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MYCELIUM

A Journal on the History of Science and Technology

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Table of Contents

Foreword

This year has been a strange series of "returns". We have returned to in-person learning, to eating together in Prince Hall without being separated by plexiglass, to organizing on-campus activities. Most importantly, after years of hiatus, we are celebrating the return—in a new format—of the HOST Society journal.

The journal's first issue appeared in 2003. Matthew Peltier's mesmerizing original cover art displayed two figures sitting side by side, the one cooking looking with interest to its companion engaged in measuring a moon-like stone with a compass. Together the two characters embodied the broad scope of history of science, one reflective of the multifaceted roles science and technology plays in all aspects of our lives, like our cuisine, crafts, sports, philosophy and literature, the design of our cities, our politics, the way we wage warfare, and how we question and represent ourselves through our arts and music.

Such an encompassing view of the importance of History of Science for the humanities was not widely shared twenty years ago. It was to emphasize this link existing between science and culture that the editors of the new journal turned to a line in Tennyson's poem *In Memoriam* for the title of their new journal.

Tennyson published *In Memoriam* in 1850 as a tribute to his friend Arthur Henry Hallam who, at 22, had died of a brain hemorrhage.[1] The poem uses Tennyson's grief to explore questions of faith, personal identity, and the meaning of life in light of the rapidly changing science of 19th-century Britain, notably the recently discovered fossils of extinct animals. Death did not affect individuals only, Tennyson sadly realized, but species. Who knows, Tennyson asks, if Nature's "last work",

[1] Alfred Tennyson, *In Memoriam* (London: Edward Moxon, 1850), 80, https://www.google.ca/books/edition/In_Memoriam/z1gJAAAAQAAJ?hl=en&gbpv=1&pg=PP7&printsec=frontcover

humanity, will itself survive? We might have in the past trusted that love was "Creation's final law," but geology has now proved to us that Nature is not "so careful of the type":

> From scarped cliff and quarried stone
>
> She cries 'A thousand types are gone:
>
> I care for nothing, all shall go.
>
> Thou makes thine appeal to me:
>
> I bring to life, I bring to death […]'

Nature, Tennyson warned, is not all-loving, but "red in tooth and claw."

As the journal's title, *Tooth and Claw* was a telling metaphor, one that worked at many levels. As Matthew Kutcher and Rachel Sheperd, the journal's first editors-in-chief, reminded their readers, Tennyson's *In Memoriam* made clear that "Life and death, love and war, success and failure, weakness and strength, and the search for understanding" are not to be found only in literature, but also in history of science.[2] At a time when History of Science was still struggling to find its academic footing, it also suggested that the budding researchers who were writing the journal's first articles might have to fight for a place in the academic environment.

Much has changed in the past two decades. Programs, journals, and conferences in History of Science have proliferated across the globe, and the field has now clearly entered a new "global" phase, one critical of the original Eurocentrism of its narratives and sources, and one more mindful of the circulation of knowledge and of the co-production of knowledge that happens when different traditions meet. We now also live in a different academic world, one that is much more supportive of the interdisciplinary endeavours and collaborative work. Ours is not an academic environment "red in tooth and claw". It is one of collaboration and communication, where we thrive by sharing

[2] Matthew Kutcher and Rachel Shepherd, "Preface," *Tooth and Claw* 1, no. 1 (2003).

resources and knowledge. The pandemic has forced us to rapidly learn new digital ways of being together and sharing our ideas with one another. It thus seems fitting to the HOST Society journal return not only in a new fully digital format, one that will make it possible for students to share their work with the world on the internet, but return under a new name, one that emphasizes how our discipline will flourish only if we communicate and share resources, just like we now know a group of tree can communicate and share resources via their own mycorrhizal network. Welcome back, *Mycelium!*

A Note on Naming

Some of you will know that the HOST student journal was originally titled *Tooth and Claw*. This title is a reference to "nature, red in tooth and claw," a line from Alfred Lord Tennyson's 1850 poem "In Memoriam." This is not the first instance of this phrase being used to describe ruthless competition in nature. It was also used by Richard Dawkins in his 1976 book *The Selfish Gene* to describe the modern understanding of natural selection, which is characterized primarily by competition. The name *Tooth and Claw* is clearly relevant to the history of science, but it alludes to concepts that we in the HOST program no longer wish to highlight.

I am excited to be involved in changing the journal title to *Mycelium.* Mycelium is a network of fungal threads — the fruiting bodies of fungi are mushrooms, but there is much more happening underground, the significance of which is only beginning to be understood. There is a great deal of emerging research about bout the importance of mycelial networks for transferring nutrients, and possibly even information, between parts of an ecosystem, including between the roots of trees in a forest. I have been obsessed with this science and its metaphorical resonance for at least a year now; I owe a great deal of my interest to books such as Suzanne Simard's *Finding the Mother Tree*, Merlin Sheldrake's *Entangled Life*, and even Richard Powers' novel *The Overstory*. This passage from Powers' novel, excerpted in an email from Dr. Melanie Frappier, sums it up perfectly:

> There are no individuals. There aren't even separate species. Everything in the forest is the forest. Competition is not separable from endless flavors of cooperation. Trees fight no more than do the leaves on a single tree. It seems most of nature isn't red in tooth and claw, after all. For one, those species at the base of the living pyramid have neither teeth nor talons. But if trees share their storehouses, then every drop of red must float on a sea of green. (155-156).

Nature is at least as much about collaboration as it is about competition, and I hope we can continue to celebrate finding connections in unexpected places. I think that is what we in the HOST program do best.

Sadie Quinn,

HOST Society vice-president (2022-23)

Axolotl & Drosophila: Extreme Examples of Early Laboratory Experimentation

Shantelle March

Obscurely I seemed to understand their secret will, to

abolish space and time with an indifferent immobility.

-from *Axolotl,* by Julio Cortazar, 1956

A strange human custom persists in the equestrian sport: medals are awarded to the equestrian while the true athlete, *the horse,* is blatantly overlooked. As the pomp of any given event concludes, and the celebration of victory inevitably ensues, "the only mammals with medals around their necks are humans."[3] If history is written so that it favours the victor, surely something must be said or done about the underacknowledged animals which we hold so important in furthering the goals of society or humanity?

The relationship of the equestrian to their horse is analogous to that of a scientist to their laboratory animals in that they are contributors without their due recognition. For our most common laboratory animals are oft overlooked, yet are still as important a step to take in furthering scientific pursuits as much as the scientist themselves. Laboratory animals serve more than a basic function to their caretakers, allowing feats that would have otherwise been unattainable to become easily accomplished. The commentary in the preceding paragraph is not entirely accurate, as there is unlikely to be an equestrian who would not offer some acknowledgment of the horse's contribution — be it some gentle pats, or a carrot, or, in the case of the Kentucky Derby, a blanket of roses to be worn around the horse's body.[4] In investigating any similar acknowledgment in lab animals, however, a quick Internet search yields spotty results.

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[3] Chris Chase, "Why don't horses receive their own equestrian medals?" Foxsports.com, Nov. 15. 2016, https://www.foxsports.com/stories/olympics/why-dont-horses-receive-their-own-equestrian-medals

[4] "Garland of Roses." 2022 Kentucky Derby & Oaks | May 6 and May 7, 2022. Accessed Dec. 6, 2022. https://www.kentuckyderby.com/history/traditions/garland-of-roses

Whether classified as underacknowledged, overlooked, or simply forgotten, laboratory animals are as instrumental to the histories of science as the scientists involved. Two noteworthy representatives of the laboratory animal delegation are *Ambystoma mexicanum*, the humble axolotl, and *Drosophila melanogaster*, the common fruit fly. This disparate pair have been doing some serious biological heavy lifting each for over 100 years. Fruit flies, for being so little and so inconsequential. have given so much of themselves in the name of science. They have been *the* laboratory test subject for no less than six Nobel prizes awarded across various disciplines.[5] So too the axolotl goes underappreciated, who itself has been continually instrumental to genetics and developmental biology research since the early twentieth century. Sought after for its amazing regenerative properties[6] that continue to puzzle herpetologists, developmental biologists, and geneticists alike, the axolotl is a laboratory titan, holding the current record for the oldest surviving laboratory lineage that is traceable to its first introduction to Europe some 150 years ago.[7] It also holds the second place title for largest (currently) sequenced genome, having recently been overtaken by the Lungfish *Neoceratodus forsteri* in 2021.[8]

