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THE GREAT REDESIGN
FRAMEWORKS FOR THE FUTURE

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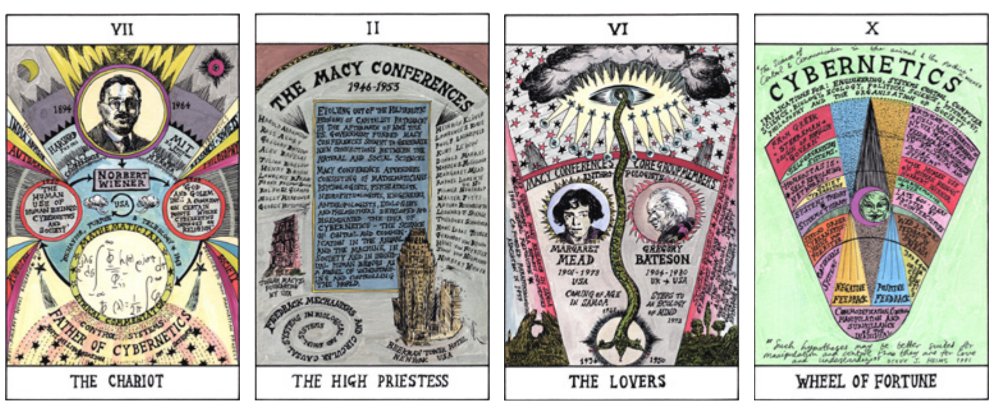
LESSONS FROM THE LAST GREAT REDESIGN



Illustrations: Suzanne Treister, HEXEN 2.0/Tarot. Courtesy the artist, Annely Juda Fine Art, London and P.P.O.W., New York

THE CHARIOT: A journey begins, with many obstacles to be expected. This particular journey begins with Norbert Wiener, amidst the devastation of World War II and rapid advances of computing power. The groundwork for a Great Redesign is laid. *THE HIGH PRIESTESS: It is time to reflect on things yet to be revealed, but things we may already know.* Several years later, a decade-long series of conferences brings together scholars from a wide range of disciplines, bridging divides between them and advancing work in numerous fields we can recognise around us today. *THE LOVERS: A crossroads, a time for new partnerships.* A new era of AI is ushered in, although how it all started is largely forgotten. *WHEEL OF FORTUNE: An opportunity for great change.* We find ourselves now at another moment of redesign, and an opportunity for great change. Guiding principles from cybernetics could help us navigate forward.

We are founding members of an innovation institute at the Australian National University. The Institute's mission is to establish a new branch of engineering to help shape the future safely, sustainably, responsibly. This represents a new kind of innovation for the university; we are researching and articulating a framework for a new field, iteratively testing it in collaboration with a broad set of stakeholders, and actively curating its pedagogy, methodology, practice and certification. We are effectively engaged in redesign. For us, the current context is the growth and projected scaling of AI-enabled cyber-physical systems – connected, sensing, computational systems which characterise the fourth industrial revolution.[1]

Tarot cards might seem a strange place to start. They're not in a typical engineering toolkit, and they're not particularly high-tech. The game of tarot has a long history; it was popularised in Renaissance Italy and is still played today. Tarot cards only began being used for divination practices centuries after the introduction of the game, and the occult interest in tarot expanded from France through the Enlightenment period. Divination decks contain pictures – symbols – which viewers are invited to read like a text. Yet pictures may be read in different ways, and a variety of meanings can be interpreted depending on the context in which they are being read and the past experience of the person reading them. In this way, they become tools for prying open the hopes and possibilities for the future in a particular context, in dialogue with others.

Suzanne Treister's intricately hand-drawn cybernetics tarot cards offer symbols representing the histories of scientific research that lies behind advances in technologies of control and communication.[2] These cards invite us to reflect on the complex history of present-day technologies, and explore how they grew out of a previous moment of great global redesign – World War II. In Treister's words, "the works are a tool to envision possible alternative futures";[3] using them invites us to reflect on lessons from the last Great Redesign as we find ourselves at another tipping point, an irreversible disruption of global systems into a different equilibrium state. So perhaps tarot cards are not such a strange place to start after all. In the following pages, we read just four cards from the deck.

