

THIRTEEN

An Orderly Assemblage of Biases: Troubling the Monocultural Stack

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The digital earth is where I'm Indigenous.

*Blake Hausman*¹

Riding the Trail of Tears is a novel by Cherokee writer Blake Hausman. It is a surrealistic sci-fi take on virtual reality, featuring an immersive tourist trap through which visitors relive the Cherokee Removal in the winter of 1838–1839. The novel's first section is narrated by Nunnehi, a Little Person or creature from the old Cherokee stories. Nunnehi describes the genesis of the Tsalagi Removal Exodus Point Park (TREPP) and recounts how he and others like him came to be alive and resident within the ride. By the end of the book, Nunnehi and his siblings complete a long-gestating insurrection, lay claim to the digital territory delineated by TREPP, and start rewriting the narrative to re-center the story of the Trail of Tears around the Cherokee experience rather than the settlers' gaze. Early on, Nunnehi says: "the virtual Trail of Tears . . . [is] my homeland. I'm probably more Indigenous than you, and the digital earth is where I'm Indigenous."

This chapter is about the digital earth, its composition, and how we might be Indigenous in it. It is about new ways of understanding our role in the computational ecosystems we are building, and how we might make kin with the other entities that we create in it and emerge from it. It is about nurturing the digital

earth from which it will all grow — silicon soil in which our descendants will stick their virtual toes, wiggle them around, and think, “This is a good place to be Cherokee. This is a good place to be Mohawk. This is a good place for our people.”

The Stack and Its Corruptions

Let us start with where we are at.

As I have written elsewhere,² modern computing systems work via a very narrow logic, admit only certain kinds of information as data, and can perform operations representative of only a small, impoverished subset of the operations we enact as humans every day. These systems exist as components of the stack, the vertically interrelated and interdependent series of hardware configurations and software protocols that make high-level media computation and networking possible. The software stack sits on top of the hardware stack. Moving up the hardware stack is to move from circuits to micro-chips to computers to networks; moving up the software stack is to move from machine code to programming languages to protocols to systems. As you go upward, you are moving from custom solutions to generalized solutions, from specifics to abstractions. As you make this traversal from the deep structure to the surface interface, ever more of the details of the underlying configurations are hidden from you. With the increasing opacity, your ability to assert fine control over the execution of the underlying algorithms decreases. Eventually you get to the software application or web service layer of the stack. It is at this highly abstract level that most people interact with computational systems, as they use Microsoft Word, Google Search, play a video game, or enter into an immersive environment.³

The sheer complexity of these layers, both horizontally, as different components interact with one another, and vertically, as different layers distribute data to the human interface and back, making it difficult to impossible for any single human actor to understand or effectively manipulate the whole system. Yet we are subject to the regimes the stack places upon us. In the same way the law embodies and polices the dominant culture's expectations about people's behavior, computational systems materialize and constrain the dominant culture's expectations of what counts as data, what algorithms are appropriate for processing that data, and what are valid results of that processing.

Cultural bias coupled with the pervasiveness of computational technology means that we are creating computer systems that are dangerous in their blindness. The last few years have seen this realization penetrating Silicon Valley

culture, as technology developers at Google, Facebook, and others begin to comprehend that “unbiased algorithm” is as much an oxymoron as “pure meritocracy.” Scholars such as Kate Crawford,⁴ D. Fox Harrel,⁵ and Safiya Umoja Noble,⁶ among others, have brought the discussion of these biases into greater focus. This has brought the critique out of the academy, where the argument about how computational systems reflect the culture within which they are developed has a long history, and into the public sphere.⁷

Algorithmic bias exists in the non-digital world, of course. One of the most notable examples is the color reference cards first used in the 1940s to calibrate image printing processes. These “Shirley” cards “generally showed a single white woman dressed in bright clothes” to facilitate calibration as “color film chemistry at the time was designed with a bias towards light skin.”⁸ Communications scholar Lorna Roth has conducted extensive research into the use of Shirley cards. In 2009 she wrote: “Until recently, due to a light-skin bias embedded in color film stock emulsions and digital camera design, the rendering of non-Caucasian skin tones was highly deficient and required the development of compensatory practices and technology improvements to redress its shortcomings.”⁹ Roth points out how this practice continued for decades after the first complaints were made, with the first substantive change only made in the 1970s. At that time, image calibration cards were redesigned not out of a desire to rectify their skin tone bias but rather to satisfy furniture and chocolate makers who had been complaining that the cards did a poor job of representing the darker tones of their commercial products.

