Hallucinations and the evolving symbiosis of humans, machines, and algorithms, as synthetic selection shapes evolution.

The cautionary tale of Thomas Midgley Jr. underscores a profound warning about the unforeseen consequences of unbridled technological advancements and hype surrounding artificial intelligence. Midgley, celebrated in his time for developing leaded gasoline and Freon were hailed as monumental achievements. Yet, it wasn't until decades later that the catastrophic effects of lead exposure and ozone depletion became widely understood, leading to millions of deaths annually and long-lasting environmental degradation. His story highlights the dangers of unchecked technological optimism, particularly when profit-driven motives overshadow ecological and ethical considerations. [1]

We have all breathed smog, which is part of a car centric speed culture in many US cities. As a bike rider, I often feel like I am breathing someone else's desire for speed. Likewise, air conditioning comforts those within the cool bubble—however, those outside the AC envelope experience hotter and more humid temperatures as a result, and AC systems have an added nightmare. Freon's depletion of the Earth's protective ozone layer leads to an alarming prevalence of skin cancers, affecting one in five Americans during their lifetime and contributing to approximately 66,000 deaths globally each year.

Andrea Polli Cloud Car, 2011 a car fitted with special effects equipment that produces a cloud of mist, enveloping car, and rider.

While leaded gasoline has been phased out, it is still estimated to cause 900,000 deaths annually by the Health Policy Watch. [2]

Kim Abeles, 30 Days of Smog made of smog as material, materializing the reality of the air we breathe makes a strong statement about the layers of car-based suit that pervades our environment, while creating artistic reminders of how this impacts our lungs.

Andrea Polli and Kim Abeles are artists whose work explores the intersections of art, science, ecology, and environmentalism. Andrea Polli focuses on climate change and environmental data, translating complex scientific information into immersive installations and digital media to foster public understanding and engagement. Her works, like *Particle Falls*, highlight air quality issues and the urgency of environmental action. Kim Abeles is known for her socially engaged art that incorporates smog and natural materials to create pieces reflecting urban ecology and environmental impact. The work *Smog Collectors* underscores human responsibility with environmental degradation while inviting dialogue on sustainability and coexistence with nature. Both artists exemplify how creative practices can inspire awareness and action in addressing ecological challenges surrounding unbridled optimism of technologies.

We must critically evaluate both the present and future implications of AI technologies, including the hype surrounding large language models (LLMs) and deep learning systems like AlphaFold 3. While LLMs are designed to process and generate human-like text, AlphaFold 3 uses deep neural networks to predict the 3D structures of proteins based on their amino acid sequences, addressing challenges in biology. Artists play a crucial role in these discussions, as their critical perspectives can uncover both the troubling downsides and the innovative potential of these technologies. Through their work, they explore and highlight the profound impacts of these advancements on the more-than-human world. AI-based AlphaFold 3 represents a significant step forward in understanding biological processes. It holds great promise to advance medicine and drug discovery. Still if offers hope that AI can be used to model biological systems and use the technologies to solve some of the challenges of living in a fossil fuel economy.

Does AlphaFold offer the potential to create innovative biological entities capable of addressing large-scale environmental challenges by modeling nature's recycling abilities? Or does it risk introducing artificial protein-based entities, derived from limited data, into complex ecosystems, potentially leading to unforeseen consequences?
In this context, artists play a crucial role by inventing new initiatives and spearheading movements that foster dialogue on how to heal ecosystems. Their conceptual explorations often offer solutions inspired by the inherent robustness of natural living systems and their capacity for self-propagation. Unlike market-driven forces that can constrain intellectual inquiry, artists are free to imagine and create alternative futures, pushing the boundaries of thought and innovation.
All living systems co-evolve in harmony, forming an interconnected web of life guided by the laws of physics and natural time. Mutualistic evolution fosters a balance among species, creating intricate relationships that include both parasitic and symbiotic dynamics. While AlphaFold 3 holds tremendous promise for designing new proteins, it also introduces risks that require careful management, testing, and isolation. On one hand, AlphaFold advances the study of viral infections, aiding in drug design and other breakthroughs; on the other hand, it enables the creation of novel viruses capable of infecting eukaryotic and prokaryotic organisms, potentially threatening humans, animals, and plants. At the same time, its potential to control pests and pathogens offers significant benefits, but its development and application must be approached with caution.