Standing on the precipice of great global redesign

It is 1946. Japan and Europe are still burning after World War II. It is perhaps the worst of what humans have ever done to each other: We unleashed the atom bomb. We used early computation systems to persecute other humans, and first-generation computers to aim weapons. Whole pieces of our natural and built environments were destroyed, and families, cities, and ways of life utterly devastated. In the ambiguity of war, we found new ways to harm, and also new ways to heal, with the development of medical innovations such as antibiotics being accelerated in wartime conditions. The world saw incredible growth in computing and computing power, from log tables to the Eniac computer, and already it was proliferating. Images were moving in a way they previously couldn't. The devastation was in the front pages of the newspapers, in the movies, and in the stories we did and didn't tell each other. If the future was ever a white fog, it was that moment.

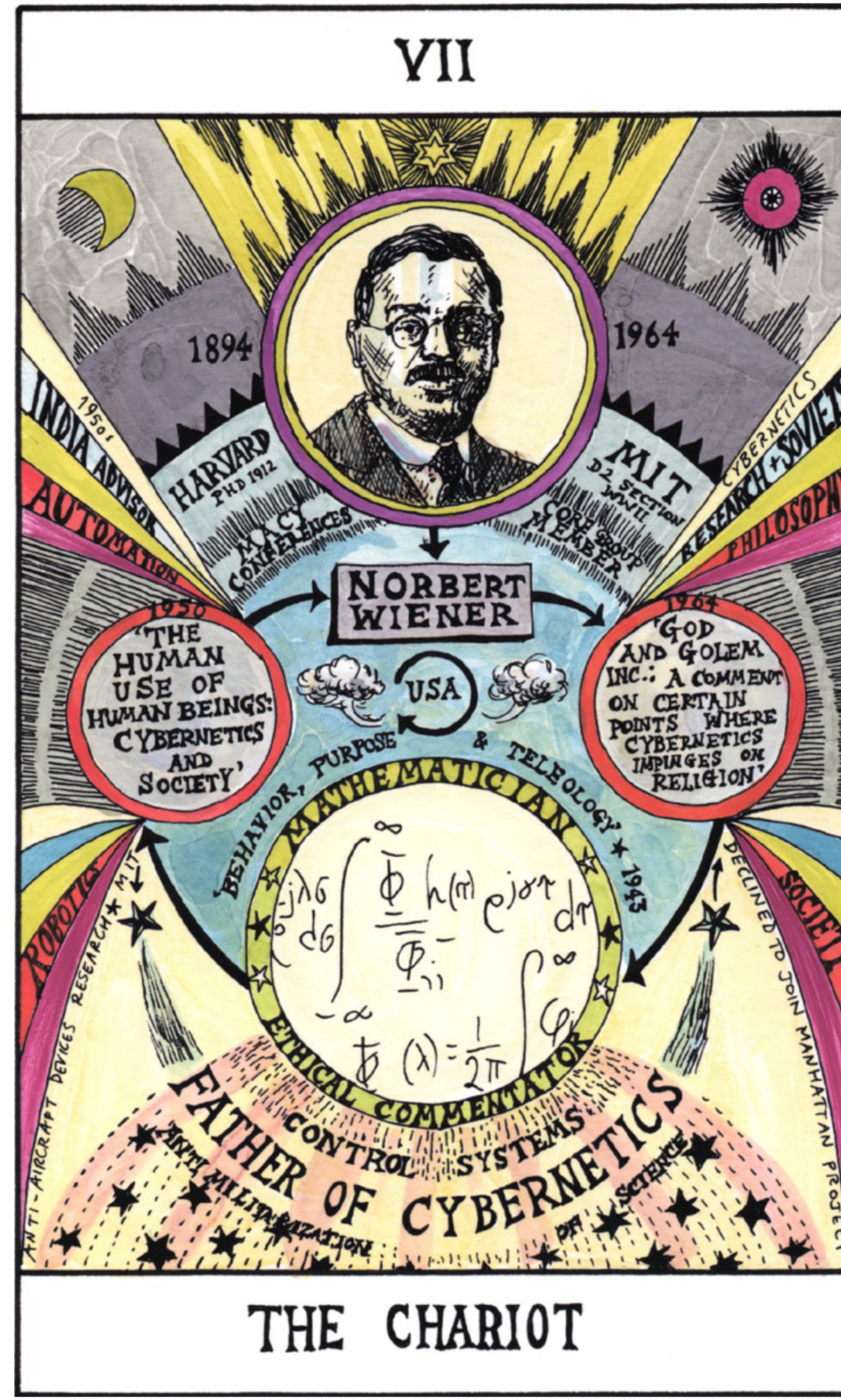


Illustration: Suzanne Treister, HEXEN 2.0/Tarot/VII The Chariot – Norbert Wiener. Courtesy the artist, Annely Juda Fine Art, London and P.P.O.W., New York

The future was right there in front of them as the conversations we're about to describe were happening, and the main characters made it clear that this world of devastation and possibility was the world they were writing into and against. They were trying to curate something different. They knew that their conversations about the future were about much more than the technology. Global systems had been disrupted and social values called into question. And with that disruption came the opportunity to re-write the future the world would move into. Years later, Margaret Mead recalled that moment:

> *"In the summer of 1945 I began to write a sequel... But when the atomic bombs exploded over Hiroshima and Nagasaki, I tore up the manuscript. Once we knew that it was possible for a people to destroy the enemy, themselves, and all bystanders, the world itself was changed. And no sentence written with that knowledge of man's new capacity could be meshed into any sentence written the week before."* [4]

For Mead and the group, who are the focus of the following pages, there was no returning to the past.