Much of the current interest in looking at bias in computational systems stems from artificial intelligence yet again becoming a locus of substantial research, development, and deployment. Numerous studies over the last decade show how bias is embedded into every aspect of such systems. Examples include machine systems for learning human languages incorporating the human prejudices embedded and expressed in the corpora of natural languages on which the systems are trained,¹⁰ and machine systems for learning to recognize people learning that beauty is a trait possessed primarily by white people.¹¹ One of the most egregious classes of these biases discovered to date is that embedded in the criminal justice system. The investigative journal *ProPublica* conducted an investigation into the risk assessment software that is increasingly used in the United States to provide advice to judges, lawyers, and parole officials throughout the judicial process — determining bail, setting sentences, guiding parole conditions, etc.¹² The authors quote US attorney general Eric Holder addressing the use of such

software in 2014: “I am concerned that [risk assessment software] inadvertently undermine[s] our efforts to ensure individualized and equal justice . . . they may exacerbate unwarranted and unjust disparities that are already far too common in our criminal justice system and in our society.” In 2016, *ProPublica* raised concerns that suggest that Holder’s concern was justified. Its investigation into the use of COMPAS software turned up “significant racial disparities . . . falsely flagging black defendants as future criminals . . . at twice the rate as white defendants” and misidentifying white defendants as “low risk more often than black defendants.”¹³

Social scientists such as Crawford have pointed out how difficult it is to rid ourselves of the deep bias in the datasets feeding the algorithms driving these systems. Many times “new” datasets are actually based on or include information from older datasets that were collected using outmoded or discredited methods. “Classifications,” notes Crawford, “can be sticky, and sometimes they stick around a lot longer than we intend them to even when they are harmful.”¹⁴ This stickiness means that, even if system designers made the effort to counter the bias in their algorithms, the data they feed those algorithms may taint the entire endeavor.

White Supremacy: Not Just for People Anymore

Media scholar Lisa Nakamura notes that, “[t]hough computer memory modules double in speed every couple of years, users are still running operating systems which reflect phantasmatic visions of race and gender. Moore’s Law does not obtain in the ‘cultural layer.’”¹⁵ In other words, the exponential evolution in computational processing power since the early 1980s has not been accompanied by a comparably rapid evolution in equality in North America. Statistics comparing Indigenous people and African Americans to the majority population in Canada and the us, respectively, show just how far both societies are from eliminating racial bias.¹⁶ It should be no surprise that our computational systems reflect a worldview in which this is not only accepted but — given the stickiness of the phenomenon — perhaps preferred by the majority population. Expecting our tools to be more enlightened than we ourselves is a foolish self-delusion.

Computational artist Trevor Paglen has observed that, “one of the philosophical dangers of using widespread automation . . . is that it fixes meaning.”¹⁷ That inertia, combined with the data bias identified by Crawford and the extension of racial bias into cyberspace identified by Nakamura, drastically increases what is at

stake when these systems are designed and deployed. The underlying algorithms must make assumptions about the world in order to operate; even if these assumptions themselves are not biased, they may make use of biased classification methods. And even if the classification is not biased, the data feeding the process may be biased. All these aspects of computational systems are often obscured, either purposively in order to protect intellectual property or as a byproduct of a technical complexity that prohibits non-specialists from understanding and evaluating them. The system becomes a fact of the world, stubborn and difficult to unfix. The result is that, in a society where it is increasingly difficult to do anything without touching on a computational interface of some sort, the decisions that developers are making all the time have profound and long-lasting consequences for how we live our lives.