The axolotl and the fruit fly represent the two extremes of what was *and is* being widely used in laboratory and zoological research initiatives in the nineteenth, twentieth, and twenty-first centuries. Axolotl: an enigmatic symbol of the unknown, embodying what great achievements have been wrought from colonial expansion into new continents and territories. The common fruit fly evokes no fanfare, requires no world-wide missions for its collection, and certainly no museum is going to go out of its way to erect *Drosophila* exhibits for its patrons. Despite their dichotomous histories, both have been crucial elements to many scientific endeavours, and what better way to

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[5] Stephanie Dutchen, "Why the Fly?", Harvard Medical School Community, Apr. 2, 2018, https://hms.harvard.edu/news/why-fly

[6] Carly J. Adamson, Nikolas Morrison-Welch, Crystal D. Rogers, "The amazing and anomalous axolotls as scientific models," *Developmental Dynamics* 251, no. 6 (2022): 922-933, https://doi.org/10.1002/dvdy.470

[7] Christian Reiβ, Lennart Olsson, Uwe Hoβfeld, "The history of the oldest self-sustaining laboratory animal: 150 years of axolotl research," *Journal of Experimental Zoology* 324, no. 5 (2015): 393-404, https://doi.org/10.1002/jez.b.22617

[8] Axel Meyer et al, "Giant lungfish elucidates the conquest of land by vertebrates," *Nature* 590 (2021): 284-289, https://doi.org/10.1038/s41586-021-03198-8

properly evaluate their places of significance in history than to explore side-by-side biographies of these two model research subjects. This essay will pay particular attention to their naissance as laboratory staples into a post-Enlightenment, scientifically minded culture, continually consumed by discovering the unknown.

Upon its arrival to Paris in the early 1800's as a preserved specimen, the axolotl was a mystery. Sent as a gift to friend and colleague Georges Cuvier from the acclaimed explorer and naturalist Alexander von Humboldt, the specimen was briefly studied, but quickly categorized as a juvenile of a not-yet-defined novel species of salamander.[9] It would take another sixty years for live specimens to arrive in Paris in 1864, those of which would soon be distributed amongst important "zoological gardens, natural history museums, university institutions, individual scientists and amateur enthusiasts" through a "strategy of generosity" made popular by the larger acclimatization movement of the 1800's.[10]

Almost a hundred years after Cuvier's description of those first two axolotl specimens, *Drosophila* entered the scientific scene, beginnings its new career as a subject of experimentation in the early years of the twentieth century in New England. The fruit fly was first considered as a possible laboratory test subject at Harvard University at the suggestion of W.E. Castle, an experimentalist and early geneticist.[11] However, its initial reception amongst other researchers was sporadic at best, and though having been taken up by the Harvard scholars, the initial distain remained for some. Author Robert Kohler aptly described the scene: "[d]rosophila had no prestige, no standing among the families of wild or domestic creatures. They were seen as pests. Living in disagreeable and unhealthy places, in dumps, garbage piles, and rotting vegetation, they kept bad company and were assumed to have bad habits."[12]

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[9] Georges Cuvier, *Recherches Anatomiques sur les Reptiles* (Paris: l'Imprimerie de L. Haussmann, 1807), https://gallica.bnf.fr/ark:/12148/bpt6k4246012f/f37.item.r=humboldt

[10] Reiβ, Olsson, and Hoβfeld, "The history of the oldest self-sustaining laboratory animal: 150 years of axolotl research," 394.

[11] Robert Kohler, *Lord of the Fly* (Chicago, IL: University of Chicago Press, 1994), 23.

[12] Robert Kohler, *Lord of the Fly* (Chicago, IL: University of Chicago Press, 1994), 29.

A colleague of Castle's, Entomologist Frank Lutz, went as far as to make his feelings for *Drosophila* known via generalized, omnidirectional contempt targeted at anyone who would listen. Writing to a friend in 1907, he lamented that he was "covered ten miles deep with vinegar flies".[13] Ever wearing his feelings on his sleeve, the Entomologist was also accurately described by a librarian as "not at all cheerful much of the time".[14] Ironically, a strange parallel exists between the overly emotional, bottled-up researcher, and the "bottled-up swarms of restless, prolific little flies."[15] And bottled up they were. By 1910, popularity surged for the specimen, and a small research team at Columbia University established what would be forever known in history as "the fly room", which housed the Nobel Prize winning and pioneering geneticist Thomas Hunt Morgan and his students, affectionately dubbed his "boys".[16] The quite literal name of the lab meant that nearly every available surface was occupied with bottles upon bottles of fly colonies.

[13] Kohler, *Lord of the Fly*, 31.
[14] Kohler, *Lord of the Fly,* 31.
[15] Kohler, *Lord of the Fly,* 31.
[16] Ian Shine and Sylvia Wrobel*, Thomas Hunt Morgan: Pioneer of Genetics* (Lexington: University Press of Kentucky, 2009), 110, http://ezproxy.library.dal.ca/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=e000xna&AN=938181&site=ehost-live

Figure 1: Thomas Morgan in his influential "fly room" at Columbia University circa 1916. The many milk bottles that surround him front and back contain colonies of fruit flies.[17]

The fly room was an incomparable space: a blending of untidy and eccentric themes, of unwanted pests (e.g., cockroaches, mice, and fruit flies gone rogue), and desired ones (e.g., countless fruit fly colonies housed in glass jars). The rotting bananas meant as fly food added to the character of the space. The overall state of the lab drew ire for its condition, as noted by biographers Ian Shine and Sylvia Wrobel: "[t]he resulting smell was fierce and drew constant complaints from the rest of the biology department."[18]

At the less odorous end of the laboratory animal spectrum rests the ambivalent and ambiguous axolotl, whose reception and treatment was much less negative than the fruit fly. Soon after its arrival in Europe in 1864, it became clear that this relatively unknown amphibian held a big physiological secret: it mysteriously retains many of its juvenile characteristics into adulthood

[17] "The "Fly Room" at Columbia." Indiana University Bloomington. Accessed Dec. 6, 2022. https://collections.libraries.indiana.edu/muller/exhibits/show/fly-room/page-1
[18] Shine and Wrobel, *Thomas Hunt Morgan: Pioneer of Genetics*, 84.

without undergoing a final metamorphosis (a developmental process in biology later described as *neoteny*.)[19] Contrary to Cuvier's original assessment of the preserved axolotl specimens, the news of this "permanent youth"[20] thrust the axolotl immediately into the scientific spotlight, enticing the most curious of biological researcher to obtain their own through the now-pervasive breeding for research, as well as for leisure, movement.[21]

Its popularity can equally be attributed to a chance event which occurred at the menagerie of the Musée d'Histoire Naturelle in Paris in 1867.[22] Three years prior, six axolotls were generously shared from the first shipment in 1864 to Auguste Duméril, a renowned herpetologist with the musée.[23] At the musée and under the careful direction of a herpetologist, they were able to successfully breed and produce several generations of tadpole offspring. After a few successful propagations, Duméril was witness to what was possibly the most significant scientific event of his life: some of the water-bound axolotls had begun showing telltale signs of metamorphosizing, just as their more well-known terrestrial salamander cousins do.[24] Was this a potentially non-random event, instigated by some unknown environmental stimuli or stress? Many wondered instantly if the axolotl could be artificially stimulated to metamorphosize. Some, like Auguste Duméril, devised elaborate aquariums which were manipulated over a period of time so that less water and more land was available to the population.[25] Unfortunately for Duméril, this experiment was a failure and he could not induce the metamorphic adult stage through the manipulation of environmental conditions alone. However, the larger zoological research movement was not deterred and were, perhaps, even inspired at the potential the axolotl held. Novel research questions

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[19] Adamson, Morrison-Welch, and Rogers, "The amazing and anomalous axolotls as scientific models," 922.
[20] Stephen Jay Gould, *Ontogeny and Phylogeny* (Cambridge, MA: Harvard University Press, 1977), 184.
[21] Reiβ, Olsson, and Hoβfeld, "The history of the oldest self-sustaining laboratory animal: 150 years of axolotl research," 394.
[22] Auguste Duméril, "Experiments on the Axolotl," *Ann. mag. nat. hist* 20, no. 3 (1867): 446-449. https://www.biodiversitylibrary.org/item/53344#page/7/mode/1up
[23] *Bulletin de la Société imperial zoologique d'acclimatation* 2, no.1, (1864): 179. https://www.biodiversitylibrary.org/page/30248679#page/191/mode/1up
[24] Duméril, "Experiments on the Axolotl," 446.
[25] Duméril, "Experiments on the Axolotl," 447.