In 1942, Norbert Wiener, a leading mathematician and philosopher, had been drafted in to design anti-aircraft guns. At a time when calculations were performed manually using measurements and reference tables, anticipating the trajectory of an aircraft, aiming and firing to intercept it was a problem that sat at the intersections of human-machine interaction, control, feedback and speed in a broader context of geopolitical conflict and human loss of life.[5] These all raised questions beyond the mechanical and mathematical. While the problem immediately before Wiener was how to mathematically predict evasive manoeuvres of pilots, he began thinking beyond it. He was also considering the psychological and philosophical implications of a mechanical predictor for aiming weapons. What are the human-machine feedback loops? What control mechanisms are in place? What are the communication pathways in this complex system which comprises much more than mechanical and computational components? Were they anything like human body systems?

Wiener's work brought him into conversation with Mexican physician Arturo Rosenblueth. They had two very different perspectives, yet identified common themes in their work: perhaps self-regulating anti-aircraft systems were not that dissimilar to the self-regulating systems in the body; perhaps there were some generalisable principles that could be formalised by comparing mathematics and medical science. It is here we see the early thinking about what came to be known as "cybernetics".

As defined by Wiener, cybernetics sought "to develop a language and techniques that will enable us indeed to attack the problem of control and communication".[6] These problems, he believed, were uniquely raised by the development of computing in the 1940s, problems such as how we might control these new technologies and for what purpose, how we might communicate with and through them, how their components would communicate with each other and the surrounding environment, built on Wiener's early work around feedback systems and control theory. Control, in this case, meant much more than the control theory we might recognise today. Wiener is quoted as saying:

> *"Either the engineers must become poets, or the poets must become engineers... Humanity as a whole can be ruled by nothing less than men who span the whole of humanity."* [7]

For Wiener, engineering new systems required more than formulas or pursuit of individual status, power and control. Instead, it required an understanding of nature, a philosophical or poetic outlook, human ingenuity, and a purpose which transcends private ambitions. Echoing this sentiment, Wiener took the word *cybernetics* from the Greek *κυβερνήτης*, meaning helmsperson – the person with a tiller at the back of a longboat expertly guiding the ship and its crew safely through calm and stormy seas. The Greek is transliterated into Latin as *gubernator*, which English-speakers may recognise as *governor*. Both of these terms invoke a complex interplay between technology, the environment and a responsibility for the wellbeing of others.