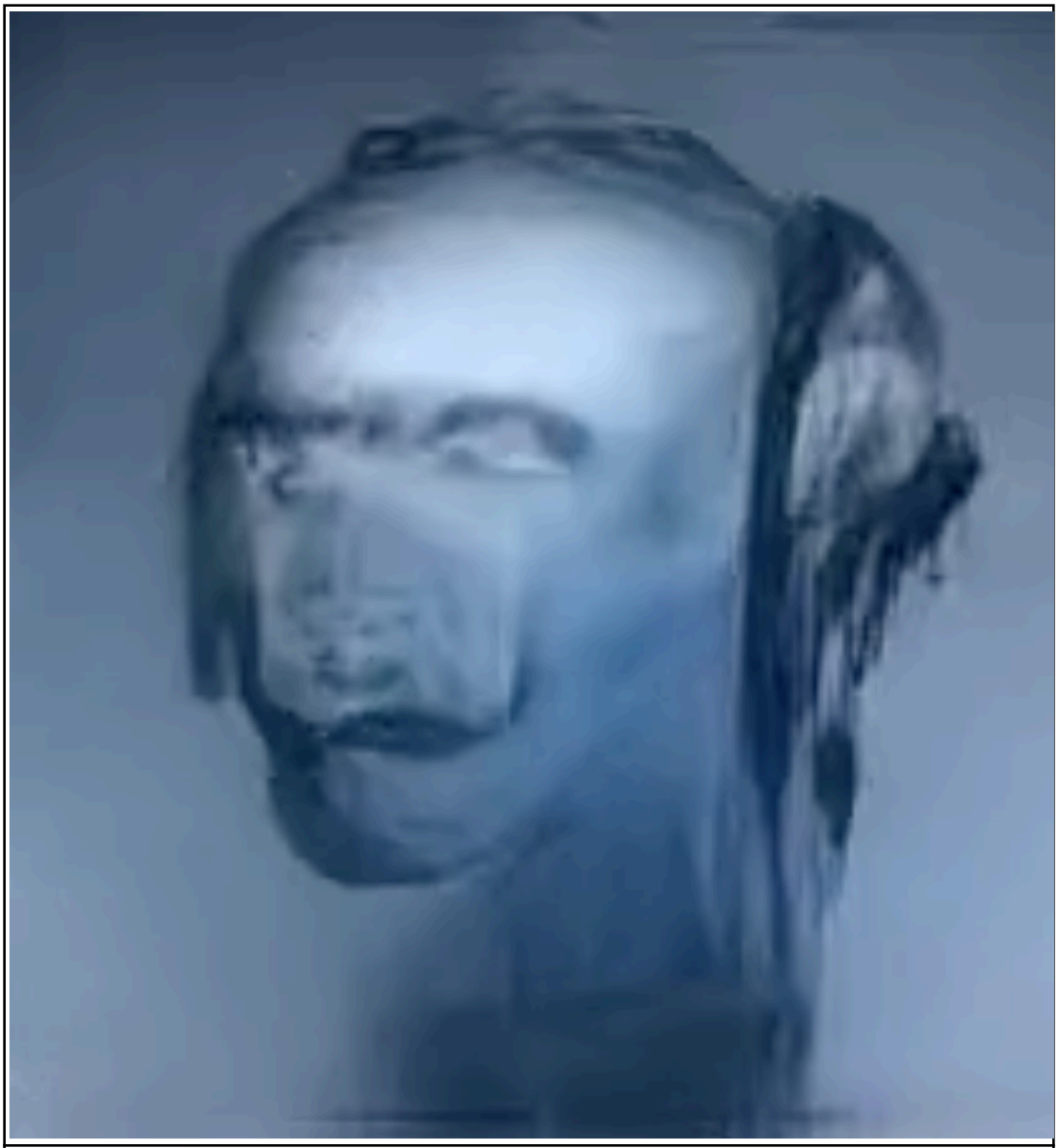
Historical lessons, like Midgley's "innovations", once hailed as progress, remind us that AI and other advanced technologies may have unforeseen, long-term consequences. This necessitates a cautious approach—balancing the immediate benefits of AI against its potential broader ecological and social consequences. At the same time, AI provides artists with powerful tools for ideational and visual exploration, offering innovative forms of synthetic perception that hold transformative potential and cannot be overlooked.

CrossLucidZone: it's-not-a-mirror-but-a-window AI generative work.

CrossLucidZone, established in 2018, is an artist collective known for its evocative and colorful AI-generated works that challenge traditional perceptions of technology and art. Described as

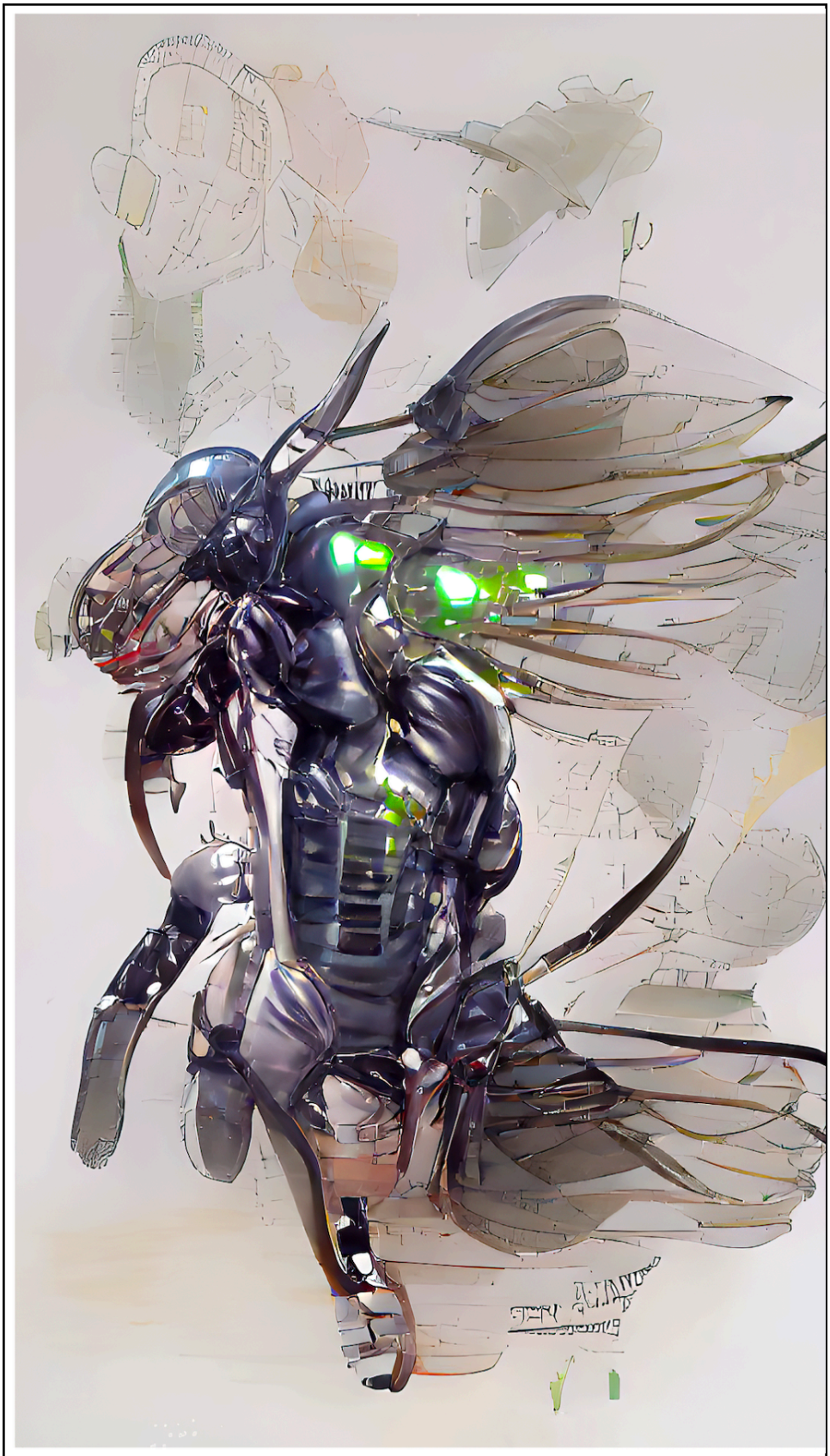
"not-a-mirror-but-a-window," their projects emphasize cross-disciplinary collaboration and co-evolution with AI, exploring how technology can create entirely new forms of expression rather than merely reflecting reality. This approach is critical to AI as it pushes the boundaries of generative systems, demonstrating their potential to inspire creativity, foster interdisciplinary innovation, and provoke deeper conversations about the human-machine relationship in art and culture.