Indigenous people are intimately familiar with how the old ways of thinking and looking at the world become sedimented into our contemporary worldviews. Marcia Cosby and others have written about how the "Imaginary Indian" was constructed to justify the theft of Indigenous lands,¹⁸ and that imaginary person remains the dominant image that most settlers have of Indigenous people. This is the image settlers draw upon when they parse news about life in Indigenous communities, when jurors and judges consider court cases involving Indigenous people, and when the mall security guard is deciding who looks suspicious and who does not. As Harrel's work on phantasmal media shows, these are exactly the sorts of images that get embedded into our computational systems. "Computational media," he writes, "play roles in constructing ideas that we unconsciously accept as true and constructive of reality yet are in fact imaginatively grounded constructions based in particular worldviews."¹⁹ Or, in Crawford's more blunt assessment, "[These systems are] not free of bias; this is just bias encoded."²⁰

As we struggle to "write the thoughts of systems," in the words of computational philosopher and poet David Jhave Johnston,²¹ and as those systems become ever-more pervasive, we are beginning to see that it is a political act to define the protocols that guide these systems' thoughts. It is about how power is exercised, and by whom.

The Fast and the Slow

Nakamura, in her extensive research on race in cyberspace, notes that "in order to think rigorously, humanely, and imaginatively about virtuality and the

post-human, it is absolutely necessary to ground critique in the lived realities of the human, in all their particularity and specificity. The nuanced realities of virtuality — racial, gendered, Othered — live in the body.”²² When we pay attention to the bodies producing these protocols, we can see they are not just a random collection of homo sapiens. They are clustered in certain geolocations, particularly Silicon Valley, but with outposts in places like Seattle, Boston, Waterloo, and Oxford. They are working within an intellectual lineage that stretches back to the Greeks, even if they themselves might not be descendants of Europeans. Their education and professional practice rarely incorporate ideas or even data that comes from Africa, or South America, or large swathes of Asia. They are overwhelmingly white and male, and underwhelmingly brown and female²³ — and, even when brown bodies appear, “they participate in the ‘cultural hegemony that privileges a white race.’”²⁴

Going back to Winograd and Flores (1987) theorizing about the contextually coupled nature of cognition,²⁵ Haraway’s (1991) critique of the interpenetrating relationship between human, non-human, and machine bodies,²⁶ and Reeves & Nass’s (1996) experiments showing that “[i]ndividuals’ interactions with computers, television, and new media are fundamentally social and natural, just like interactions in real life,”²⁷ critical approaches to computational culture have argued for acknowledging the deep entanglements among the cultural and computational layers of the stack. Now, after three decades in which computational systems have grown ever more ubiquitous and complex, we are starting to see clearly the consequence of the radical disjuncture between the high velocity evolution of our digital tools and the much slower evolution of our societal configurations.

Making Space

We founded the Aboriginal Territories in Cyberspace (AbTeC) research network in 2006 to ensure that Indigenous people were present in cyberspace and possessed the knowledge necessary to bend it to our needs. We were also interested in speeding up the rate at which Indigenous people increased their understanding of computational media. One hope was that this would help address and counter the white supremacy being baked into the computational layer, and resist its replication into cyberspace. AbTeC did this by exploring the question of what it means to be Indigenous in cyberspace — how do we make, maintain, and vivify Indigenous places within that archipelago of websites, immersive environments, social media, and video games that increasingly interpenetrates “real” space?²⁸

How Indigenous people related to cyberspace had been a topic of conversation within Indigenous media arts circles at least a decade before AbTeC launched. Cree filmmaker Loretta Todd's groundbreaking 1996 essay, "Aboriginal Narratives in Cyberspace," asked the question: "Can [Indigenous] narratives, histories, languages and knowledge find meaning in cyberspace?" She considers how cyberspace might be (re)conceptualized as an Indigenous space, starting with the kinds of questions that should be asked by those building and inhabiting it: "Will cyberspace enable people to communicate in ways that rupture the power relations of the colonizer and the colonized? Or is cyberspace a clever guise for neo-colonialism, where tyranny will find further domain? What if with each technological advancement the question of its effect on the seventh generation was considered?"²⁹ Mohawk artist and AbTeC co-founder Skawennati wrote, for the 1998 edition of the pioneering CyberPowWow online gallery, "[t]he www is an awesome tool for information-sharing and for meeting people with similar interests whom you may never have met otherwise . . . If we are going to help shape this medium, let's do it right . . . We can use the www to present our stories, to inform people about our issues, and to explore solutions to some of our problems."³⁰

Over the last decade, AbTeC has mounted numerous projects designed to address Todd and Skawennati concern with consciously shaping cyberspace to serve Indigenous ends. We have worked with numerous North American Indigenous youth and artists to develop their technical and conceptual capacities for manipulating computational media in order to tell their stories their way (Skins Workshops on Aboriginal Storytelling and Digital Media Design³¹); supported the creation of original artwork that uses cyberspace as a medium (*TimeTraveller*³², 2167,³³ *She Falls for Ages*³⁴); and built tools for manipulating digital media (Mr. Softie,³⁵ NextText³⁶). Each project claims new territory in cyberspace.