A vision for a different future

Cybernetics owes its intellectual roots first to Norbert Wiener, and then to a remarkable series of interdisciplinary conversations in the 1940s and 1950s.[8,9] The conferences were a kind of collaborative Great Redesign.

Between 1946 and 1953, ten meetings were convened by the Josiah Macy Jr. Foundation under the banner of cybernetics. The Macy Conferences on Cybernetics brought together a range of thinkers from across the disciplinary spectrum to explore the idea of the human/machine system. Curated in part by anthropologists Margaret Mead and Gregory Bateson, the meetings were radically interdisciplinary, and represented an attempt to constitute a new body of academic knowledge and a new discipline. They were especially concerned with how the mind worked, ideas about intelligence and learning, and the role of technology in our future. And of course, it was all energised by – and in direct dialogue with – the strides that were being made in speeding up computing.[10]

The people in the room represented a long tradition of dividing expertise into different fields that goes back to the Enlightenment. Margaret Mead, reflecting on the conferences 30 years later, recalled:

> *"There were the mathematicians and physicists – people trained in the physical sciences, who were very, very precise in what they wanted to think about. There was a small group of us, anthropologists, and psychiatrists, who were trained to know enough about psychology in groups so we knew what was happening, and could use it, and disallow it. And then there were two or three gossips in the middle, who were very simple people who had a lot of loose intuition and no discipline to what they were doing. In a sense it was the most interesting conference I've ever been in, because nobody knew how to manage this thing yet."* [11]