Hallucinations: The ability of large language model systems in artificial intelligence (AI) to "hallucinate" makes them fascinatingly engaging, as they emulate biological systems more closely than anticipated. Rather than being limited to achieving visual or data accuracy, these hallucinations can be seen as an inherent and potentially beneficial feature of AI, particularly in the realm of artistic creation. For instance, in the human brain, structures like the fusiform gyrus are designed to recognize faces, leading to pareidolia—a phenomenon where we perceive faces in clouds, rocks, or other inanimate objects. This concept has been beautifully explored by artist Pierre Huyghe, who pioneered the use of AI in his intricate systems-based installations.



Pierre Huyghe, Serpentine Gallery in 2018, Huyghe exhibited videos that showed a flickering procession of vaguely figurative, half-formed images revealing an AI / human pareidolia.

This inclination for hallucinations isn't a neural flaw. Instead, it's a sophisticated feature—an evolved predisposition—rooted in the brain's architecture.



Ken Rinaldo 2022, Insect Human Cyborg an AI-manipulated print from an original drawing, that tends toward figuration, based on the AI models' predispositions.

This "neural algorithm" optimizes our chances of recognizing faces and human bodies, a vital skill for social interaction and survival. Still, systems that abstract reality from flawed data sets also present an issue when it comes to using AI for surveillance and policing, and the tendency for AI to reveal the

hidden racial bias that already exists in culture, amplifying rather than eliminating cultural biases. Similarly, AI hallucinations can be seen as an advanced form of pattern recognition, where the system explores the fringes of its programmed understanding, sometimes producing unexpected, artistic, and imaginative results. AI systems are transforming technology by closely mirroring these biological processes. They excel in finding patterns amidst vast, seemingly random data, making decisions, and simulating potential solutions.

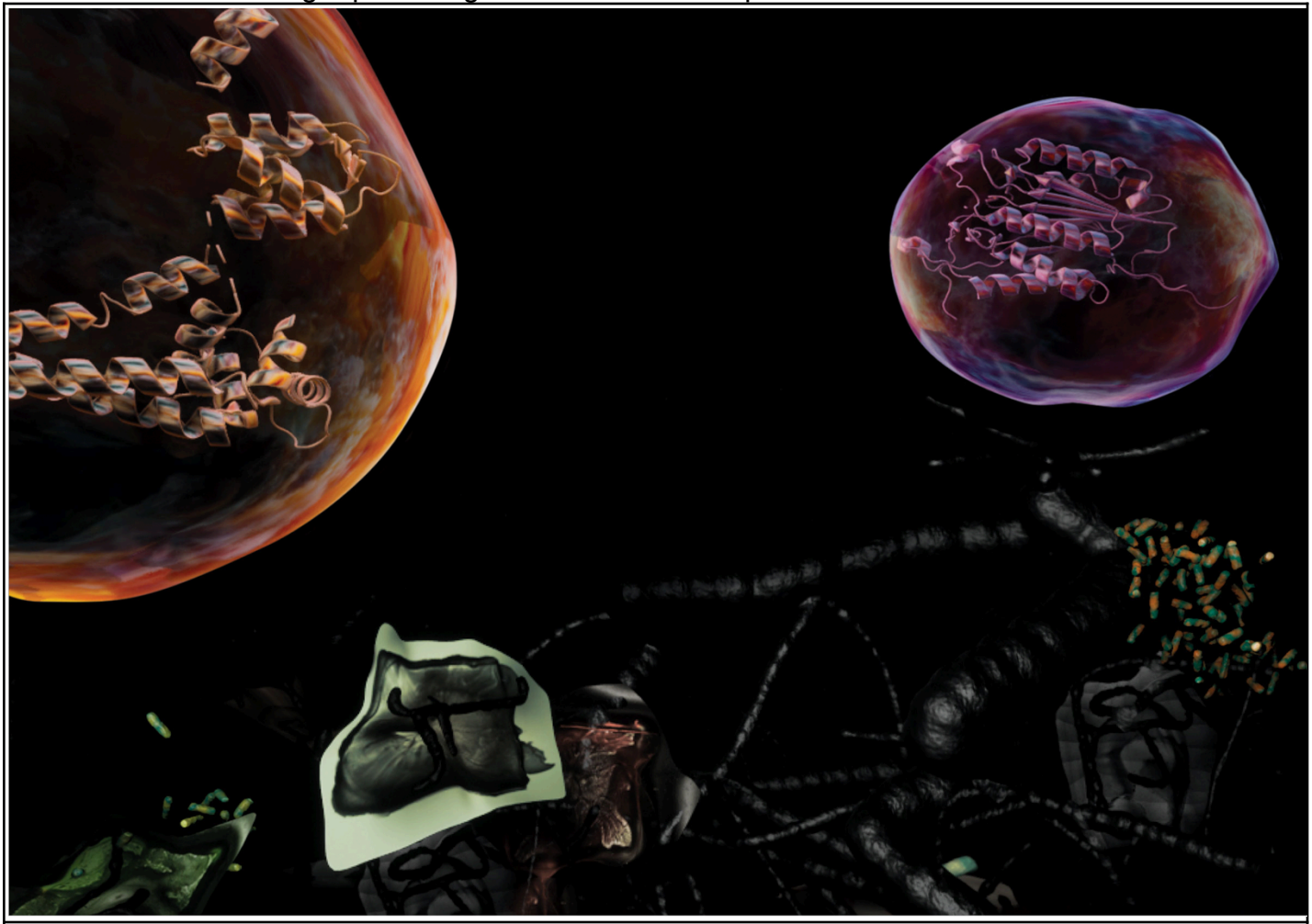
This unique ability signifies a transformative era in our capability to discern previously unnoticed connections within the overwhelming noise of information. I am most excited that it may allow us to decode cetacean (Whale) languages and understanding other species' modes of communication, holding great promise for developing a more sustainable future of acknowledging and respecting the more-than-human other. This is an area where art and science can collaborate and one that excites me the most given the promise of transspecies communication.