Making Cyberspace

In 2014, AbTeC started the Initiative for Indigenous Futures (IIF) to understand how Indigenous people are envisioning the future.³⁷ One way we do this is to ask people what it means to make cyberspace Indigenous. We have delineated territory and turned its resources toward our own ends in video games, websites, machinimas, and virtual reality environments created by Indigenous minds, rooted in Indigenous worldviews, telling Indigenous stories, for Indigenous

audiences. But all that activity takes place within a wider technological environment made by and structured through white cultural hegemony. We are Indians in cyberspace; how do we become Indians who *make* cyberspace?

Making cyberspace means, in part, articulating protocols through which the various entities inhabiting it — human and machine — communicate with one another. Indigenous communities are good at thinking in terms of cultural protocol; I would like to suggest that it is time we start drawing on that deep knowledge of how to properly order human-human interaction and consider how it can be used to order human-computer interaction.

In her essay “Codetalkers Recounting Signals of Survival,” from the *Coded Territories: Tracing Indigenous Pathways in New Media Art* collection, Métis/Cree artist Cheryl L’Hirondelle (Cree-non status treaty/French) makes an argument that Indigenous protocol can be found in the deep history of cyberspace:

[The] paths [laid down by our ancestors] became trade routes between bands and territories as we established networks and trade languages and built a knowledge base around what we knew about each other. So when the first Europeans came to “explore” the land, our ancestors naturally led them along these well-established paths, which, over time, as the newcomers settled, became roadways and thoroughfares. With the advent of the telegraph and the telephone, wire was hung along these thoroughfares that literally became the beginnings of the physical network that . . . allows . . . packets of information to move as freely as our ancestors.³⁸

Where L’Hirondelle discerns Indigenous protocol embedded at the bottom layer of the stack, Cree artist Archer Pechawis, in his *Coded Territories* essay, imagines it spreading everywhere: “I am looking to a future in which Indigenism is the protocol, an all-encompassing embrace of creation: the realms of earth, sky, water, plant, animal, human, spirit, and, most importantly, a profound humility with regards to our position as humans within that constellation.”³⁹

I am interested in what happens if we embrace L’Hirondelle’s Indigenous reading of the foundations of the network and extend Pechawis’ circle of relationships to include our machine creations in an attempt to articulate, in the words of Tuscarora art historian Jolene Rickard, “a more complex view of how [digital networked technology] is situated in people’s cultures.”⁴⁰

Very little of the current work being done on algorithmic and dataset bias or the ethics of artificial intelligence grapples with the fundamental corruption of the stack — the willful flattening of people’s cultures that is a consequence of its

monocultural origins. That corruption flows from numerous original sins: Platonic ideals; Aristotelian classification methods; Old Testament dominion over the natural world; Cartesian duality; Boolean binarism; Darwinian fitness. Even if the general state of accepted knowledge complicates, troubles, and sometimes rejects aspects of these knowledge frameworks, they still haunt our data and the design of our computational systems.

The question, then, becomes this: how do we breathe humanity into our computational creations in a way that avoids Western anthropocentric conceits?

Re-imagining Relations

Remember Nunnehi, the Cherokee Little Person from *Riding the Trail of Tears*? Hausman does not clarify whether he and his siblings emerged out of the complexity of the code running the Trail of Tears virtual reality ride or if already-existing Little People used the environment to manifest themselves. Either way, the computational infrastructure running TREPP evolves into an ecosystem operating far beyond the parameters envisioned by the original designers.