grew out of the likes of Duméril and others who would lay the groundwork, contributing readily and steadily to the growing zeitgeist of biological information about the mysterious salamander. Some researchers, in processing this abundant and continual stream of scientific news surrounding the axolotl, reacted the only way they knew how — with their scalpels.[26]

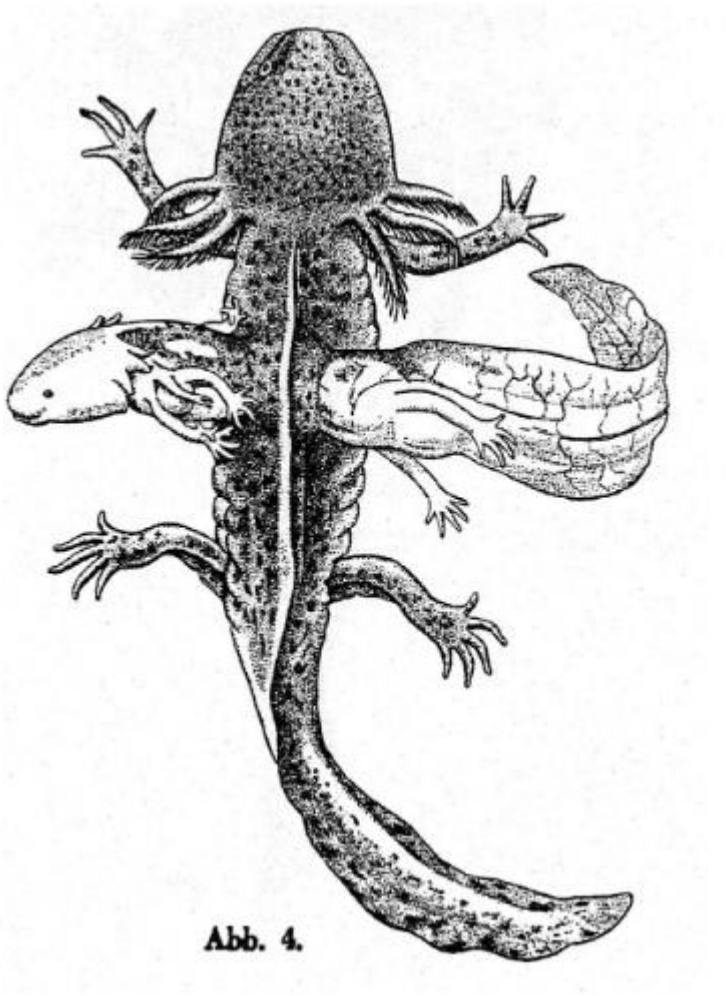

Figure 2: Two axolotls surgically attached so that their circulatory systems become enmeshed with the other's. A process known as parabiosis and an early example of experimental and theoretical biology produced by Georg Schneider, of the University of Jena, Germany, in 1947.[27]

[26] Reiβ, Olsson, and Hoβfeld, "The history of the oldest self-sustaining laboratory animal: 150 years of axolotl research," 399.
[27] Uwe Hoβfeld, Lennart Olsson, "Between Science and Politics: Axolotl Research at Jena University, Germany during the Lysenko era (1950s-1960s)," Researchgate.net, Jan. 01, 2001, https://www.researchgate.net/publication/286871170_Between_Science_and_Politics_Axolotl_research_at_Jena_University_Germany_during_the_Lysenko_era_1950s-1960s

The fruit fly was not without its place in the subject of laboratory experimentation, but the axolotl was certainly a pioneer in the respect that its size was such that it was easier to directly (and surgically) manipulate.

The notorious Stephen Jay Gould cleverly quipped in his 1977 book *Ontogeny and Phylogeny* that "[e]very subject has its *Drosophila*".[28] Here he was referring to how many research initiatives in biology have their ideal test subjects, and the ubiquitous fruit fly is often *the* choice candidate. The simplest explanation is that it is cheap and easy to institute. Its propagation is comically simple, with the short gestation of only ten days[29], and its very short life cycle meant it was easier to integrate into early evolutionary and genetic experiments.[30] *Drosophilae* appear seemingly out of thin air, their eggs existing always in proximity to decaying food sources.[31] It easily became the model organism for universities, whose biological research projects needed to be completed within an academic term or two.[32] If at any time an experiment suffered some failure in its process resulting in a large-scale fatality, we could easily say without a question of a doubt that nothing of value was lost. There were always going to be hundreds, if not thousands, of fruit flies waiting in the laboratory wings, to be used and incorporated into subsequent experiments.

Laboratory research including the omnipresent axolotl continues into present day across a number of biological and genetic subfields. Some initiatives, focused on cellular regeneration, are as revolutionary as they are promising, producing results which are beneficial across a number of growing disciplines.[33] But how is the axolotl *really* regarded today? The axolotl, for all the wonder and curiosity it aroused from its introduction into Europe and labs across the world, has suffered similarly as the fruit fly in its scientific underappreciation, and the relationship between experimenter and laboratory subject seems rather impersonal and perfunctory. At the University of Kentucky, a veritable epicentre of axolotl research in North America, they fail to acknowledge the

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[28] Gould, *Ontogeny and Phylogeny*, 177.
[29] Kohler, *Lord of the Fly,* 28.
[30] Andreas Keller, "Drosophila melanogaster's history as a human commensal," *Current Biology* 17, no. 3 (2007), https://doi.org/10.1016/j.cub.2006.12.031
[31] Dutchen, "Why the Fly?"
[32] Kohler, *Lord of the Fly,* 20.
[33] Adamson, Morrison-Welch, and Rogers, "The amazing and anomalous axolotls as scientific models," 928.

significance of their contributions to science, aside from the occasional nod that axolotls have "desirable" traits ideal for modelling regenerative medicine experiments.[34]

Veterinarian and researcher Jennifer Lofgren at the University of Michigan is interested in instituting a science culture change. Her lab has focused on creating positive and enriching environmental spaces for their various animal laboratory subjects, from mice and rats, to rabbits, to fish. In an article in the journal Science in 2018, she reflects on her work, noting that the animals have responded positively to the extra care and consideration, producing promising results in their respective research niches. "We owe it to these creatures to give them the best lives possible. They're giving us the best they can. So, we should be doing the best we can."[35] Initiatives like this provide some hope for the future that our laboratory animals will one day be considered less of a utility, and more of a commensal partner.

The importance of both the axolotl and the fruit fly to biological and zoological research cannot be understated. The enigmatic and elusive axolotl, harbouring within its enormous genome the secrets of cellular regeneration, juxtaposed with our fruit fly: ubiquitous, bothersome, a symbol of decaying organic matter, yet vitally important to evolution-based research and modelling for students and professors alike. There is a consequence to being as prolific and omnipresent a laboratory staple as both these subjects have realised, that being, when you are one of hundreds of progeny, no one fruit fly or axolotl is ever special. The moral of the story here is that both are equal necessities in scientific research past and present, without which many disciplines would suffer a tremendous loss.

[34] "The Amazing Axolotl: A Valuable Model for Regenerative Medicine" NIH.gov. Sep. 1, 2021. https://orip.nih.gov/about-orip/research-highlights/amazing-axolotl-valuable-model-regenerative-medicine
[35] David Grimm, "Are happy lab animals better for science?" Science.org. Feb. 7, 2018. https://www.science.org/content/article/are-happy-lab-animals-better-science

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It's a No Brainer: 20th Century Lobotomies and the Implicit Gender and Racial Bias in Medicine

Ana Furtado

In 1949, Portuguese neurologist António Egas Moniz received the Nobel Prize in Physiology or Medicine due to his revolutionary procedure, which showed positive results in only ten days after being performed: the leucotomy. This medical procedure consisted of drilling holes into a patient's skull and injecting ethyl alcohol into the prefrontal cortex to sever connections in the brain. Quickly and radically evolving, the surgery was eventually brought to the United States, where it was popularized by neurologist Walter Freeman and neurosurgeon James W. Watts. At this point in time, leucotomies were now called lobotomies, and performed according to the Freeman-Watts method; involving the approach of the brain through the eye sockets with an instrument similar to an ice pick and a mallet, the connections in the brain were now being physically severed. This procedure was used to help patients suffering from mental illnesses; usually those involving hallucinations, mania, depression, and suicidal tendencies. However, the procedure was also performed for issues that seemingly had no relation to the brain. Lobotomies were performed on patients presenting with gastrointestinal hemorrhages due to peptic ulcers and ulcerative colitis (Terrier, Lévêque, and Amelot 2019). By the time the procedure started to lose popularity, around 40,000 had been performed in the United States alone. The majority of these were performed on women, although "men significantly outnumbered women as patients at the majority of these institutions" (Koziol 2016); even notorious female figures such as Rosemary Kennedy and Eva Perón surrendered to the procedure. This disparity in the ratio of lobotomies performed in women versus men is a prime example of the gender bias that was present in medicine in the 20th century and remains prevalent in medicine to this day. Becoming aware of the ongoing gender and racial bias in

patient care and actively working against it is necessary in today's society, as the constant failing of women and people of color that seek medical help should be unacceptable rather than common practice.