Other promising developments in AI is its potential in medical diagnosis. Cybil cancer diagnosis is a prime example of how AI can be a powerful tool in the fight against disease. AI-assisted medical imaging systems significantly enhance diagnostic accuracy, reducing error rates by up to 30% while relying on human expertise for context and decision-making. [4] Take the complex task of interpreting neural signals for prosthetics as an example; at the interface where the prosthetic attempts to mimic the natural movement of a limb, the neural signals are often interwoven with a significant amount of noise. Traditionally, parsing through this "noise" has been highly challenging. Yet, AI has now made it possible to filter these signals with remarkable precision, enabling more accurate interpretation and control of these neural signals. It's important to understand that this noise isn't a defect; it is an intrinsic aspect of how neural systems have evolved, shaped by evolutionary pressures and morphogenetic development.

This process of noise filtration by AI is analogous to how large language models process data. By sifting through enormous datasets and isolating relevant information, AI provides real-time, sophisticated analyses, revealing patterns once obscured by noise. In doing so, AI moves closer to becoming a biologically mimetic system, with its decision-making processes and problem-solving abilities mirroring the complexity and adaptability of living organisms. Like the human brain, AI doesn't just process information passively; it engages in a dynamic exploration of possibilities, including generating creative, albeit sometimes hallucinatory, outputs.

This intersection of technology and biology heralds a new era of inquiry-based discovery and AI artmaking. AI's ability to replicate and extend biological systems' pattern-recognition capabilities opens novel ways to interact with and understand the world. Just as our brains interpret and sometimes creatively misinterpret sensory input to make sense of our surroundings, AI's "hallucinations" can lead to innovative insights, providing a powerful tool that transcends the limitations of both biological and machine-based intelligence.
Endosymbiotic relationships in biology refer to a symbiotic relationship where one organism lives inside another, often to their mutual benefit. This concept is exemplified by the theory that mitochondria and chloroplasts in eukaryotic cells originated from free-living bacteria that formed a symbiotic relationship with early eukaryotes. These bacteria were engulfed by the host cell, providing it with energy while benefiting from protection and access to nutrients. This theory is central to the understanding of the evolution of complex life.
Similarly, human-AI relationships can be seen as evolving into a form of "techno symbiosis," where humans depend on AI to enhance their cognitive capacities—whether in decision-making, artistic creation, language processing, or medical diagnostics. Simultaneously, AI systems are continuously shaped and improved through human input and interaction, creating a mutually influential relationship.

Laura Splan's artworks explore the intersections of science, technology, and the human body, blending intricate aesthetics with conceptual depth to examine the unseen and overlooked. Her philosophy emphasizes revealing hidden systems and narratives, often transforming biological and scientific data into thought-provoking visual and tactile experiences.



Linda Dement & Laura Splan 2024, in collaboration with the Cardiovascular Regeneration Group at UTS interactive immersive 360° installation with 16-channel spatial soundscape interactive environment production by Michael Bullo. “Bloom” both visualizes and connects material aspects of failure and success from the scientific research process.

Experiencing these works, I am stunned by their profound beauty, and yet I feel guilty about the energy-intensive processes and the infrastructure required, to support such advancements. The long-term negative impacts on our planet may be equivalent to the widespread pollution caused by leaded gas, and ozone-depleting Freon.

Human coevolution with technology can be observed in how we adapt to technological advancements and how these technologies evolve in response to human needs and interactions. As humans integrate technologies like AI into everyday life, there's a constant feedback loop where, human behaviors and perceptions shape AI systems. AI, in turn, influences human decision-making, perception, and even societal structures.

This coevolution reflects the growing interdependence between biological and technological systems, much like the symbiotic relationships found in nature. In this sense, humans and AI enter a symbiotic relationship where technology extends human abilities, like endosymbiosis in biological evolution.

Still, because of a massive difference in how these systems arise, we must be more aware of

dangers ahead. Bottom-Up Vs Top-Down.

Bottom-up: In biological systems, bottom-up modeling refers to how complexity emerges from simple building blocks through evolutionary processes fundamental to the laws of physics. In the case of DNA, the molecular structures give rise to all forms of life through cumulative, adaptive changes in response to actual physical laws, environmental material, and coevolved information. DNA encodes the rules for how proteins fold and how cells function, and from this "bottom" level, all biological complexity (phenotype, behaviors, ecosystems) emerges.