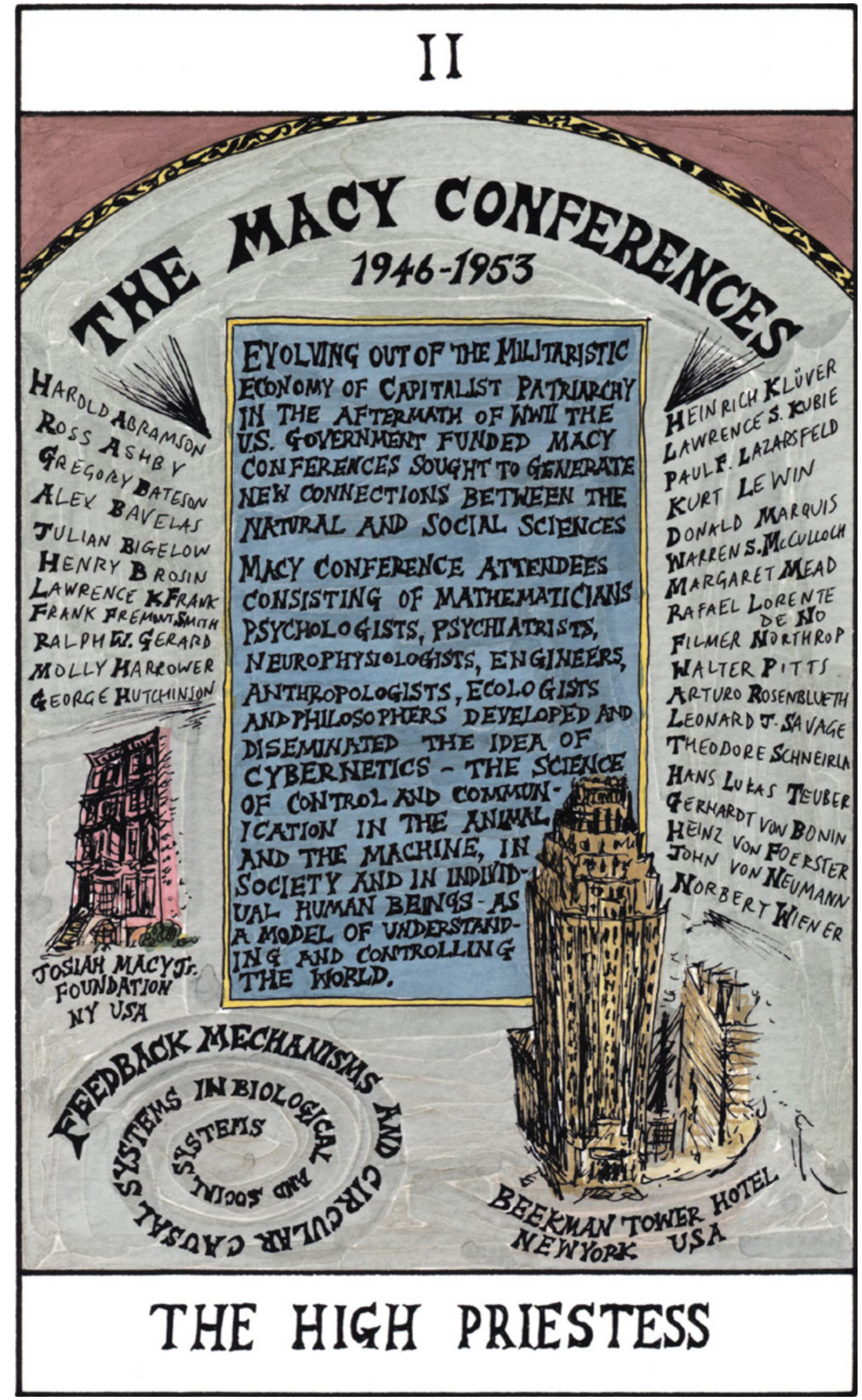


Illustration: Suzanne Treister, HEXEN 2.0/Tarot/II The High Priestess – Macy Conferences. Courtesy the artist, Annely Juda Fine Art, London and P.P.O.W., New York

Why bring all these people together? The war had raised new questions, revealed new complexities and opened new possibilities. They had started to notice that the interstitial spaces between fields of expertise were equally as vital as the fields themselves, yet no one in academic establishments specialised in these. For example, one could take something like an automated anti-aircraft gun apart and lay out its components. But expert knowledge about its individual components or code will not reveal its most characteristic properties: its accuracy, impact on cities or safety perhaps. Assembly of parts into a system – including human, environmental, and mechanical components – generated new, emergent properties. Cybernetics was about trying to find the holistic view that understands the way parts of a system shape each other as they come together. In addition, it was addressing questions about what sort of world we thought we were building with and through these systems.

The Macy Conferences focused on topics that cut across their separate disciplines of expertise, such as control, information and communication. For example, all fields have some sort of sense of "control", of things not going completely crazy in a system. But the participants at the conferences all recognised control to be different things and expressed them in different ways; for example, politics might refer to regulation, astrophysics to gravitation, neurophysiologists to homeostatic mechanisms, ecologists to the seasons, prey and predators, and anthropologists to social hierarchy.[12] They did not seek a common, unifying or dominant definition. Instead, they created space for their different perspectives to co-exist on equal terms. It took years for them to start understanding what the others were saying in their own terms; the more they understood, the more they perceived common identity and unifying features, and this pursuit of similarities led them to developing new theories and bodies of knowledge.

Cybernetics' insistence that computation technology must be understood in a larger system that comprises technological, human and ecological dynamics seems especially pertinent to the problems and potentials of a post-pandemic world.

The conversation narrows from cybernetics to artificial intelligence

Cybernetics argued persuasively that one had to think about the relationship between humans, increasingly smart computing and the broader ecological world as a holistic system. As such, it was an important intervention into the first wave of somewhat techno-deterministic imaginings of computerisation and proto-AI research.[13]

Cybernetics, however, was deemed politically complicated in McCarthy's America and lost much of its shine in the mid-1950s. The scars of war had begun to heal into memories, cities had been rebuilt, and economies began to flourish. The threat of the Cold War continued to simmer in the background and fuel global competition in numerous sectors, including technology. At the same time, the world seemed more stable and more sure.