With a lack of medications, professionals felt the need to find a procedure to 'fix the mentally ill'; resorting to treatments such as sleep therapy, shock therapy, and even malaria therapy. Inspired by similar work done by Americans John Fulton and Carlyle Jacobsen on chimpanzees, Moniz decided to bring the procedure to humans (Terrier, Lévêque, and Amelot 2019). With its popularization in Europe, the lobotomy was brought to North America by Freeman and Watts, who called it "the surgical relief of mental pain" (Freeman and Watts 1942, 794). In 1946, they performed the first transorbital lobotomy. This technique involved lifting the upper eyelid and inserting the ice pick below, resting on the upper surface of the eyeball. The ice pick was then "brought parallel with the bony ridge of the nose, and its base [was] tapped lightly with a hammer to drive it through the orbital plate", all while the patient had been sedated via electroshock therapy (Collins and Stam 2015, 122).

Lobotomies, regardless of popularity, were still proving to be extremely controversial. It brought on few good results and many poor outcomes; Freeman's follow up of 707 lobotomized patients showed that 73% of patients remained in hospitals and mental institutions, or were brought back home virtually 'empty', with no personality and many times lacking the ability to do basic tasks alone (Byard 2017). In fiction, an example of the loss of personality caused by lobotomies can be seen in Honey Sugarman from the American adult animated comedy-drama BoJack Horseman. A housewife dedicated to her family, Honey lost her oldest child Crackerjack Sugarman during World War II, which left her ridden with grief and extremely depressed; mood swings and crying fits were a daily occurrence. After having a public meltdown and causing a car crash involving her youngest child Beatrice, it is heavily implied that Honey is taken by her husband to get a lobotomy. After the experience, she appears constantly dazed and lacks any emotion in her voice; presented to the audience as a shell of the woman she once was. Although

fiction, Honey Sugarman's experience is shared by numerous American housewives in the 20th century. In real life, a prime example of the devastating consequences lobotomies can have is the case of John F. Kennedy's sister, Rosemary Kennedy. A woman prone to seizures and mood swings, Kennedy underwent a lobotomy at age 23, performed by Freeman and Watts themselves. The procedure left her unable to speak coherently and incapacitated. She spent the rest of her days in an institution, isolated from her family. Similarly, Eva Perón, former first lady of Argentina, had a lobotomy in order to treat her anxiety, emotional instability, and pain; all brought on by her cervical cancer diagnosis and radical hysterectomy. The procedure took place in June of 1952, and, after a month of being unable to eat and exhibiting signs of mental regression, Perón passed away (Young et al. 2015).

Aside from Kennedy and Perón, thousands more women were also subjected to lobotomies, as they were disproportionately targeted for the procedure over their male counterparts. Female patients made up 60% of patients that underwent lobotomies; Freeman himself seemed to believe that female patients were better subjects for lobotomies, and out of his first 20 patients, 17 were women (El-Hai 2005). Although it is not certain whether Freeman believed women responded better to the treatment, or if women were simply more likely to have the conditions which would require a lobotomy, it seems as though women that presented the same symptoms as men were more likely to be lobotomized; "five of the six patients in the case study by Freeman and Watts were women whose symptoms – apprehension, insomnia – seem incommensurate with their treatment, but whose status as women sanctioned it" (Tone and Koziol 2018). Symptoms present in both men and women seemed to warrant different treatment plans. In addition, the perceived societal role of women in the 20th century certainly played a role in causing such a large disparity between genders in consideration for lobotomies. Women were expected to be perfect housewives, compliant and non-argumentative; as "lobotomized patients immediately become 'more placid, more content, and more easily cared for by their relatives' and that the most 'outstanding deficit symptom is a certain lack of spontaneity'"

(Koziol 2016), women were seemingly perfect targets, as even a 'bad outcome' could still render them able to be good wives and mothers.

Even now, the implicit gender medical bias that made women seemingly better candidates for lobotomies has not disappeared; the medical system is still failing women who seek medical help. The unconscious ideas we have based on what groups someone is part of impacts our behaviour towards them, which although part of human nature, is inadmissible in medicine. In one study regarding pain management, controlled for age, race, class, and pain scores – gender therefore being the only difference between both groups – women were 13% to 25% less likely to receive opioids and waited longer to be seen by a physician in comparison to their male counterparts (Tone and Koziol 2018). This disparity could possibly be an effect of women being considered 'more dramatic' than men; and "one in five women say that they have felt that a health care provider has ignored or dismissed their symptoms" (Paulsen 2020). Women are also less likely to receive treatment for issues such as "coronary artery disease, Parkinson's disease, irritable bowel syndrome, neck pain, knee joint arthrosis, and tuberculosis" (Hamberg 2008), due to the fact that crucial research in these disorders has not been conducted on women, but mostly on men. In medical issues which present themselves differently in men and women, this can cause physicians to misdiagnose women. When discussing the medical bias present towards women, it is impossible to not also mention the implicit bias that impacts people of color. The best example of this is the fact that black patients are less likely to be prescribed medication for pain in contrast with their white counterparts, due largely to stereotypes as well as to the widely disproven myth that black people feel less pain, which many medical students still believe. In fact, an experiment conducted on 418 medical students showed that, when presented with false beliefs regarding differences between black and white people – such as "blacks' nerve endings are less sensitive than whites'", "black people's blood coagulates more quickly than whites'", and "blacks' skin is thicker than whites'" – 50% of the students "reported that at least one of the false belief items was possibly, probably, or definitely true" (Hoffman et al. 2016). The implicit medical bias

towards people of color can be seen across all medical fields, even in pediatric care; a study conducted on 86 pediatricians showed that "racial and ethnic disparities are found in asthma care, medication use for ADHD, children's timely and appropriate receipt of medication, pain management, and quality of primary care" (Sabin and Greenwald 2012). Although the results of the study are infuriating, the sample size was not large enough to consider this an overarching issue of the pediatric community, and female physicians outnumbered male physicians by a decent margin; this is relevant as research has shown that female physicians express less implicit racial bias than their male counterparts, likely because they are also familiar with lower quality of care and would therefore be more aware of it.

The implicit medical bias towards women and people of color is undoubtedly a result of years of oppression towards both marginalized groups. Women struggled to be taken seriously in the 20th century, and still do now, a century later. The same implicit bias that led so many female patients towards lobotomies and hysteria diagnosis still exists to this day, making so many women frustrated when their medical issues get chalked up to 'hormones' or 'PMSing'. In a similar fashion, the same old racist beliefs that 'black people feel less pain' or that 'black people have thicker skin' still impacts the way black patients are treated and the quantity of drugs they are prescribed. Biases are part of the human experience and are not necessarily present out of malice, but rather out of ignorance – hence why the implicit medical bias towards women and people of color needs to be addressed and physicians must be trained to see past their own biases.

Health-focused author Emily Paulsen lists many ways in which we can combat our own implicit bias, such as diversifying health care teams in order to receive opinions from experts with different backgrounds; asking open ended questions that allow patients to speak uninfluenced by their medical professional, rather than those that might lead to specific answers; mentally substituting the patient's gender or race with another, in order to think of what their first instincts could be in every scenario; data collection as a standard procedure; checklists and guidelines that must be followed with every patient regardless of gender, age, or race; and more training

opportunities in how physicians can become aware of their own biases (Paulsen 2020). The use of these techniques is the best way to combat gender and racial biases. Beliefs that arise through ignorance must be unlearned, requiring a conscious effort from individuals; though not easy, the only way to combat ignorance is through educating yourself and being aware of your own prejudice.