Ken Rinaldo, The Opera for Dying Insects, 2017. Cameras connected to artificial intelligence software, view the inside of the constructed ecosystem, and compose a tragic opera based on their movements to speak to the insect apocalypse where insects have declined worldwide by 40%

The bottom-up nature of biological systems allows for emergent properties—unpredictable new characteristics or functions arising from simpler components' interactions. Life and evolution operates on these bottom-up principles, where small mutations or variations in DNA or epigenetics can lead to new adaptations and capabilities. The interactions of genes, proteins, and environmental factors create highly dynamic ecosystems capable of self-organization and complex ecologically sound behaviors. Furthermore, biological systems degrade and become sustenance to other beings, such as detritivores that obtain nutrients by consuming detritus. These detritivores contribute to decomposition and the nutrient cycles in natural ecosystems. The author Rinaldo has posited that detritivorous could replace the word humane, as eating only dead detritus makes them the most ecologically kind and humane beings, recycling our planet's green detritus.

Top-Down: On the other hand, top-down structures, such as that seen in AI and large language models (LLMs), work by starting with an overarching goal or dataset and applying mimetic algorithms to discern patterns, make predictions, or generate outputs. In the case of LLMs, top-down refers to how the system is designed with specific objectives (e.g., text generation, problem-solving) and is trained using massive amounts of data. The AI doesn't evolve through random mutations and natural selection but through supervised learning, where algorithms are adjusted to better fit predefined

tasks.

The real danger lies in a market-driven economy, and Silicon Valley's maxim, "move fast and break things," and it echoes this Midgley moment, where profit is seen as the only concern, and the earth and its living systems are dammed. Sadly, AI systems do not degrade naturally, becoming part of an ecosystem, and instead contribute to environmental degradation to generate profit and wealth. This is true for the material components of AI-based systems, their manufacturing processes, and the toxic metals and materials they leave in their wake, often for third-world countries who deconstruct for minimal wages. It is also true for misinformation, where AI-generated content and viral memes can spread quickly on social media, creating an epidemic of misinformation and fear.

The bottom-up approach inherent in natural living systems fosters complexity through unpredictable processes driven by random mutations, environmental pressures, and natural selection. This dynamic interplay has given rise to the exquisite and diverse forms of life that we see on our planet today and I call on all AI companies, to protect and celebrate that life, by proceeding with caution.

Top-Down Toxins: Although we can create exotic chemicals and materials through complex manufacturing processes for commercial purposes, this does not mean we permanently should—particularly when these processes can harm life. Consider the example of plastics and oil and the widespread environmental nightmares they have triggered. Approximately 85,000 chemicals are in use, with new ones continually entering the market. Yet only a tiny percentage of these chemicals have undergone thorough toxicity testing, leaving a significant gap in understanding their impacts. For instance, PFAS (per- and poly-fluoroalkyl substances) is found in the blood of 98% of Americans tested, and recently, research has revealed a connection between PFAS exposure and kidney damage, linked to the dysregulation of the gut microbiome—a community of bacteria and other microorganisms essential to the digestive system and our health.

AI and LLM models operate based on predefined architectures and objectives. Even though AI can "discover" new patterns or insights, the scope of input data broadly frames these discoveries through the system's materiality and architectures. In other words, AI isn't evolving in the same sense that biological systems evolve—it is constrained by its top-down design and the processes by which we create them. Sadly, AI systems, when operating within this top-down paradigm, reflect the values and goals of the corporations that control them, which are primarily profit-hungry stockholders.

When these corporations prioritize profit and market dominance over ethical or ecological considerations, narrow commercial constraints stifle the potential for genuinely emergent, ecologically based AI intelligence. While sometimes creatively generative, AI hallucinations may also reflect the biases, blind spots, or inaccuracies inherent in the data sets used for training. When these hallucinations serve the interests of consumerist AI development, they risk reinforcing harmful social norms, perpetuating disinformation, or promoting exploitative practices.

The potential dangers to naturally intertwined ecosystems are substantial when AI development is driven primarily by extractive capitalist practices. If AI technologies are designed to maximize data extraction and increase consumer dependence, they will exacerbate ecological crises, social inequities, and systemic injustices. This is particularly concerning as AI systems continue to gain influence over critical infrastructure—whether in agriculture, healthcare, news delivery, or environmental monitoring.

The ecological and societal consequences of AI systems under extractive capitalism or technocracy may include resource depletion and the massive computational resources required for training and deploying AI models, contributing to energy consumption and environmental degradation. According to one study, the carbon footprint of training a single AI model can be as large as five times the lifetime emissions of an average car.

While most of the oxygen we breathe is created by algae, each day, our oceans absorb the heat equivalent of 604,800 thousand Hiroshima bombs (Seven per second), and the public further wonders why hurricanes and rains increase in severity each year.
Bill Gates and other tech giants restart nuclear reactors (Three Mile Island) without public discussion to power AI systems. This is one example of how policy changes are afoot rather than building technologies harmonizing with nature and human communities. Surveillance capitalism and AI tools already profit by exploiting user data and reinforcing systems of surveillance, all while reducing individual privacy and autonomy. As AI tools become integral to decision-making processes, they may further exacerbate the inequality of individuals and communities most affected by their outputs, who may have the least control or influence over how these systems are designed and used.

Katherine Behar, "Buffering" is part of "Modeling Big Data," a series of four videos in Behar embodies "big data." Big data is any set of data that is too big for human comprehension and must be processed by computer.

Katherine Behar's *Buffering* is part of her video series *Modeling Big Data*, in which she critiques the overwhelming nature of big data—datasets so vast they surpass human comprehension and require computational processing. Through the portrayal of an "obese data body," Behar visualizes the cyclical overproduction and excess inherent in computer culture, highlighting how it leads to a glut of information that both traps and overwhelms. Her work questions the cultural obsession with data hoarding, exposing its unsustainable and self-defeating consequences.

