinblittersdorf, Musikwissenschaftliche Verlags-Gesellschaft: 1970), 11.
88 See §§ 15 and 16, Martin Heidegger, *Sein und Zeit* (Tübingen: Niemeyer, 1986), 69ff. *Being and Time* (Oxford: Blackwell, 1962), chapter III "The Worldhood of the World," 91-107.
89 Graham Harman, "Tool-Being: Elements in a Theory of Objects" (PhD Dissertation: De Paul University, 1999).

90 "Object-oriented ontology," *Wikipedia*. http://en.wikipedia.org/w/index.php?title=Object-oriented_ontology. Accessed 8 September 2014.
91 As expressed in Morton Riis, "Machine Music. A Media Archaeological Excavation" (PhD dissertation: Aarhus University, 2012).
92 R. Landauer, "Computation: A fundamental physical view" [1987], in eds. Harvey S. Leff and Andrew F. Rex, *Maxwell's Demon. Entopy, Information, Computing* (Bristol: Adam Hilger, 1990), 260-267, 262.
93 Morten Riis, "Where are the Ears of the Machine? Towards a sounding micro-temporal object-oriented ontology," *Journal of Sonic Studies* 10 (10 October 2015). https://www.researchcatalogue.net/view/219290/219291.
94 Johannes Maibaum, "Fast Transformations. A media-archaeological and object-oriented investigation of Fourier-Transform algorithms" (M.A. Thesis: Humboldt University, 2016), http://edoc.hu-berlin.de/18452/.
95 Ibid.
96 As discussed in Ioana Yucan's forthcoming PhD dissertation in Theatre and Performance Studies at Brown University.
97 "Heideggerian terminology," *Wikipedia*. https://en.wikipedia.org/wiki/Heideggerian_terminology. Accessed 13 April 2021.
98 This is accentuated as well by Fazi in her Whiteheadian approach to the contingencies of computation.
99 For an application of this thought to computing, see Terry Winograd and Fernando Flores, *Understanding Computers and Cognition* (Norwood: Ablex, 1986).
100 "[e]ine Fehldeskription der alltäglichen Welt," *Hermeneutik der Faktizität* (Frankfurt am Main: Vittorio Klostermann, 1995), § 19, 88f.
101 See Fritz Heider, "Ding und Medium," *Symposion* 1.2 (1927): 109-157.

6 Compression Artefacts
On the Aesthetics of Compressibility

A. A. Cavia

> Admitting pure spontaneity or life as a character of the universe, acting always and everywhere though restrained within narrow bounds by law, producing infinitesimal departures from law continually, and great ones with infinite infrequency, I account for all the variety and diversity of the universe, in the only sense in which the really sui generis and new can be said to be accounted for.
>
> —Charles Sanders Peirce[1]

In the late 1950s, the artist François Morellet began integrating chance operations into his painting practice, utilizing the decimals of the transcendental number pi, or else digits selected at random from the telephone directory, to determine color and other factors in his compositions. A prime example is the silkscreen *Répartition aléatoire de 40 000 carrés selon les chiffres pairs et impairs dun annuaire de téléphone* (1961), in which odd and even numbers from a phone book determine the colors of cells on a vast grid. The appeal to telephony is apt and presumably not coincidental. Claude Shannon acted in the capacity of a signal engineer at Bell Labs while developing the theory of information a decade or so earlier, published in his landmark 1948 paper, "A Mathematical Theory of Communication."[2]

Shannon by no means invented the notion of information outright—major contributions from Nyquist, Hartley, and others preceded him—but his theory formalized the concept in unambiguous terms, as a measure of uncertainty established via a powerful thermodynamic analogy. Through this information theoretic lens, Morellet's work can be approached as an incompressible representation, its content strictly irreducible in a formal sense. The title is in effect a *lossy* compressed encoding of the work, though grasping this does not suffice to recreate it, given the indeterminate nature of each cell's color. To follow its instructions inevitably produces unique outputs, as it can be modeled as a program with non-deterministic inputs. Upon encountering the work in person at Dia Chelsea in 2018, I was struck by its resemblance to John Conway's Game of Life, appearing to my apophenic human eye to depict a *cellular automaton,* despite no such determinate rule being in effect. All forms of traditional painting, not to mention the plastic arts in general, are trivially irreducible to formal description in this sense. However, as computer scientist Ken Perlin pointed out decades later, working with materials such as oil and acrylic leads to intrinsically stochastic outcomes, which can be conceived statistically in terms of their information carrying capacity:

> The fact that noise doesn't repeat makes it useful the way a paint brush is useful when painting. You use a particular paint brush because the bristles have a particular statistical quality - because of the size and spacing and stiffness of the bristles. You don't know, or want to know, about the arrangement of each particular bristle. In effect, oil painters use a controlled random process.[3]

Perlin was fascinated by the supposed incomputability of natural textures, analog fluid mechanics, and organic forms, taking these as a challenge to algorithmic compression. He developed his own noise algorithm to render the computer-generated imagery for the feature-length film *Tron* (1982), becoming the first computer scientist to receive an Academy Award for inventing an algorithm. The open-source *Perlin Noise* algorithm is capable of mimicking a dizzying array of textures, from marble to wood grain, rocky landscapes to water, utilizing a nested set of periodic functions to achieve the illusion of organic form. It is an astonishing feat of compression, its original implementation in the programming language C coming in at under 200 lines of code. It remains a popular algorithm in the computational arts, not to mention video game rendering engines, and variants of it often supply computers with *random()* functions when a dose of illusory indeterminacy is required at low computational cost.

I wish in this article to make some remarks on the notion of compressibility as a symptom of intelligibility, marking the passage from what Ladyman and Ross call "real patterns" to what I call *encodings*.[4] This follows from a specific rendering of the relation between computation and information, theories cast as close siblings by virtue of their mutual appeal to encodable symbols arranged into syntactic structures. A diachronic assessment of these twin theories would trace their appearance in the early twentieth century as emerging from a shared set of concerns rooted in novel interpretations of uncertainty.[5] The developing nature of their close relationship fuels lively contemporary debates on the semantic claims and epistemic traction attributable to either theory. Fodor claims that there can be

"no computation without representation,"[6] while Piccinini has recently defended the view that computational states are fully individuated in a purely mechanical manner.[7] Floridi has attempted to argue for a semantics intrinsic to the notion of information,[8] while in Chaitin's view the latter is instead subordinated to an algorithmic interpretation.[9] Here I seek to develop an account that situates both information and computation as symptoms of a broader project, identified as the *encoding of syntax*. While information theory is strictly concerned with the efficacy of binary encoding over a communication channel, introducing notions of compression and redundancy, I take computation to represent a more general epistemic theory, and such a lens conditions their mutual relation to logic. Indeterminacy is the thread that binds these kindred concepts, a theme I will develop into two metaphysical principles: the irreducibility of contingency (IOC) and the principle of encoding (POE). Both follow from a specific treatment of computational reason, a term I take to refer to explanations that are distinctly computational in nature, as opposed to causal, logical, mathematical, or otherwise. The IOC is laden with a rich history in philosophy, ranging from the *clinamen* of Lucretius to the critique of determinism offered by C. S. Peirce. The POE, by contrast, follows from a distinct treatment of computation developed in the post-war period. Both principles are grounded in a specific philosophy of mathematics. The overarching motivation for this research, admittedly well beyond the scope of this short article, is to attempt what Ladyman and Ross call a "naturalistic metaphysics" of these two epochal theories, with the eventual aim of gleaning a *minimum viable metaphysics* capable of unifying the physical phenomena they claim to describe.[10]

This methodological stance casts the role of philosophy as the unification of disparate strands of scientific research and abandons positivist assumptions regarding theory and its object, endorsing instead a metaphysics constrained by a naturalistic view anchored in physics.

Following Fazi, we can frame canonical models of computation as the products of a diagnosis of contingency in formal systems. Each model develops its own portrayal of indeterminacy, be it incompleteness (Gödel), inconsistency (Church), or undecidability (Turing). Indeed, each of these three models is intimately connected to its articulation of contingency, so much so that the very existence of Turing Machines is owed to his attempt to resolve Hilbert and Ackermann's *entscheidungsproblem*, a question posed about the determinacy of decision procedures. In the case of Gödel, the first incompleteness theorem seeded the notion that recursion could burst logical frames of reference from within, laying the groundwork for the conception of the *general recursive functions*, and in particular the unbounded search operator, *mu*. Lastly, Church's students, Kleene and Rosser, proved the inconsistency of the *lambda calculus*, spurring the introduction of type theory into computation. Each of these canonical models expresses a different facet of computation, by turns mathematical (Gödel), linguistic (Church), or mechanistic (Turing), and the Janus-faced nature of the concept will aid us in distinguishing it from the theory of information. By the time these models were published around the late 1930s, the nascent theory of computation had methodically dismantled all three central pillars of Hilbert's axiomatic project, placing indeterminacy at the core of its foundations. As Fazi has noted, "To argue that computation is to be understood not in terms of total