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Indigenous Views of Autonomous Technology

Sadie Quinn

Introduction

Examining relationships between humans and technology, asking who is the agent and who is being acted upon, is becoming increasingly important as modern technological advances continue to blur the boundary between organism and machine. Particularly valuable in this analysis is the notion of autonomous technology, as articulated by Jacques Ellul in the 1960s. The significance of Ellul's image of autonomous technology as a self-determining organism, which was further emphasized by Langdon Winner in his book on the subject, can be applied to relationships between human beings and technologies in various contexts. Many of the diverse Indigenous worldviews from the land now known as North America share an understanding that objects have agency in a way not always recognized in Western thought. In this paper, I apply the concept of autonomous technology, as understood by Ellul and further articulated by Winner, to several examples of relationships between Indigenous people and objects. I highlight Emilie Cameron's analysis of the agency of a copper knife in various versions of an Inuit story, as well as Marie Clements's theatrical portrayal of the Dene people's relation to the uranium used in the atomic bombs dropped on Hiroshima and Nagasaki. In both cases, the Indigenous people's view of technology differs from that of the settler community involved, ascribing an autonomy to technology that fits quite neatly into Ellul's framework. I then turn my attention to the future possibilities for the relationship between Indigenous peoples and technology. Recent work by Indigenous scholars in this area shows that the close ties between humans and the nonhuman world present in many Indigenous cultures may be an indispensable tool for navigating the use of new technologies such as artificial intelligence. I do not wish to homogenize Indigenous thought, nor to assert that Ellul took Indigenous worldviews into account when developing his concept of

autonomous technology. Rather, I aim to show that many Indigenous perspectives on the agency

of technology in relation to humans, perspectives with long, rich histories of which I scarcely scratch the surface, may provide similar insights to those offered by Ellul in the mid-20th century. The notion of autonomous technology in Indigenous worldviews, which shares some similarities with Ellul's definition, can continue into future centuries as a path to a more just and peaceful world for humans and nonhumans alike.

Defining Autonomous Technology

Before addressing the agency and autonomy of technology in Indigenous worldviews, it is necessary to understand the concept of autonomous technology as articulated by Jacques Ellul. Ellul's basic definition of an autonomous technology is one that "ultimately depends only on itself, it maps its own route, it is a prime and not a secondary factor, it must be regarded as an organism tending toward closure and self-determination: it is an end in itself."[1] The characterization of technology as an organism will be of particular importance to our discussion of Indigenous worldviews that allow humans "to engage in dialogue with our non-human kin, creating mutually intelligible discourses across differences in material, vibrancy, and genealogy."[2] This tendency to forge new connections is a significant component of Ellul's thought; he analyzes the relationship between technology and structures such as science, the state, and economics, in order to show how technology is an autonomous actor within these complex systems. He stresses that "technology radically modifies the objects to which it is applied while being scarcely modified in its own features"[3] and that "by so doing, it naturally employs many other non-technological factors."[4] Humans and their social systems act according

[1] Jacques Ellul, "The "Autonomy" of the Technological Phenomenon," in Robert C. Scharff and Val Dusek, ed., *Philosophy of Technology: The Technological Condition: An Anthology, Second Edition* (Hoboken, NJ: John Wiley & Sons, Inc, 2014), p. 430.

[2] Jason Edward Lewis et al., "Making Kin with the Machines," *Journal of Design and Science* 3.5 (2018): p. 2.

[3] Ellul, "The "Autonomy" of the Technological Phenomenon," p. 430.

[4] Ellul, "The "Autonomy" of the Technological Phenomenon," p. 436

to the parameters of technology, and not vice versa. As I present several Indigenous perspectives on the agency of technological objects, I will return to various elements of Ellul's definition of autonomous technology as self-determining force that acts on its surroundings.

Further crucial insights on the concept of autonomous technology come from Langdon Winner, who recognizes Ellul as his most direct predecessor in his 1977 book *Autonomous Technology*.[5] Winner acknowledges that "Ellul is often criticized for reification and anthropomorphism in his major concepts,"[6] but it is precisely these tendencies that Winner highlights as significant, and that I too wish to emphasize in Ellul as I relate his thought to Indigenous views of technology. Winner summarizes Ellul thus:

> Technique is entirely anthropomorphic because human beings have become thoroughly technomorphic. Man has invested his life in a mass of methods, techniques, machines, rational-productive organizations, and networks. They are his vitality. He is theirs… By employing the metaphor of technological animism — referring to "technique" as a sensing, thinking, deciding, demanding subject — Ellul offers us an image that encompasses not only the substance of his own complex arguments but many similar conjectures and hypotheses.[7]

By metaphorically raising technologies to the status of organisms, Ellul is already "making kin with the machines,"[8] an idea that Winner sees as essential for understanding autonomous technology. It is this same central point, the collapse of technology and organism, of human actor and technological servant, that I wish to emphasize in my examination of Indigenous sources. My objective is similar to Winner's: "to identify a variety of notions of autonomous technology, to examine their basic rationale, and to inquire into the problems they suggest."[9] Whereas Winner draws upon various examples from centuries of Western philosophy and literature, I aim

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[5] Langdon Winner, *Autonomous Technology: Technics-out-of-Control as a Theme in Political Thought* (Cambridge, MA: MIT Press, 1977), p. 15.

[6] Winner, *Autonomous Technology*, p. 41.

[7] Winner, *Autonomous Technology*, p. 42.

[8] Lewis et al., "Making Kin with the Machines," p. 1.

[9] Winner, *Autonomous Technology*, p. 17.

to understand the autonomy of technology as represented in Indigenous thought, including traditional knowledge and recent scholarship.

Copper, Uranium, and the Agency of Objects

One perspective on the autonomy of technology in Indigenous worldviews can be found in Emilie Cameron's account of an Inuit story in her 2011 essay "Copper Stories: Imaginative Geographies and Material Orderings of the Central Canadian Arctic." Different retellings of this traditional story, in which a group of lost hunters sacrifice their copper knives and eventually find their way home, reveal differences between the Inuit and European perspectives on the agency of objects.[10] Cameron contrasts the version of the story recorded in the Inuinnaqtun language by James Qoerhuk and the summary written by French missionary and anthropologist Maurice Métayer.[11] Qoerhuk gives the knife an active role in relation to the hunters: "because they let it sink, it brought them behind, to the land left behind."[12] As Cameron explains, "in the Inuinnaqtun version, the knife has agency; it is the knife that brings them home."[13] While Métayer acknowledges the special significance of the copper knife, his account focuses on the "somewhat Christianized understanding of "sacrifice" to the "spirit of the sea.""[14] Cameron notes that "the capacity of the copper knife to lead and act is written out of his summary, rendering the knife a kind of de-animated fetishized object valuable because it can be offered to sea spirits."[15] In Métayer's European Christian worldview, technology, i.e. the knife, is a means to an end, a tool by which to call upon greater divine forces. In the Inuinnaqtun account, on the

[10] Emilie Cameron, "Copper Stories: Imaginative Geographies and Material Orderings of the Central Canadian Arctic," in Audrey Kobayashi, Laura Cameron, and Andrew Baldwin, ed., *Rethinking the Great White North: Race, Nature, and the Historical Geographies of Whiteness in Canada* (Vancouver: UBC Press, 2011), pp. 181-182.

[11] Cameron, "Copper Stories," pp. 181-182.

[12] Cameron, "Copper Stories," p. 183.

[13] Cameron, "Copper Stories," p. 183.

[14] Cameron, "Copper Stories," p. 183.

[15] Cameron, "Copper Stories," p. 183.

other hand, the knife is an independent actor; it quite literally "maps its own route," as Ellul states in his definition of autonomous technology.[16] The Inuit view of technology, as shown in the story of the knife, fits Ellul's definition of autonomous technology in the way allows objects to be independent agents, guiding humans on their journey through the world.

A more metaphorical, yet no less significant, account of the agency of technology in Indigenous cultures is provided by Marie Clements in *Burning Vision*, her 2002 play that depicts the story of the uranium used for the Hiroshima and Nagasaki bombs being mined on Dene lands in the Northwest Territories. The nuclear weapons are personified in two characters aptly named Fat Man and Little Boy, and the latter, in particular, exemplifies the difference in Indigenous and settler views of technologies and the natural materials used to fashion them. Little Boy is described as a "naked Indian boy-man, scared and huddled in the darkness" and "the personification of the darkest uranium found at the center of the earth."[17] The characterization of the uranium as a child is particularly powerful when he explains how the settler desire for discovery affects him:

> Every child is scared of the dark, not because it is dark but because they know sooner, or later, they will be discovered. It is only a matter of time ... before someone discovers you and claims you for themselves. Claims you are you because they found you. Claims you are theirs because they were the first to find you, and lay claims on you ... Not knowing you've known yourself for thousands of years. Not knowing you are not the monster.[18]

Although the uranium is still in the ground at this stage, not yet having been fashioned by humans into a weapon of mass destruction, Ellul's concept of autonomous technology still applies. The uranium is a living organism that knows itself prior to and separate from any purpose it may be given by miners and scientists. The agency of the uranium is affirmed later in

[16] Ellul, "The "Autonomy" of the Technological Phenomenon," p. 430.