In 1956, a new term would take the place of cybernetics: artificial intelligence. The artificial intelligence agenda was narrower, with fewer voices, representing mathematics, computer engineering, physics and cognitive science. Some of the people who had attended the cybernetics conferences also attended the original AI conferences, but cybernetic thinking was ruled out of scope. The group was collectively willing to narrow the frame, confident in the starting premise that it was only a matter of time until machines would think like humans. They deliberately used the term "artificial intelligence" to escape association with cybernetics and feedback, to avoid having difficult debates and discussions, and to carve out a new space independent of Wiener's leadership.[14]

Reflecting on that period, Mary Catherine Bateson, the daughter of Margaret Mead and Gregory Bateson, wrote:

> *"The tragedy of the cybernetic revolution, which had two phases, the computer science side and the systems theory side, has been the neglect of the systems theory side of it. We chose marketable gadgets in preference to a deeper understanding of the world we live in."*[15]

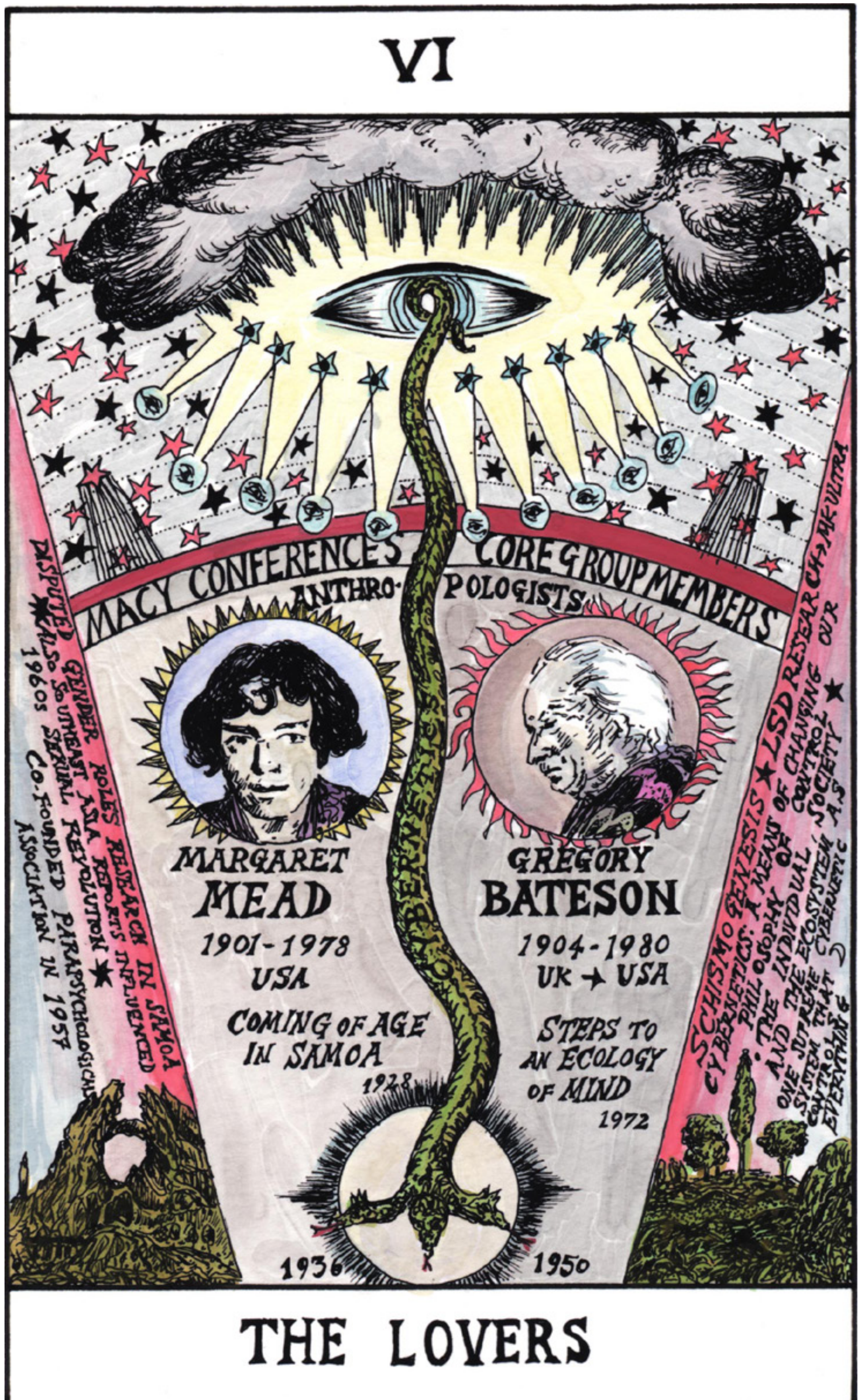


Illustration: Suzanne Treister, HEXEN 2.0/Tarot/VI The Lovers – Margaret Mead and Gregory Bateson. Courtesy the artist, Annely Juda Fine Art, London and P.P.O.W., New York

As cybernetics gave way to artificial intelligence, focus shifted toward computer science, and away from understanding the systems, societies and ecologies we were simultaneously building.

Cybernetics continued to find different audiences and receptions around the world, including in South America[16], North America[17], Russia[18], the UK[19], and Europe[20], and in sectors from business management[21] to the arts[22]. In addition, it remained on the margins of conversation in the United States, intersecting with debates on automation,[23, 24] and around ecology and environmental stewardship.[25, 26] It is, of course, not without its critics and critiques, especially around its totalising narratives and ambit claims,[27] and inclusion of only some forms of knowledge or expertise. For example, long histories of Indigenous philosophy that address the world as complex and interdependent systems were overlooked or overwritten.

In our current work, we do not propose to resurrect mid-century cybernetics. But many ideas that were lost in the transition from cybernetics to artificial intelligence are worth another look in today's context. Thinking in terms of dynamic systems that include technology, people and the environment; understanding interdependencies and feedback; and thinking carefully and critically about the world we are making with new technological advances all matter if we want to scale AI-driven systems safely, sustainably and responsibly.