determinism but in terms of a process of determination involves putting contingency at the heart of axiomatics."[11] This challenge to axiomaticity exposes Hilbertian formalism as ill-equipped to absorb such forms of contingency, a bind summarized by Gödel in his private correspondence as follows:

> The few immediately evident axioms from which all of contemporary mathematics can be derived do not suffice for answering all Diophantine yes or no questions of a certain well-defined kind. Rather, for answering these questions, infinitely many new axioms are necessary, whose truth can (if at all) be apprehended only by constantly renewed appeals to mathematical intuition…[12]

The Hilbertian project would appear to offer incompatible foundations for a strictly computational view of logic, encouraging the abandonment of axiomatics in favor of a view which I call inferential. Elsewhere, I have argued for an intuitionistic interpretation of computation that provides adequate logico-mathematical foundations for such a treatment of contingency, and I will not elaborate the argument in full here, but merely provide a brief sketch.[13] Brouwer's doctrine of intuitionism was the only viable alternative to Hilbert's project of formalism at the time the modern theory of computation was incubated between Princeton, Cambridge, and Vienna, and its influence on the development of computational ideas cannot be overstated. Brouwer's rejection of the Law of The Excluded Middle (LEM)—the axiom stating that all propositions must be either true or false, and one of the three immutable laws

at the heart of Western logic—admits undecidability into the foundations of logic. Known as the *realizability* interpretation, this view provides its own distinct semantics, which we can summarize as proof-theoretic; as Dummett has shown, the central notion of truth is essentially replaced by proof, while truth becomes synonymous with a multiplicity of operations or methods of construction.[14] This stance emphasizes denumerable methods and physically realizable proofs over abstract notions such as transcendental numbers or Cantor's *transfinitude*, in effect casting out uncountable infinities from the pantheon of valid mathematical objects. From the vantage point of the ensuing proof theory, the inferential is distinguished from the axiomatic in its substitution of static immutable laws for a revisable set of inferential rules. This is typified by Gentzen's innovative system of *natural deduction* (1934), which proffers a proof-centric treatment of logic, emphasizing rule formation and premises over axioms. Danielle Macbeth, in a survey of modern logic, distinguishes these two views through the lens of Gentzen's system:

> In an axiomatic system, a list of axioms is provided (perhaps along with an explicitly stated rule or rules of inference) on the basis of which to deduce theorems. Axioms are judgments furnishing premises for inferences. In a natural deduction system one is provided not with axioms but instead with a variety of rules of inference governing the sorts of inferential moves from premises to conclusions that are legitimate in the system. In natural deduction, one must furnish the premises oneself; the rules only tell you how to go on.[15]

In contrast to the insular order of the axiomatic, governed as it is by *a priori* judgements, the inferential is oriented towards the creation of novel premises subject to extensible operations. Only through this proof theoretic lens does the relationship between computation and contingency come to be fully expressed as a rejection of static conceptions of truth in favor of open-ended procedures. The intuitionistic view of logic can thus be seen as an insistence on an inferential dynamics over a static axiomatics, presenting a temporal view of truth at odds with the timeless formalist conception of mathematics. This commitment to temporality manifests what Fazi calls "computation's very own indeterminacy," an indeterminacy she posits as intrinsic to the computational regime.[16] For Fazi, this contingency is "logically inscribed into every computation," but is "beyond symbolic representation."[17] While Fazi locates this indeterminacy in the inscription of the incomputable, this relation is fully elaborated only via intuitionist semantics, destabilizing the appeal to an incomplete axiomatics internal to computation itself and locating it instead in the temporal nature of decision procedures. Such a view serves to reorient Fazi's account of contingency in formal systems by providing an adequate rendering of the relation between computation and time in line with contemporary physics, a point I will try to clarify via a compatible treatment of the continuum in due course.