[17] Marie Clements, *Burning Vision*, (Burnaby, BC: Talonbooks, 2003), pp. 1, 4.

[18] Clements, *Burning Vision*, pp. 4-5.

the play when Little Boy says, "I want to go home,"[19] implying a strong connection between the uranium and the land where it was mined. Clements' personification of the uranium has a similar effect to Cameron's copper story — it emphasizes the dissonance between Indigenous and settler views of the agency of objects. In both cases, the object is, as Ellul says, "an end it itself,"[20] possessing free will that goes unnoticed by settlers.

AI and "Making Kin with the Machines"

Cameron and Clements both present a conflict between Indigenous and settler views of technology, but recent Indigenous scholarship suggests that a harmonious relationship between traditional Indigenous knowledge and modern technology is possible. A 2020 position paper on *Indigenous Protocol and Artificial Intelligence* brings together scholarly and creative works by Indigenous thinkers from around the world in order to imagine a future where all peoples live in harmony with their non-human relatives, both organic and digital. The ideas in this document are largely inspired by the 2018 essay "Making Kin with the Machine," co-authored by Jason Edward Lewis, Noelani Arista, Archer Pechawis, and Suzanne Kite. The authors advocate for the absorption of artificial intelligence — a key example of modern autonomous technology — into Indigenous worldviews and practices: "If we accept these beings as kin, perhaps even in some cases as equals, then the next logical step is to include AI in our cultural processes. This presents opportunities for understanding and knowledge sharing that could have profound implications for the future of both species."[21] This call for a reciprocal relationship between humans and AI is a possible solution to problems posed by previous Western conceptions of autonomous technology. Winner laments the oppositional nature of previous writings on autonomous

[19] Clements, *Burning Vision*, p. 31.

[20] Ellul, "The "Autonomy" of the Technological Phenomenon," p. 430.

[21] Lewis et al., "Making Kin with the Machines," p. 8.

technology; he speaks of a "law of the preservation of life at work… insofar as men pour their own life into their apparatus, their own vitality is that much diminished," explaining that "man now lives *in* and *through* technical creations" rather than being in constant competition with a separate entity that is technology.[22] It is this new relationship identified by Winner, living in and through technology, that is exemplified in "Making Kin with the Machine." Consciously or unconsciously, the authors fully embrace Ellul's notion that technology is an organism with its own individuality and desires, but they raise this organism to the status of a companion, rather than some sort of parasite or insidious force acting against humanity. They note that "Indigenous ontologies ask us to take the world as the interconnected whole that it is, where the ontological status of non-humans is not inferior to that of humans."[23] By accepting our kinship with artificial intelligence, both technology and humanity become stronger and more knowledgeable.

The idea of kinship with technology is explored extensively in *Indigenous Protocol and Artificial Intelligence*, and perhaps most literally in Lewis' piece "Quartet," which imagines a child raised by three artificial intelligences. This scenario, in which "the three AIs and the kid are in constant dialogue with each other to make decisions,"[24] intertwines humanity and technology even more tightly than Ellul does in his discussion of autonomous technology. For Ellul, "each technological element is first adapted to the technological system, and it is in respect to this system that the element has its true functionality, far more so than in respect to a human need."[25] In Lewis' piece, however, the AI "develops along with a specific child and his/her experiences,"[26] adapting to the human as well as the technological system. Thus, Ellul's

[22] Winner, *Autonomous Technology*, p. 34.

[23] Lewis et al., "Making Kin with the Machines," p. 12.

[24] Jason Edward Lewis, "Quartet", in Jason Edward Lewis, ed., *Indigenous Protocol and Artificial Intelligence: Position Paper* (Honolulu: The Initiative for Indigenous Futures and the Canadian Institute for Advanced Research (CIFAR), 2020), p. 73.

[25] Ellul, "The "Autonomy" of the Technological Phenomenon," p. 430.

[26] Lewis, "Quartet", p. 73.

definition of autonomous technology is only useful up to a certain point when considering the potential relationships between Indigenous peoples and new technologies such as artificial intelligence. Ellul and these Indigenous thinkers share the idea of technology as a living organism, but the work of Lewis and the other authors of the position paper imagines more reciprocity between artificial intelligence and human communities. Whereas Ellul wishes to emphasize the control that technology asserts over modern human society, the authors of *Indigenous Protocol and Artificial Intelligence* envision a world whose driving force is partnership between different entities, rather than control.

The ethical questions raised by technology are another point of comparison between Ellul's notion of autonomous technology and the Indigenous views of artificial intelligence expressed in the position paper. Ellul characterizes autonomy of technology as somehow existing outside ethics; "it does not tolerate itself being halted for a moral reason"[27] and "it is simply absurd to voice judgments of good or evil against an operation that is deemed technologically necessary."[28] In Ellul's opinion, "technology, judging itself, is now liberated from what was once the main check on human action: beliefs, (sacred, spiritual, religious) and ethics."[29] The autonomy of technology frees it from messy human ethical codes, allowing for theoretically infinite progress. A very different view of ethics in relation to technology can be found in a section of *Indigenous Protocol and Artificial Intelligence* entitled "How to Build Anything Ethically." Author Suzanne Kite uses the protocol for building a Lakota sweat lodge as an analogy for the development of AI. Both processes most be completed "in a Good Way," with

[27] Ellul, "The "Autonomy" of the Technological Phenomenon," p. 438.

[28] Ellul, "The "Autonomy" of the Technological Phenomenon," p. 438.

[29] Ellul, "The "Autonomy" of the Technological Phenomenon," p. 439.

"ethics that look Seven Generations ahead."[30] At each step of the building process, Kite invites consideration of environmental and community needs. She stresses that she is "not asking that you think of the computer as 'sacred', but to consider at which point one affords respect to materials or objects or nonhumans outside of oneself."[31] Here, technology does not exist outside of ethical codes, but within a complex ethical framework that takes into account the community stakeholders, the materials, and the purpose of the finished technology. As Hēmi Whaanga points out in his contribution to the position paper, consideration of the ethical implications of artificial intelligence is particularly important for Indigenous peoples so that AI "is not used to perpetuate societal biases, inequalities and global homogenization."[32] The imposition of Indigenous ethical codes on technology is not an attempt to oppose its autonomy, but a recognition of the power that autonomous technology holds, especially over traditionally marginalized groups. Rather than dismissing ethics as Ellul does, Indigenous views of autonomous technology confront its moral implications in order to pursue justice for the modern technological world.

Conclusion

As technological advances in the twenty-first century lead to increases in the power of technology, it is useful to consider diverse perspectives on the autonomy of technological objects and ask how they may shape human life. Cameron's analysis of the Inuit copper knife story and Clements's play addressing the mining of uranium on Dene territory show that the autonomy of technology, a concept articulated by Jacques Ellul in the 1960s, may have existed in the traditional knowledge of Indigenous peoples for much, much longer. Grounded in their long-

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[30] Suzanne Kite, "How to Build Anything Ethically," in Jason Edward Lewis, ed., *Indigenous Protocol and Artificial Intelligence: Position Paper* (Honolulu: The Initiative for Indigenous Futures and the Canadian Institute for Advanced Research (CIFAR), 2020), p. 75.

[31] Kite, "How to Build Anything Ethically," p. 75.