The amygdala is a cluster of almond-shaped cells located at the base of the brain, responsible for regulating emotions and encoding memories. In survival situations, the amygdala is highly beneficial, helping us react swiftly to danger. However, this exact mechanism can also contribute to mental health issues, such as PTSD. One common phenomenon is an "amygdala hijack," which occurs when the amygdala overrides more rational brain functions, leading to an intense emotional response. In such moments, individuals may react with disproportionate physical or emotional intensity, far exceeding the actual threat posed by the situation. In today's world, especially with the advent of social media and the polarizing far-left and far-right news cycles, the amygdala is constantly bombarded with stimuli designed to capture attention. These isolated echo chambers shape how we interpret information and fuel emotional responses, often in extreme ways. AI algorithms, which drive

much of this content, exacerbate the issue by continuously reinforcing fearful worldviews, keeping users' attention for commercial gains.

An analogy for how this operates can be found in nature, with starling murmuration's—large, synchronized flocks of birds moving together for survival. Memes and narratives, like these murmuration's, serve as collective cultural survival mechanisms, spreading ideas and values that resonate within society.

However, when subject to an amygdala hijack, these cultural patterns can become distorted, perpetuating divisive or harmful behavior, and allowing social media and recursive news cycles to exploit feat to attract viewers. Another relevant analogy is the "phantom limb" phenomenon, which was studied by Dr. Ramachandran, who proposed that phantom limb sensations in humans might result from the reorganization of the brain's somatosensory cortex. When a person with an amputated limb looks in a mirror at their intact limb, the reflection can trick the brain into believing the missing limb has returned. Similarly, the information we consume often creates a distorted reality that feels real but merely reflects selective data tailored to our biases and emotional vulnerabilities. In both cases, whether through amygdala hijacking or manipulated information, the lines between perception and reality blur, leaving us vulnerable to influences that can skew our understanding of the world.

Bottom-up Natural Cures: To avoid the pitfalls of a market-driven AI ecosystem, we must envision and build technologies that foster genuine symbiosis between natural systems cycles, humans, and technological systems. This symbiosis would focus not on short-term profit but on long-term, ecologically integrated, and ethically sound goals and artists and researchers are showing us how.

AI could play a critical role in supporting regenerative systems. Fungi and forests are great models here, and research into fungible computing, as exemplified by Dr. Andrew Adamatzky and his work with fungi Basidiomycetes, offers hope for computer processing systems that someday may reach an ecological pinnacle of symbiotic relationships with natural living systems. Inspired by the underground mycelium networks of fungi, which transfer nutrients across forests, these networks offer a vision for future AI systems that are ecologically integrated and sustainable. Like fungi, such systems would operate within natural cycles, benefiting from decentralization and symbiosis rather than relying on resource-intensive, extractive processes.

Artist professor Amy Youngs pioneers the world of decomposition ecologies, a field dedicated to transforming organic materials into nutrient-rich resources that rejuvenate and restore the health of our soils. She demonstrates creative and practical methods for engaging with natural decomposition cycles through her innovative projects, such as the domestic *Worm Cozies* and *Handshake* works. By fostering these processes, her work highlights sustainable ways to recycle waste and emphasizes the interconnectedness of living organisms and their environments. Youngs' efforts inspire us to consider how our actions can contribute to a cleaner, more balanced ecosystem.

Amy Youngs, Worm Cozies, 2015 are designed to help humans feel more comfortable hosting worms in their domestic spaces, based on the concept of appliance cozies to hide the sight of garish machines inside the home space.

This is one example where natural processes recycle industrial waste (pots, pans, synthetic fabrics) while removing food waste and reducing methane spewing from municipal garbage dumps. If you ask the media, what are the new green technologies?... the corporate elite will repeat greenwashing methods, which are often false, based on extractive philosophies that don't solve the fundamental problems and only serve the profits to the shareholders.

These greenwashing campaigns, such as **plastics recycling,** need to inform us that only 10% of plastic is currently recycled. Thanks, Pepsi, and Coke! Plastics must be eliminated from production, with alternatives like mycelium or algae-based solutions, which can be scaled up.

Plastic manufacturers have for years created misleading labels implying recyclability, which is downright evil. Recent research that recycled plastics leaches more particles into soft drinks, given their complex chemical compositions, further questions the logic of continuing these dangerous product productions. A 2019 study by the University of Newcastle, commissioned by the World

Wildlife Fund (WWF), estimates we all consume about one credit card worth of plastic per week by eating plants, breathing air and fish that absorb microplastics.

Amy Youngs, Handshake, 2015, acknowledges composting worms as important partners and proactive agents of domestic waste removal. She performed a three-hour handshake on live broadcast webcam and manipulated the footage into a five-minute video piece.

Carbon Capture: A significant promise that oil companies primarily fund is Carbon capture and storage (CCS), which faces significant challenges that limit its effectiveness.

These include high costs, energy-intensive processes, and lower-than-expected CO_2 capture rates, with many projects failing to meet targets. Storage risks, such as potential CO_2 leakage and the slow global deployment of CCS, further undermine its viability. Despite its potential, CCS captures only a fraction of global emissions and remains expensive compared to other climate solutions. It requires technological advancements and better economic incentives to become a meaningful tool for

combating climate change. According to the Global CCS Institute, only 44 million metric tons of CO_2 are captured annually worldwide, representing less than 0.1% of global emissions. The cost per ton ranges from $50 to $200. [3]

Electric Cars are designed for one thing, which is to save the car industry. Bicycles are a far superior alternative to cars in urban environments, offering unmatched efficiency, sustainability, and health benefits. Unlike cars, including electric ones, bicycles take up minimal space, produce zero

Ken Rinaldo Signs of Life, Signs of Death 2024 situates critical signs to those driving to allow them to question their chosen modes of transport and its impact on our environment.

emissions, and significantly reduce city congestion. They require far less infrastructure investment, with dedicated bike lanes and parking proving more cost-effective and space-efficient than sprawling car-centric developments. Biking promotes physical activity, reduces stress, and allows faster

commutes during peak hours. Cities like Copenhagen and Amsterdam showcase how prioritizing bicycles over cars improves air quality, reduces traffic, and elevates overall urban quality of life. In contrast, while greener than traditional vehicles, electric cars still contribute to congestion, infrastructure strain, and particulate pollution, making bicycles the optimal choice for urban mobility.