The realizability interpretation of logic paves the way for a general correspondence between constructive logic and the simply typed lambda calculus (STLC), enshrined in an isomorphism developed by logician Haskell Curry in the 1960s. This isomorphism binds computation and logic, mapping any proposition to its corresponding type, and any

proof to a realizable program. Under this formalism, the relation between computation and logic can be expressed thus:

$$A \,\&\, B : (\mathrm{M}, \mathrm{N}) \;\rightarrow (\mathrm{M}, \mathrm{N}) \;\Vdash A \,\&\, B$$

The conjunction of logical propositions, *A* & *B*, is mapped to two types (M, N) via the assignment operator (:)—the primitive operation in type theory, and one that I call encoding. The types in turn can accept terms as elements, as in the language of the STLC developed by Church; the expression then conveys a correspondence between two distinct languages, one logical (natural deduction) and one computational (the lambda calculus). Following the logician Martin-Löf, these types are defined as the set of proofs for each respective proposition, and can be said to *realize* ($\Vdash$) A and B respectively. Popular examples of encoding include Gödel sentences, the Unicode standard, or even JPEG and MP3 media formats. Indeed, Gödel's method frames this movement as the *arithmetization of syntax*, but the sense of encoding proposed here is broader in scope, encompassing the manifestation of programs in their entirety and grounded not in number, but in more primitive notions of operation and structure. This coupling of logic and computation provides the motivation for the POE, asserting that any logical expression is necessarily mirrored by its corresponding computational type, rejecting this isomorphism as a mere syntactic analogy, and centering it as the definitive computational operation. The POE is required to avoid a strong co-referential circularity, whereby a (logical) syntax and its (computational) encoding would seem to precipitate an infinite regress of definition. Absent

such a principle, one would risk the collapse of logic and computation under a single formalism, a move that fails to accommodate encoding as an autonomous operation. But precisely because encoding does not exhibit alethic properties in itself, it compels a distinct semantic treatment, leading to a principle that asserts the precedence of encoding. This principle acts as a guarantor for what I call the *encoding of syntax*, the notion that all syntactic structure is vulnerable to encoding. From this view, no pattern or regularity can theoretically escape the clutches of intelligibility, and computation comes to mark the movement from a real pattern to its encoded form, the very mechanism that renders the given as intelligible.

The inferential view of computation admits contingency into its foundations, while a semantic analysis of its operations appears to lead us towards a metaphysics of encoding resulting from a type theoretic interpretation of logic. The canonical theory of information, by contrast, presents its own framing of indeterminacy; Shannon defined information entropy in 1949 by direct analogy with Boltzmann's microstate model of thermodynamics. Shannon entropy is given by the following formulation,

$$H = -\sum_i (P_i \times \log_2 P_i)$$

where Pi is the probability that a variable adopts a given state, *i*, and entropy, *H*, comes to define the level of uncertainty experienced by a receiver in predicting a message within a given medium. Shannon's theory defines information as a binary encoded message sent over a communication channel, and its contents are irrelevant for the notion of uncertainty he was trying to define; rather, it is

the statistical properties of any given regularity which affect its information-bearing capacity. This presents a strictly syntactic theory, providing its own definition of contingency in terms of *surprisal,* or the uncertainty encountered in communication. In this sense, it echoes Turing's attempt to present a purely formal theory applicable to any encodable phenomena—what we might call a pattern or regularity. Here we see contingency binding the two theories, with entropy or surprisal offering a fourth expression of indeterminacy specifically suited to an interactive medium, a context that presupposes a sender and a recipient. Floridi has made the case that information theory can be expanded from this canonical model to assume alethic properties with a claim to semantic contents, introducing the notion of "correct" information.[18] Semantic theories of information of this kind constitute an active research area, and we should attempt to distinguish such theories from computational reason. I take the latter to be an explanatory framework grounded in inferential procedures, whereas I take information to be a physical theory regarding uncertainty in data, as classically conceived by Shannon. From this vantage point, a theory of informational states possesses far weaker claims on conceptual content than those invoked by computational kinds, while conversely it is afforded a broader scope for describing natural kinds via *degrees of freedom* in physics. This view follows from the observation that information seems ill-suited to a semantic treatment, as it would need to be transformed into a fully-fledged logical theory—a significant departure from Shannon's formalism that would risk a conflation with computation itself.