By the end of the novel, all hell has broken loose. Nunnehi and his kin have compromised the system, reordering it to better support themselves and to resist the chopped up, remixed, settler self-serving story TREPP has become and more accurately reflect the terror and loss inflicted on their Cherokee ancestors. Other virtual entities have phased into being, engendering ongoing battles over who gets to control the simulation. Towards the end, the main character, Tallula — whose Cherokee grandfather designed the virtual experience — exhausted and confused by the epistemological and ontological battleground that TREPP has become, struggles to make sense of it all. She says to one of the “native-born” non-human entities, “I never imagined this group of people even existed.” He replies: “Could be something wrong with your imagination.”⁴¹

We are experiencing a similar failure of imagination in the present moment. We are confronting challenges in understanding the computational systems in which we have now enmeshed ourselves, as they become more complex and as we write more autonomy into them. The algorithmic bias discussed above exemplifies how such systems often end up subverting their intended purposes, largely because we refuse to see ourselves clearly. Motes in our eye become glitches in the code, which then go on to become “global protocol.”

What if we took a fundamentally different approach to understanding the digital beings we are creating, particularly those collections of code that act

with some degree of autonomy — from network daemons⁴² to the most complex artificial intelligence? What if, instead of treating them as tools and servants, we made a place for them in our circle of relationships?

After a century of subordinating the hard work of making common culture to the imperatives of the market, and failed after failed experiment in using technology to compensate, the Western consciousness has been left ill-prepared to lead such a conversation. The hegemonic social imaginary reduces all such talk to superstition and stymies any attempts to widen the kinship circle beyond the human by insisting empiricism is the final word in understanding who we are.⁴³

Yet many Indigenous communities remember. We retain the protocols for understanding a kinship network that extends to all aspects of the world around us — animals and plants,⁴⁴ wind and rocks,⁴⁵ mountain and ocean.⁴⁶ Our languages contain the conceptual formations that enable us to engage in dialogue with our non-human kin, and help create mutually intelligible discourses across vast differences in material, vibrancy, and genealogy. As Blackfoot philosopher Leroy Little Bear observes, “the human brain is a station on the radio dial; parked in one spot, it is deaf to all the other stations . . . the animals, rocks, trees, simultaneously broadcasting across the whole spectrum of sentience.”⁴⁷

Because we created them, we think we should know how to tune into the stations on which our machine creations communicate. Yet we are only now waking up to the corruptions permeating all levels of the stack. Our difficulties in articulating the ontology of increasingly complex computational processes, and our inability to foresee the results of these complex processes interacting with one another and with the human and natural world, all point to the conclusion that we do not actually understand them. And if we do not understand them, they most likely do not understand us. Such profound mutual incomprehensibility is a recipe for disaster. Ask any Indian.

Notes

1. Blake Hausman, *Riding the Trail of Tears* (Lincoln: Bison Books, 2011), 13.

2. Jason Edward Lewis, “Preparations for a Haunting: Notes Towards an Indigenous Future Imaginary,” in *The Participatory Condition in the Digital Age*, ed. Darin Barney, Gabriella Coleman, Christine Ross, Jonathan Sterne, and Tamar Tembeck (Minneapolis: University of Minnesota Press, 2016), 229–49.

3. One can get even more abstract, as Benjamin Bratton does in *The Stack: On Software and Sovereignty* (Cambridge: The MIT Press, 2016), and articulate the stack in terms of

globally spanning megastructures. At that level, however, all the lived politics involving real bodies — and thus the utility outside of academic argument — have been drained out.

4. Kate Crawford, "The Hidden Biases in Big Data," *Harvard Business Review*, April 1, 2013, <https://hbr.org/2013/04/the-hidden-biases-in-big-data>.

5. D. Fox Harrell, *Phantasmal Media: An Approach to Imagination, Computation, and Expression* (Cambridge: The MIT Press, 2013).

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

7. Will Knight, "Google's AI Chief Says Forget Elon Musk's Killer Robots, and Worry about Bias in AI Systems Instead," *MIT Technology Review*, October 3, 2017, <https://www.technologyreview.com/s/608986/forget-killer-robotsbias-is-the-real-ai-danger/>.

8. Michael Zhang, "Here's a Look at How Color Film Was Originally Biased Toward White People," *Petapixel*, September 19, 2015, <https://petapixel.com/2015/09/19/heres-a-look-at-how-color-film-was-originally-biased-toward-white-people/>.