Hope in the Green: Helen and Newton Harrison are renowned environmental artists whose collaborative works have made significant contributions to sustainability, ecology, and public policy. Their projects often focus on complex ecological issues like watershed restoration, urban renewal, agriculture, and forestry. What sets their work apart is its interdisciplinary nature, blending art with environmental science, policy, and community engagement. Their installations and interventions have not only raised awareness about pressing environmental issues but also catalyzed concrete changes in environmental policy and practice.

For example, their *"Oceanography and the Sediment Cycle"* and other large-scale projects, such as *"The Lagoon Cycle,"* use both visual and conceptual approaches to tackle environmental problems. These projects engage the public and policymakers in new ways, encouraging a more integrated understanding of the connections between natural systems, human activity, and sustainability. Through their visionary projects, the Harrisons have often bridged the gap between artistic expression and practical, on-the-ground solutions.

Given that the web is currently the largest coal-fired network on the planet, Tega Brain offers solutions. She is an artist, engineer, and educator known for her work intersecting with environmental issues, technology, and systems design. Her projects often challenge traditional notions of efficiency and productivity, exploring how systems can be reimagined to prioritize ecological considerations.

The **Solar Protocol** is one of her notable projects. It is a web platform hosted across a network of solar-powered servers in different parts of the world. The platform's primary innovation lies in its dynamic functionality: it routes web traffic to whichever server is experiencing the most sunlight. This project challenges mainstream digital infrastructure, prioritizing speed and availability at the cost of significant energy consumption. Instead, the Solar Protocol embraces variability and dependence on natural resources like sunlight, highlighting an ecological approach to technology. It begs the question why the captains of industry are NOT talking about solar and or wind to power AI data processes. Joana Moll critically examines the hidden environmental costs of the digital economy, particularly its reliance on vast amounts of energy and resources. In her project *DEFOOOOOOOOOOOOOOOOREST*, she visualizes the carbon footprint of online activities, such as the energy-intensive processes behind a single Google search, by equating it to the amount of forest required to absorb the emitted CO_2. By making these otherwise invisible environmental harms tangible, Moll exposes the unsustainable nature of the digital infrastructure.

Her work aligns with the principles of digital degrowth, challenging the unchecked expansion of the digital economy and advocating for more transparent, accountable, and ecologically mindful practices. Moll's efforts highlight the urgent need to reconsider how we engage with technology and encourage a shift toward slower, more sustainable development that values environmental stewardship.

Joana Moll, *DEFOOOOOOOOOOOOOOOOOREST.* 2016 Courtest of the Artist

Recently, I had the exciting opportunity to deliver a workshop on building your own microbial fuel cell at The Ohio State University's Eco Arts Laboratory in the Department of Art, where I explored the fascinating world of microbial fuel cells (MFCs). These innovative systems leverage the unique abilities of microorganisms like *Geobacter sulfurreducens* and *Geobacter metallireducens*to generate electricity by breaking down organic materials.

By working collaboratively with these microbes, MFCs provide a sustainable method of producing electricity and offer significant potential for improving local and municipal waste processing. 3 This dual functionality makes microbial fuel cells a promising solution for reducing environmental impact while supporting energy generation at a community level.

The workshop was an inspiring look into how cutting-edge bioengineering can lead to practical, eco-friendly energy and waste management advancements. In experiments, *Geobacter sulfurreducens* has been shown to generate up to 2.9 W/m² of power density, making it a promising technology for wastewater treatment and electricity production.[5] The artist, Benini Allaquate, created a beautiful, functional lamp sculpture, betting that microbial techniques could produce sustainable public lighting systems.

Sean Cubitt is a media theorist whose work critically examines digital media systems' ecological and social impacts, emphasizing their reliance on finite natural resources and the environmental consequences of their production and consumption. In his book *Finite Media: Environmental*

Implications of Digital Technologies, he explores how the growth-driven logic of digital industries exacerbates ecological degradation through unsustainable practices like the extraction of rare earth metals, energy-intensive data processing, and the proliferation of e-waste. Cubitt challenges the pervasive narrative of technological progress, arguing that digital media must operate within planetary boundaries rather than striving for infinite scalability and speed.

He advocates for "slow media" practices that prioritize meaningful engagement over instantaneity and sufficiency over excess, aligning with the principles of digital degrowth. Central to his philosophy is the need for transparency and accountability in media systems, making the hidden ecological costs of digital infrastructure visible to users and policymakers.

By linking media theory with environmental concerns, Cubitt reimagines media systems as resource-efficient, localized, and ecologically harmonious, offering a critical framework for building a sustainable digital future. His work serves as a call to reevaluate the design and use of media technologies, urging a shift from profit and efficiency toward ecological health and social responsibility.

Olga Kisseleva. Oaks That Think They Are Baobabs. Photo by Michel Masson. Courtesy of the artist

Olga Kisseleva's scientific and artistic research, situated at the intersection of ecology, sociology, philosophy, and art, explores profound questions about the past, present, and future, with nature as her guiding inspiration. For years, she has observed trees across the globe—from the Amazonian

rainforests and ancient oak groves of France to millennia-old olive trees in Greece and the distinctive flora of Indian Ocean islands. Her journey has given rise to artworks that confront vital topics such as ecology, biopolitics, urbanism, cultural memory, and future technologies, all with the goal of restoring and deepening humanity's connection to nature. By foregrounding the narratives of non-human entities (like plants), Kisseleva challenges the anthropocentric focus of technological innovation, encouraging a shift toward a more inclusive, ecosystem-centered perspective.