The foremost attempt to unify computation and information is to be found in *algorithmic information*

theory (Kolmogorov, Solomonoff, Chaitin), which poses the complexity of an expression in terms of the shortest program able to produce it, identifying the information content of said expression as the length of the program.[19] In this theory, information is in effect subordinated to an algorithmic definition, as it is to be equated with a measure of complexity expressed in computational terms. Some expressions may occupy more physical space but contain considerable redundancies, whereas a concise expression may be irreducible without shedding information in the form of a lossy encoding. This framing positions expressivity on a spectrum that ranges from pattern-governed regularities to incompressible chaos, signal to noise, an axis offered as an arbiter of complexity. The role that information plays here is purely syntactic, representing the output or size of a program divorced from any interpretative duties or obligations. Compressibility is manifested as a necessary property of intelligibility, where the latter marks the passage from patterning to encoding, the movement from real patterns to syntactic structures we could call *programs* in the broadest sense of the term.

The underlying link between contingency and compressibility is essentially thermodynamic, the entropic analogy at the heart of information theory compelling the lawlike Landauer principle, which states that "any logically irreversible manipulation of information, such as the erasure of a bit or the merging of two computation paths, must be accompanied by a corresponding entropy increase in non-information-bearing degrees of freedom."[20]

This connection between logical and thermodynamic irreversibility has its critics, but it is widely accepted in theoretical computer science and has been convincingly

defended as a physical law.[21] This motivates a stance integral to the IOC, namely the reality of information thesis, which holds that information is not the product of measurement enacted by an observing subject, instead taking up a realist position on the information content of pattern-governed regularities. Ladyman and Ross defend this position under the rubric of "ontic structural realism," an ontology in which a notion of structure is primary and objects are no more than derived epistemic props, categorical forms used to grasp real patterns.[22] This theory mirrors developments in fundamental physics, and in particular quantum field theory, in which particles are not physical primitives but rather derived from field interactions. If we take an example from cosmology, in 1967 *pulsars* were first detected as a regular pattern of radio waves by Jocelyn Bell Burnell, utilizing a large-scale field radio telescope. Representing beams of electromagnetic radiation emitted by a rapidly rotating neutron star, the ensuing "lighthouse effect" is perspectival and observer-relative, but it is effected by a real pattern, exposed by an instrument designed to detect the amplitude of radio waves at specific frequencies. Under the reality of information thesis, the information content of these electromagnetic pulses is independent of any potential observer who may be at hand to perceive their regularity. Here, Shannon's theory is recast in terms of the degrees of freedom of physical matter, a notion that posits a phase space of possible states that any given pattern can assume, subject to the constraints of physics. Moreover, it is shorn of a sender and receiver, and transformed into a general theory of structure in the universe. That is to say, it introduces a modal commitment regarding the objective nature of possibility, which rests on a portrayal of scientific laws as a compression of real patterns.

This ambitious rescoping of information raises a number of theoretical challenges, which I will attempt to summarize shortly. For now, let us follow the thread to tease out a compatible physics. This stance is adopted by quantum cryptographer Nicolas Gisin as part of an intuitionistic physics that necessarily follows from computational principles. The aim is a treatment of the continuum compatible with the realizability interpretation of logic. As is well known, the question of determinism in physics is unresolved absent a unified theory capable of integrating general relativity with quantum mechanics. Gisin suggests the intuitionist continuum generates an indeterministic view of time at odds with the static depiction of a block universe, situating it closer to the uncertainty to be found in the quantum realm.[23] This indeterminism lies beyond the reach of statistical physics, a pure contingency distinct from the algorithmic randomness formalized by Martin-Löf that resembles instead an irreducible form of indeterminacy. This follows from the fact that real numbers in the classical sense are incompatible with realizability—because they represent uncountable infinities, no physical process could ever construct these mystical objects. This in turn leads to the substitution of the principle of infinite precision by *finite information quantities*. If one accepts the reality of information thesis, this would suggest a physics guided by a fundamental indeterminism, rendering the universe incapable of encoding its own future states, with no physical recourse to the infinite information storage required for such a feat. This essentially Brouwerian interpretation of time—conjectured by Gisin as the creation and destruction of information—allows computation to refigure the continuum in its own mold as a process of becoming real.[24]

From this perspective, real numbers are synonymous with processes that tail off into pure randomness, the domain of the computable becomes dynamically sensitive, and the real is grounded by an irreducible contingency. Time is cast as an entropic medium, beyond the block universe presented by relativity: a figure of time continuously animated by the dissipation of information resulting from immanent interactions. Within such a conception of time, undecidability expresses itself as a symptom of the indeterminacy of the real, a condition resulting from processes of encoding that are necessarily computational.