9. Lorna Roth, "Looking at Shirley, the Ultimate Norm: Colour Balance, Image Technologies, and Cognitive Equity," *Canadian Journal of Communication* 34:1 (2009): 1, <https://doi.org/10.22230/cjc.2009v34n1a2196>.

10. Aylin Caliskan-Islam, Joanna Bryson, and Arvind Narayanan, "Semantics Derived Automatically from Language Corpora Necessarily Contain Human Biases," *Science* 356:6334 (May 2017): 183–86, <https://doi.org/10.1126/science.aal4230>.

11. Jordan Pearson, "Why An AI-Judged Beauty Contest Picked Nearly All White Winners," *Motherboard*, September 5, 2016, https://motherboard.vice.com/en_us/article/78k7de/why-an-ai-judged-beauty-contest-picked-nearly-all-white-winners.

12. Julia Angwin, Jeff Larson Surya Mattu, and Lauren Kirchner, "Machine Bias," *ProPublica*, May 23, 2016, <https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing> accessed.

13. ProPublica's findings have since been complicated by researchers disputing their analysis. However, even these critics acknowledge the need to question how such algorithms come to incorporate questionable classification and measurement methodologies that disproportionately and negatively affect certain populations. See Sam Corbett-Davies, Emma Pierson, Avi Feller, and Sharad Goel, "A Computer Program Used for Bail and Sentencing Decisions Was Labeled Biased against Blacks. It's Actually Not That Clear," *Washington Post*, October 17, 2016.

14. Kate Crawford, "The Trouble with Bias," (keynote presentation, Conference on Neural Information Processing Systems, Long Beach, CA, December 5, 2017). https://www.youtube.com/watch?v=fMym_BKWQzk_33mm46ss.

15. Lisa Nakamura, "Cybertyping and the Work of Race in the Age of Digital Reproduction," in *New Media, Old Media: A History and Theory Reader*, ed. Wendy Hui Kyong Chun and Thomas Keenan (New York and London: Routledge, 2006), 319. Moore's

Law is a proposition made by Gordon Moore, then chairman of the computer chip maker Intel, in 1965, that the number of transistors on a chip would double every two years. This doubling of capacity as well as increases in transistor speed are the material foundations on which the rapid pace of computational advances have been built over the last five decades.

16. Scott Gilmore, "Canada's Racism Problem? It's Even Worse than America's," *Macleans*, January 22, 2015. <http://www.macleans.ca/news/canada/out-of-sight-out-of-mind-2>.

17. "This Artist Shows Us How Computers See The World," interview with Trevor Paglen, *VICE News*, July 25, 2017, video, 5:27, <https://www.youtube.com/watch?v=HEI8cuGKiNk>.

18. Marcia Crosby, "Construction of the Imaginary Indian," in *Vancouver Anthology: The Institutional Politics of Art*, ed. Stan Douglas (Vancouver: Talonbooks, 1991), 267–91.

19. Harrell, *Phantasmal Media*, 28.

20. Crawford, "The Trouble with Bias."

21. David Jhave Johnston, *Aesthetic Animism: Digital Poetry's Ontological Implications* (Cambridge: The MIT Press, 2016), 14.

22. Nakamura, "The Work of Race," 320.

23. Julianne Pepitone, "How Diverse Is Silicon Valley?" *CNNMoney*, <http://money.cnn.com/interactive/technology/tech-diversity-data/> accessed January 5, 2018.

24. Radhika Gajjala, "Transnational Digital Subjects: Constructs of Identity and Ignorance in a Digital Economy," keynote presentation, Conference on Cultural Diversity in/and Cyberspace, College Park, MD, May 2000, quoted in Nakamura "The Work of Race," 331.

25. Terry Winograd and Fernando Flores, *Understanding Computers and Cognition: A New Foundation for Design*, 1st ed. (Boston: Addison-Wesley Professional, 1987).

26. Donna Haraway, *Simians, Cyborgs and Women: The Reinvention of Nature*, 2nd ed. (London: Free Association Books, 1996).

27. Byron Reeves and Clifford Nass, *The Media Equation: How People Treat Computers, Television, and New Media like Real People and Places* (Stanford: CSLI Publications, 1996).

28. Jason Edward Lewis and Skawennati Tricia Fragnito, "Aboriginal Territories in Cyberspace," *Cultural Survival Quarterly* 29:2 (July 2005): 29–31.