Through works such as *Atlas of AI*, Kate Crawford provides a critical examination of the extractive processes that underpin artificial intelligence systems, shedding light on the often-overlooked environmental and social costs embedded in their development. She highlights the resource-intensive demands of data collection, storage, and computation, which contribute to significant ecological harm, including carbon emissions and resource depletion. Crawford's research resonates with the principles of digital degrowth by challenging the relentless pursuit of technological efficiency and advocating for more sustainable, equitable, and ethically conscious approaches to innovation. By revealing the hidden labor, material, and environmental dimensions of AI, she urges a rethinking of the tech industry's trajectory toward one that prioritizes human and planetary well-being over unchecked progress.
Sustenance: Other promises of AI, for me, are using the technology (if we can solve the energy issue) to create more complex intertwined farming practices, not based on monocultural farming where pesticides and large quantities of fertilizers are poured into the dead soil. Instead, if we had AI farming machines that could, for example, harvest the three sisters, corn, squash, and beans, all while weeding at the same time, we could reduce fertilizer pesticide use and restore the healthy soil microbiome where many of the natural microbiota provide the plants and then our microbiota, with necessary nutrients and vitamins.

Vertical farming has been one promise for feeding the planet, and in 2008, Amy Youngs and I looked to vertical farming to create a work called the Farm Fountain. This project explored vertical farming, where fish waste was used along with denitrifying bacteria to clean the water and feed the edible plants. While the project won a United Nations Green Leaf Award for an invention most likely to feed the planet, the project had some inherent difficulties. One was harvesting the fish, which made it difficult to look into their eyes and take their lives. We ate less Tilapia and started to see them as pets we could not eat, and having more humans raise their food would likely help us not waste entirely 1/3 of all food we purchase.

The Egyptian and Mayan cultures were already masters of aquaponic farming, where Tilapia were grown with edible vegetables. The earliest example of one branch of aquaponics might be traced to the lowland Maya, followed later by the Aztecs, who developed a method of growing plants on rafts atop lake surfaces around 1000 A.D. The Aztecs created an agricultural system called chinampas, which some consider to be an early form of aquaponics. Chinampas consisted of a network of stationary artificial islands and canals, where crops were grown on the islands using nutrient-rich mud and water drawn from the surrounding canals. Early Egyptian farming provides some of the earliest evidence of aquaponic-like practices, particularly with Tilapia, a significant part of their agriculture and diet. Ancient Egyptians are often credited as pioneers in fish farming, with Tilapia (commonly referred to as "Nile tilapia") being one of the primary species cultivated.

The problem with vertical farming today is that it needs to model nature properly, and it is energy intensive. It also uses chemicals as sustenance to grow leafy green veggies, which are often packed into plastic containers. Bar Codes and efficiency at self-checkouts are now all built into these systems, which must be reversed. Home systems powered by solar are one solution as the Farm Fountain is model. As part of our system, we created a free online system to share our research and methods.

Another artist working at the intersection of technology and learning the lessons of nature is Argentine artist Tomas Saraceno, who researches to understand more about ecosystem harmony from spiders, using them as a metaphor for interconnectedness and symbiotic relationships that may exist between nature and culture.

Shelter: The Solarleaf Bioreactor Façade by ARUP is an innovative architectural project that integrates bio-reactive technology to generate renewable energy. By cultivating microalgae within its façade, the system captures sunlight and carbon dioxide to produce biomass and heat, offering a sustainable energy solution and improving building insulation.

The Solarleaf Bioreactor Façade by ARUP located in Hamburg, Germany. It was first installed on the BIQ (Bio Intelligent Quotient) House, which was showcased as part of the International Building Exhibition (IBA) in Hamburg in 2013.

Although it doesn't utilize Geobacter, this project exemplifies bio-integrated architectural design, merging ecological processes with modern infrastructure to creatively address energy and environmental challenges.

Tire houses, pioneered by architect Michael Reynolds, are an innovative form of sustainable housing constructed primarily from discarded tires filled with compacted earth. These "Earthships" utilize

passive solar design, thermal mass, and recycled materials to create self-sufficient, energy-efficient homes that regulate temperature naturally. Reynolds' designs emphasize sustainability by integrating renewable energy systems, rainwater harvesting, and food production, making these homes environmentally friendly and suitable for off-grid living. His approach repurposes waste materials and challenges traditional construction methods, demonstrating how eco-friendly architecture can coexist with modern living needs. Still, when I think of the four-wheel drive cars necessary to get back to the homestead in New Mexico outback, the technique is not so easily scaled to cities, while waste tires are plentiful.

Sources: Low-Tech Magazine embodies digital degrowth through its solar-powered, low-bandwidth website, which reduces energy consumption while delivering meaningful content. This project demonstrates how small-scale, low-tech solutions can counter the resource-hungry nature of the modern internet.

The Journal of Nature in Visual Culture founded by Giovanni Aloi, explores the interplay between nature, art, and visual culture, grounding its philosophy in the critical examination of how nature is represented, perceived, and constructed through visual mediums. The journal emphasizes the cultural, historical, and philosophical dimensions of these representations, challenging conventional narratives and advocating for more nuanced understandings of nature's role in visual and artistic practices. By engaging with interdisciplinary perspectives, it seeks to uncover the ways visual culture shapes and is shaped by human conceptions of the natural world, addressing themes like environmentalism, aesthetics, and the politics of visual representation.

Just as endosymbiotic relationships in biological systems create complex, self-sustaining life forms, human-AI relationships could evolve to support mutual flourishing—if designed with care.

But achieving this requires moving away from extractive, profit-oriented motivations and toward systems of creative technological development grounded in cooperation, sustainability, and ethical stewardship. AI is exciting and now a critical part of our co-evolution; however, wind and solar are only one way to imagine a greener future as we evolve away from damaging our planet's delicate ecosystems, and caring for the more than human others, we share the earth with.

By understanding AI as part of a broader co-evolutionary process—where humans and machines evolve in tandem—we can foster new possibilities for intelligence and discovery. Like the endosymbiotic relationships that created complex life, human-AI relationships could evolve to promote mutual flourishing. However, this will require moving away from profit-oriented development and toward systems grounded in cooperation, sustainability, and ethical stewardship.

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