Such a position is open to a range of potential objections—a lively and unresolved debate in contemporary physics surrounds the *black hole information paradox*, which posits the destruction of information as a necessary outcome of the existence of black holes, and Gisin's view follows this observation by resolutely rejecting the notion that information is conserved in the universe. Gisin's theory is also reliant on additional metaphysics, since it provides a specific interpretation of the quantum measurement problem known as *spontaneous collapse*, a view in which interaction (measurement) is not required to precipitate stochastic acts of localization in time and space. Moreover, Landauer's principle leverages information theory in a way that appears to link it inextricably to logical notions, which seems at odds with the purely syntactic view of information I am endorsing. In a sense, information theory is acting as a bridge—via the modal notion of degrees of freedom—between computation and thermodynamics, linking computational and natural kinds while allowing us to maintain a clear distinction between the two. I should clarify that this does not countenance any form of pan-

computationalism, as long as information and computation are maintained as two independent theories. Lastly, critics of scientific realism will find it difficult to stomach assertions regarding the objective modal structure of the real posited by this stance. These criticisms notwithstanding, the merit of Gisin's theory rests on its anchorage in a mathematical foundation that acknowledges contingency's challenge to axiomatics, following its repercussions through a treatment of the number line that does not indulge in speculative forms of hypercomputation.

The intuitionist link between symbolic modes of incompleteness and the indeterminacy of physics may seem somewhat obscure at first glance, so let us try to render it in terms of infinity. Gödel proved that any axiomatic system contains an endless number of undecidable propositions, not just a handful of exceptions. What these propositions share is an appeal to infinity occasioned by acts of infinite regress, unbounded search, or infinite quantification, all of which equate to identities in the Real. This is what binds the Gödelian sentence, Euclid's parallel postulate, or even Conway's Game of Life under the rubric of undecidability. But taming such infinities represents the major challenge in fundamental models of physics, from quantum field theory to string theory, in which subnuclear interactions pose a seemingly insurmountable obstacle to determinist accounts. From the computational standpoint, these infinities represent non-terminating procedures that enact an encoding of infinite time. It is this specter that subsumes them under a vector of entropy which, in Gisin's rendering, tends towards contingency. This does not serve to undermine decision procedures as such, but rather, as Fazi remarks, "to enhance the possibility of an open-ended—or indeed of a contingent—understanding of them."[25]

The irreducibility of contingency presents itself as a metaphysical principle following from an intuitionistic rendering of the continuum, a physics ensuing from a realizability interpretation of real numbers. Together with the POE, it forms a minimum viable metaphysics outlined by a constructive treatment of computation. The resulting view conditions the relation of computation and the real with consequences for the semantics of both information and computation, proffering a notion of real patterns that necessarily bear informational states. The structural realism that follows binds the notion of compression to processes of encoding characteristic of computational reason; algorithmic compressibility comes to represent the very method that renders a real pattern intelligible through the movement from patterning to encoding. This brief sketch is no more than an outline of the inferential view of computation, a worldview that places type theory in direct correspondence with logic and mathematics without giving one form precedence over the other, but offering instead a metaphysics of encoding to unify them under a single concept. Moreover, its treatment of contingency implies an incomputable physics theoretically compatible with symbolic modes of indeterminacy, ensuing from the intuitionistic view.

I would like to end these remarks on the aesthetics of compressibility with a nod towards poetry, arguably the most powerful mode of compression in all the arts. George Oppen's epochal poem, "Of Being Numerous," stands as a tribute to the multiplicity of a condition of finitude we might call human, engaged in tracing the limits of the intelligible via its own incompleteness:

So spoke of the existence of things,
An unmanageable pantheon

Absolute, but they say
Arid.[26]

Perhaps, as these two stanzas from Oppen suggest, the absolute totality of objects, or else the unity of the continuum, is an empty distraction from the real aesthetic challenge posed by intelligibility, which ultimately rests on the interplay of normative (theoretical) and observational (empirical) acts. The inferential view of computation places compression at the very nexus of these modes of reasoning, enmeshing them within an intrinsically generative model, a composition yielding a resolutely dynamic view of the intelligible.