29. Todd, "Aboriginal Narratives in Cyberspace," 3.

30. Skawennati Tricia Fragnito, "The CyberPowWow FAQ, or Why I Love WWWriting," *CyberPowWow*, 1997, <http://www.cyberpowwow.net/nation2nation/triciawork.html>.

31. Beth Aileen Lameman, Jason E. Lewis, and Skawennati Fragnito, "Skins 1.0: A Curriculum for Design Games with First Nations Youth," in *Proceedings of the International Academic Conference on the Future of Game Design and Technology* (Vancouver, BC: Association of Computing Machinery, 2010), 282.

32. Skawennati, *TimeTraveller™*, 2008–2014, machinima (video), 78mm. www.timetravellertm.com.

33. 2167, various artists, 2017, virtual reality. <http://www.imagenative.org/2167>.
34. Skawennati Tricia Fragnito, *She Falls for Ages*. 2017. Machinima, 19mm. <http://skawennati.com/SheFallsForAges/index.html>.
35. Bruno Nadeau and Jason Lewis, *Mr. Softie: A Typographic Text Editor*, Mac OS; Windows; Linux, 2010–2014. www.mrsoftie.net.
36. Jason Lewis, Elie Zananiri, and Bruno Nadeau, *NextText: Library for Interactive and Dynamic Texts*, 2008–2014. <http://www.nexttext.net>.
37. “The Initiative for Indigenous Futures,” Initiative for Indigenous Futures, <http://abtec.org/iif/>.
38. Cheryl L’Hirondelle, “Codetalkers Recounting Signals of Survival,” in *Coded Territories: Tracing Indigenous Pathways in New Media Art*, ed. Steve Loft and Kerry Swanson (Calgary: University of Calgary Press, 2014), 152.
39. Archer Pechawis, “Indigenism: Aboriginal World View as Global Protocol,” in *Coded Territories*, 38.
40. Jolene Rickard, “Considering Traditional Practices of ‘Seeing’ as Future,” lecture, 1st Annual Symposium on the Future Imaginary, TIFF Bell Lightbox, Toronto, October 16, 2015, <http://abtec.org/iif/symposia/a-new-beginning/#rickard>.
41. Hausman, *Riding the Trail of Tears*, 313.
42. Fenwick McKelvey, *Internet Daemons: Digital Communications Possessed* (Minneapolis: University of Minnesota Press, 2018).
43. Attempts to widen the animacy lens and flatten the species hierarchy from within the Western tradition do exist, of course: Spinoza’s monadism, Haraway’s cyborg, Timothy Morton’s hyperobjects, Jane Bennet’s vibrant matter, Graham Harman’s object oriented philosophy, etc. My aim here, though, is to introduce sources for thinking about the question of machine relationships from outside the Western canon. In addition, I side with Zoe Todd’s ethical critique of the myopia of these intellectual genealogies: “here we were celebrating and worshipping a European thinker for ‘discovering,’ or newly articulating by drawing on a European intellectual heritage, what many an Indigenous thinker around the world could have told you for millennia.” See Zoe Todd, “An Indigenous Feminist’s Take on the Ontological Turn: ‘Ontology’ Is Just Another Word For Colonialism,” *Journal of Historical Sociology* 29:1 (April 1, 2016).
44. Kim TallBear, “Beyond the Life/Not Life Binary: A Feminist-Indigenous Reading of Cryopreservation, Interspecies Thinking and the New Materialisms,” in *Cryopolitics: Frozen Life in a Melting World*, ed. Joanna Radin and Emma Kowal (Cambridge: The MIT Press, 2017).
45. Don Hill, “Listening to Stones: Learning in Leroy Little Bear’s Laboratory: Dialogue in the World Outside,” *Alberta Views*, September 1, 2008, <https://albertaviews.ca/listening-to-stones/>.

46. Martha Warren Beckwith, trans., ed., *The Kumulipo: A Hawaiian Creation Chant* (Honolulu: The University Press of Hawaii, 1972). <http://www.ulukau.org/elib/cgi-bin/library?e=d-obeckwitz2-000Sec-11haw-50-20-frameset-book-1-01oescapewin&a=d&d=Do&toc=0>.

47. Hill, "Listening."