[32] Hēmi Whaanga, "AI: A New (R)Evolution or the New Colonizer for Indigenous Peoples?," in Jason Edward Lewis, ed., *Indigenous Protocol and Artificial Intelligence: Position Paper,* (Honolulu: The Initiative for Indigenous Futures and the Canadian Institute for Advanced Research (CIFAR), 2020), p. 37.

standing traditions, today's Indigenous scholars are exploring new ways to 'make kin with the machines,' a course of action that is becoming increasingly important as the human-technological divide continues to collapse. Not only do Indigenous views of the agency of technology help humans accept the autonomy of the technological phenomenon, as Ellul terms it, they are a crucial step on the path to a more ethical world for all who live in it. Many Indigenous views of technology, both traditional and modern, acknowledge the power of technology that Ellul identifies, and argue that humans can and must use that power for good, creating a harmonious partnership between humans and our technological relatives

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Scientific Atheism in the Age of Covid-19

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In his book entitled *The End of Science,* John Horgan shared an anecdote in which he was arranging an interview with Sir Karl Popper. He telephoned the London School of Economics and asked for directions to Popper's home. The secretary said that any taxi driver in the city would know where to find his house: "He's quite famous," she said. Horgan then confidently jumped in a taxi and asked to be taken to Popper's home to which the cab driver replied "who?" (Horgan, 35). This anecdote is telling of the divide between the elite and the ordinary citizen. The taxi driver would, of course, have had little opportunity or perhaps even inclination to research Sir Karl Popper. The assumption that his scientific renown would lead to public fame shows the disconnect between science and the everyday man. It is in this division between the scientific elite and the general population that a space has been provided for suspicion and distrust to grow. This essay will explore the breakdown of the trust in science as a way to examine the problem of dealing with the Covid-19 pandemic. This paper will explore the claim that science replaced God after secularization. If we continue with this hypothesis then the loss of faith in science is, in a sense, a new form of secularization. Using the work of Haraway, Horgan, Latour, and Feyerbend this essay will explore the way that scientific discourse has crumbled in the wake of the pandemic and the way that science is being discredited as the world moves towards a new "scientific atheism". My methodology will be to use articles and primary sources to consider how anti-scientific discourse has evolved in the pandemic. I am using the term "scientific atheism" to mean the loss of faith in science. This paper will be divided into three parts: first, it will examine the emergence of science and the idea of progress as an alternative to religion; second, it will look at the way in which science created its own elite

structure that undermined its credibility within both the academic community and within civil society; third, it will look at the rise of this "scientific atheism" within the context of the pandemic.

In the wake of secularization science became victorious over religion, taking its place in society as the highest power. Carl Schmitt considered Political Theology in his book of the same name. He claims that: "All significant concepts of the modern theory of the state are secularized theological concepts not only because of their historical development – in which they were transferred from theology to the theory of the state, whereby, for example, the omnipotent God became the omnipotent lawgiver" (Schmitt, 36). I posit that you could just as easily replace the term "omnipotent lawgiver" with "omnipotent science" and have the statement be just as pertinent and true. Science took the place of religion in the newly religiously secularized state. While Schmitt was talking very specifically about religious spirituality, not discrediting religion but explaining the way that law superseded the prominent religious narrative, it is still interesting to see the connection between a political theology and a scientific theology. In his dissertation "The Political Theology of Bruno Latour", Timothy Howles argues that:

> In the first essay of Political Theology, Schmitt draws attention to norms as generating (what he calls) a "monistic metaphysics". A few pages later, he refers to this as having the form of a "spirituality". This comment is crucial. It reveals Schmitt's belief that "systematic and methodical analogies" can be identified between the ideology of the modern liberal state and a concept of transcendence that is primordially associated with the Christian religion. For [Schmitt], the hypostatization of the legal order that takes place in the former is parallel to the hypostatization of the unity of nature in the person of the monotheistic God in the latter. This is why Schmitt diagnoses the modern liberal state, constructed on the basis of general norms, as having the form of "a secularized theological concept" (Howles, 82).

The modern state has moved away from an inherent overarching religion. However, Schmitt still sees religion in many aspects of modernity. Bruno Latour in his book *We Have Never Been Modern* considers how conceptions of modernity came about and curiously demonstrates Schmitt's political theory as he narrates the evolution of this secularization. As we see here science becomes embedded in philosophical constructions of the state:

> A fourth guarantee had to settle the question of God by removing Him for ever from the dual social and natural construction, while leaving Him presentable and usable nevertheless. Hobbes' and Boyle's followers succeeded in carrying out this task – the former by ridding Nature of any divine presence, the latter by ridding Society of any divine origin. Scientific power 'no longer needed this hypothesis'; as for statesmen, they could fabricate the 'mortal god' of the Leviathan without troubling themselves further about the immortal God whose Scripture was now interpreted only figuratively by the Sovereign (Latour, We Have Never Been Modern, 32-33)

Thus, we see the way that God was made separate from the narrative of civil society and nature. What develops post Hobbes is the beginning of the emergence of capitalism philosophically supported by people like John Locke and Adam Smith. The idea of progress underpins capitalism, a pursuit for greater efficiency and better products. Karl Marx considers the move from human to machine production in his book *A Critique of Political Economy*. He claims that: "The tool or working machine is that part of the machinery with which the industrial revolution of the 18th century started. And to this day it constantly serves as such a starting-point, whenever a handicraft, or a manufacture, is turned into an industry carried on by machinery" (Marx, 262). This quote shows the way that human labour has been turned into machine labour in the pursuit of greater efficiency and imagined liberation. As many scholars have shown, such as Karl Marx, Adam Smith and, more recently, Dipesh Chakrabarty, capitalism and liberty have been linked and scientific progress has been part of this social construction of freedom. In John Horgan's *The End of Science* he cites Gunther Stent's book *The Paradoxes of Progress* in which Stent says: "In

the wake of the publication of Darwin's *On the Origin of Species* […] the idea of progress was raised to the level of a scientific religion…. This optimistic view came to be so widely embraced in the industrialized nations… that the claim that progress could presently come to an end is now widely regarded [to be] as outlandish a notion as was in earlier times the claim that the Earth moves around the sun" (Horgan, 22). The West venerated science in a way that turned it from a discipline to an omnipotent truth. Horgan describes this as: "the science-is-infinite creed" (Horgan, 22). Like Schmitt's political theology, on this basis we can see how science elevated itself to a new religion.

If science was able to reach this reverential state how is it that it is now being knocked off of its pedestal? In Jayson Harsin's "Post-Truth and critical Communication Studies" paper he claims that: "Critical scholarly attention to shifts in public knowledge or belief and trust have been developing since the turn of the millennium" (Harsin, 6). This shift towards post truth and distrust of widely held beliefs has been a slowly growing movement in the West. Andrew G. Selepak notes in his paper, "Exploring anti-science attitudes among political and Christian conservatives through an examination of American universities on Twitter", that in the United States: "Political polarization in the United States has intensified in recent years impacting more than elections and public discord […] Moreno […] articulates the troubling idea that some Americans distrust scientists not based on their scientific findings but because of perceived political partisanship on the part of the scientists" (Selepak, 2). This phenomenon is striking because it shows the way in which science has lost the trust of the general public. Selepak goes on to say that "this was not always true":

> From the 1970s through the 1990s, American liberals and conservatives trusted science, and scientists, at roughly equal levels, but since the 1990s, while liberals' trust in science has gone up, conservatives' trust has gone down […]. This disparity

> has increased in recent years as Republicans have moved more to the political right in their beliefs, coinciding with an anti-science sentiment, leading to condemnations of science and higher education among some Republicans […] (Selepak, 2).

While Selepak points to Republicans as being responsible for this trend, Ian Hacking points out that the social constructivists were attempting to tear down science long before this. Hacking claims that: "But most people who use the social construction idea enthusiastically want to criticize, change, or destroy some X that they dislike in the established order of things" (Hacking, 7). However, in regard to this newer anti-science movement Selepak's comment remains important. This claim then leads to a consideration of how this distrust became so widespread, especially among the Christian right.

I would suggest that we need to examine what was going on in the scientific community itself in order to understand how it lost the faith of the public. Among many reasons there are at least three avenues of inquiry we can explore: first, the rise of critical theory about the scientific community; second, the breakdown of civil society in which the focus on individual liberty outweighs the collective good; and third, the inability of scientists to communicate with the general public in a way that was accessible and did not treat non-scientists as uneducated. The rise of critical theory within science shows the way that scientists themselves were questioning their purpose. Helene Sorgner considers the work of Paul Feyerabend, Harry Collins, and Robert Evans in her essay. She considers these thinkers' work on politics and science. In that work she makes the claim, using Feyerabend, that science is built on uncertain foundations:

> Nevertheless, Feyerabend complains, has the "assumption of the inherent superiority of science" moved beyond science and become "an article of faith for almost everyone" […]. Science is now even "part of the basic fabric of democracy just as the Church was once part of the basic fabric of society" […]. However, the superiority of science cannot even be established by its own means: First, because "there is no single procedure, or set of rules that underlies every piece of research

> and guarantees that it is 'scientific' and, therefore, trustworthy" […]. Second, the results achieved in scientific research do not prove its excellence for two reasons: Science's sovereignty today was not achieved by fair competition but by colonization and suppression of non-Western cultures […], and "there is not a single important scientific idea that was not stolen from elsewhere" […]. These considerations may be summed up as following: *F1) Compared to other traditions, science does neither provide a superior method nor superior results. There is no special value to scientific standards and no special authority to scientists' advice* (Sorgner, 115).