Notes

1 *The Monist* 2.3 (1827): 321-337.
2 Claude E. Shannon, "A Mathematical Theory of Communication," *The Bell System Technical Journal* 27.3 (1948): 379-423.
3 Ken Perlin, "In the Beginning: the Pixel Stream Editor," 1999. https://www.csee.umbc.edu/~olano/s2001c24/ch02.html. Accessed 10 Aug 2021.
4 J. Ladyman, D. Ross, D. Spurrett, and J. Collier, *Every Thing Must Go: Information-Theoretic Structural Realism* (Oxford: Oxford University Press, 2006), 224.
5 Indeed, Shannon's research expertise was in the development of integrated circuits, in the realization of logic gates mediated by the amplitude of electrical currents flowing through transistors.

6 J. A. Fodor, *Representations: Philosophical Essays on the Foundations of Cognitive Science* (Brighton: Harvester Press, 1981), 225-257.
7 G. Piccinini, *Physical Computation: A Mechanistic Account* (Oxford: Oxford University Press, 2015).
8 L. Floridi, *The Philosophy of Information* (Oxford: Oxford University Press, 2013).
9 G. J. Chaitin, "Algorithmic Information Theory," *IBM Journal of Research and Development* 21.4 (1977): 350-359.
10 *Every Thing Must Go*, 1-65.
11 M. B. Fazi, *Contingent Computation: Abstraction, Experience, and Indeterminacy in Computational Aesthetics* (Lanham: Rowman & Littlefield, 2018), 131.
12 Quoted in H. Wang, *Reflections on Kurt Gödel* (Cambridge: The MIT Press, 1990), 129.
13 A. A. Cavia, *Logiciel: Six Seminars on Computational Reason* (Tripleampersand Press, 2022).
14 M. Dummett, "Philosophical Basis of Intuitionistic Logic," *Studies in Logic and the Foundations of Mathematics* 80 (1975): 5-40.
15 D. Macbeth, *Realizing Reason: A Narrative of Truth and Knowing* (Oxford: Oxford University Press, 2014), 75.
16 Fazi, *Contingent Computation*, 183.
17 M. B. Fazi, "Digital Aesthetics: The Discrete and the Continuous," *Theory, Culture & Society* 36.1 (2019): 3-26.
18 Floridi, 182-208.
19 Chaitin, 350-359.
20 C. H. Bennett, "Notes on Landauer's Principle, Reversible Computation, and Maxwell's Demon," *Studies In History and Philosophy of Science, Part B: Studies In History and Philosophy of Modern Physics* 34.3 (2003): 501-510.
21 J. Ladyman, S. Presnell, A. J. Short, and B. Groisman, "The Connection Between Logical and Thermodynamic Irreversibility," *Studies In History and Philosophy of Science, Part B: Studies In History and Philosophy of Modern Physics* 38.1 (2007): 58-79.
22 Ladyman and Ross.

23 F. Del Santo and N. Gisin, "Physics Without Determinism: Alternative Interpretations of Classical Physics," *Physical Review A* 100.6 (2019): 062107.
24 N. Gisin, "Indeterminism in Physics, Classical Chaos and Bohmian Mechanics: Are Real Numbers Really Real?," *Erkenntnis* 86 (2021): 1469–1481.
25 Fazi, *Contingent Computation*, 116.
26 G. Oppen, *New Collected Poems* (New York: New Directions Publishing 2008), 163.

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ART / THEORY / PHILOSOPHY

When M. Beatrice Fazi claims that "computation is computation," we know this is so precisely because computation is never simply contained within the skin of computers, but is instead singularly generative. That generativity—in the fullest sense of the term, and perhaps even a little more than that—is the premise of this book, and thinking with Fazi opens onto more-thans precisely because her analyses are so self-contained. Indeed, the thinkers in this collection demonstrate that because "computation is computation," attendant concepts of media, race, intelligence, digitality, aesthetics, and compression are troped in new ways, yielding novel trajectories.

Contributors

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Catalyst books build speculative communities, inviting a wide range of perspectives into conversations about shared artistic, political, and intellectual values while privileging the unique, distinct and personal insights that characterize any single voice of engagement. Each volume in the series provides an in-depth look at an active thinker or artist—seeking after the full relevance of their work in the present moment. The series focuses in particular on voices that have not already been widely featured but who have unique and relevant perspectives to share on questions of art, theory and culture.

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