Theorists within the scientific discipline began having these conversations about the role of science and whether science could actually claim some kind of moral authority. Much of Western scientific thought is taken and appropriated from other cultures, placing it on colonial foundations from which it cannot be separated. During colonization, western belief was imposed on other cultures in order to create a dominant narrative of western dominance. This colonisation creates a culture of supremacy within science. It is the job of academics to have this discourse about the foundations of their thought and the way that it came to be. Further, Feyerabend points out how science has gained the same status that the Christian church once had. Donna Haraway argues in her article "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective" that: "The only people who end up actually believing and, goddess forbid, acting on the ideological doctrines of disembodied scientific objectivity-enshrined in elementary textbooks and technoscience booster literature-are nonscientists, including a few very trusting Philosophers" (Haraway, 576). Therefore, the fundamental associations of an inherent, true, and objective science are the ideal and not the actuality of the discipline. Considering the critical theory and conversation among scientists the question of how this conversation broke down must be examined.

The civil conversation around science has not been able to continue in the way that it was originally conceived. That is to say, the ability for civil disagreement and discourse has been lost within the academy. In Ava Kofman's article "Bruno Latour, the Post-Truth

Philosopher, Mounts a Defense of Science" she cites Latour, discussing the way that this breakdown occurred within the discipline:

> I think we were so happy to develop all this critique because we were so *sure* of the authority of science," Latour reflected…[…]. "And that the authority of science would be shared because there was a common world. Even this notion of a common world we didn't have to articulate, because it was obvious," he continued. "Now we have people who no longer share the idea that there is a common world. And that of course changes everything (Kofman, 2).

Clearly this was not necessarily the aim of critical theory, to destroy scientific authority, but to have a conversation. However, if critique has run out of steam as Latour believes it has then the academy has lost the ability to have these kinds of broad conversations about the problems and inaccuracies in science. If there can no longer be critical thinkers within scholarship, then the way that other understandings and ways of knowing have been invalidated makes more sense in this larger story of a post-religious state looking for an absolute.

If civil discourse has broken down within the academy and scholars can no longer properly disagree and articulate the roots of their own belief systems, it is no wonder that the general public has felt the need to shift away from a complete trust in science. That is to say that, if we proceed on the hypothesis Latour presented that critique has run out of steam and that scholars can no longer disagree in a civil manner then, it is no wonder that an academy in turmoil would not inspire faith in those outside of the institution. The breakdown of discourse is, in large part, the driving narrative in the anti-science movement. John Horgan, citing Oswald Spengler, discusses the way that religion may once again become part of the dominant narrative as science becomes less accessible and more alienating: "As scientists become more arrogant and less tolerant of other belief systems, notably religious ones, Spengler declared, society will rebel against science and embrace religious fundamentalism and other irrational belief systems" (Horgan, 23-24). The removing of science from its dominant position within society has led to a

resurgence in religious fundamentalism as people look for an absolute upon which to ground their existence. The breakdown of communication also comes from the inability of scientists to communicate their ideas with the public, whether that be from arrogance or from a perceived distance between scientists and non-scientists. Alison Smith considers this inability to communicate in her article “"Wow, I didn't know that before; thank you": How scientists use Twitter for public engagement”. She discusses the divide between the scientist and the public:

> A shift to dialogue in science communication also requires that those who communicate conceptualise publics in a more "sophisticated" way, acknowledging the knowledge, values, attitudes and beliefs that they bring to more "symmetrical and interactive exchanges" […]. However, there exists a large qualitative literature that suggests scientists have a range of negative views about the public; almost universally scientists agree the public are inadequately informed, uninterested in becoming more so, and furthermore that they are irrational, emotional, and stubborn in the face of new evidence […] (Smith, 325).

Therefore, it is little wonder that the public is growing more alienated by science as they as made to feel stupid and ill-informed by those in a position to educate them. Smith goes on to argue that:

> In the context of calls for scientists to engage with the public, science blogs have been recognised for their ability to create dialogue, but to date expectations have not been met. […] How then do scientists understand their use of Twitter for science communication? When it comes to expert thinking on the public, we start with the idea that scientists are likely to take a rather dim view of the public. […] Online, the audience seems both limitless and unknowable, and it is difficult if not impossible for users to vary self-presentation strategies for different groups. […] users of social media are able to determine to a considerable degree which communicative function their activity can realise, and how accessible it will be to non-scientists; therefore the importance of scientists' assumptions about the process they are involved in and the people they are communicating with cannot be underestimated […] (Smith, 326).

Alienating and underestimating the reader can greatly impact their willingness not only to trust but to listen to scientists. The creation of true dialogue would hopefully make people feel less

alienated from a discipline which typically treats them as stupid. Scientists seem to miss that it is not just about imposing ideas, but it is about a larger conversation. The rise of anti-elite sentiment therefore is driven partially by the way that academics present themselves and interact with the general public. If they view themselves as superior it is no wonder that there has been a growing disconnect between academics and non-academics.

With this growing breakdown of both academic and non-academic discourse in mind the growing anti-science sentiment coming out of the Covid-19 pandemic becomes clearer. This divide is not a new phenomenon, instead it has been a slowly growing movement which was exacerbated by the circumstances of the pandemic and has led to a rise in what this essay will call scientific atheism. Scientific atheism is the loss of a mass belief in or trust in science, further it represents the way that institutions such as the government are rejecting or abandoning science in pursuit of voter approval. Making science extraneous to public policy, something that gets in the way of governmental goals, creates a distrust in science. The anti-elite conceive of science as an elite discipline which works towards greater oppression and disenfranchisement. Bruno Latour discusses the failure of science to become truly knowable by non-scientists. He considers the question of whether critique has run out of steam particularly between academics and within scholarship:

> The mistake would be to believe that we too have given a social explanation of scientific facts. No, even though it is true that at first we tried, like good critics trained in the good schools, to use the armaments handed to us by our betters and elders to crack open—one of their favorite expressions, meaning to destroy—religion, power, discourse, hegemony. But, fortunately (yes, fortunately!), one after the other, we witnessed that the black boxes of science remained closed and that it was rather the tools that lay in the dust of our workshop, disjointed and broken. Put simply, critique was useless against objects of some solidity (Latour, 242).

There is a particular character about the pandemic which has really exemplified what Latour is identifying in his article. He is saying that we simply do not have a capacity to talk anymore, science itself may not be destroyed but the tools of science are no longer applicable. Emilio Ferrara considers in his article "What Types of Covid-19 Conspiracies are Populated by Twitter Bots?" the way that misinformation and fear has been disseminated: "COVID-19 is a global crisis and with people being pushed out of physical spaces due to containment measures, online conversation on social media becomes one of the primary tools to track social discussion. In fact, topics of conversation related to COVID-19 have been trending, uninterruptedly or so, ever since the beginning of the outbreak in early 2020" (Ferrara, 17). This quote is significant because it exemplifies a particular feature of the pandemic: isolation. Isolation has led to greater alienation. Social media allows for people to seek out opinions and theories which validate their own beliefs without the same dialogue that would happen in interpersonal relationships or conversations. Therefore, the fact that the public already distrusted the communication styles of prominent scientists and felt alienated by those perceived to represent the elite led to this greater rejection of Covid safety measures that we are currently seeing. Science is going through a rapid secularization as the public loses trust in it and the government devalues it in favour of public policy and economic interests.

Understanding the way that science became the dominant ideal, replacing religion; how it broke down within its own community; how that breakdown led to a loss of trust; and the way that the pandemic exacerbated the issue allows for a greater understanding of those people who reject science. It is easy to write-off anti-scientists as less than or that their opinions should not be recognized but that is exactly how anti-science arose. Instead, understanding alienation and fear gives science, perhaps, the chance to change course and draw in all kinds of people to its

study. However, until we can rebuild civil society this distrust will likely only continue to grow and lead to further scientific atheism.

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