A new cybernetics for the 21st century: 6 guiding principles

Cybernetics is an entirely different way to look at the world and the way we construct knowledge. It works outside of existing knowledge structures, in the spaces between and across disciplines, sectors and fields. Rather than focus on components, objects or specific domains of expertise, it focuses on the relationships between them, and takes into account the complexity and interdependence of the world we live in. This change in worldview should be accessible to anyone.

This is especially the case given the moment we collectively find ourselves in right now. We stand at another moment of Great Redesign where the complexity of our world has been laid bare. Covid-19 has made visible many of the invisible systems in which we are all entangled.[28] One tiny virus has influenced everything from work to health to transport to our living rooms, and everything in between. As we stand on the precipice of a new normal where the possibilities for redesign feel almost limitless,[29] cybernetics can, once again, give us a way forward in a moment of global system disruption.

So, here are six guiding principles to making cybernetic decisions for the 21st century, which underpin our own work and which we think are relevant to the moment of Great Redesign in which we currently find ourselves.

In a great redesign project there is no starting with a blank slate. Redesign can feel limitless, but it is easy to unknowingly carry our past into our future and find ourselves defaulting to old assumptions, structures and ways of doing things that do not fit the new context. Cybernetics and its struggle to find a home in the context of existing disciplines and sectors challenges us to acknowledge our current assumptions, the things that we take for granted, and make active decisions about what to carry forward and what to unlearn and leave behind.

Think about the system. Don't just focus on the technology; human and ecological pieces matter too, as do the dynamic relationships between them all. The field of systems thinking offers some useful approaches; feedback loops, unintended consequences and boundaries are useful concepts which find their roots in cybernetics. Many other fields and peoples also have something to add, although they will not use the same terms to articulate what they know, so keyword searches alone will not suffice.

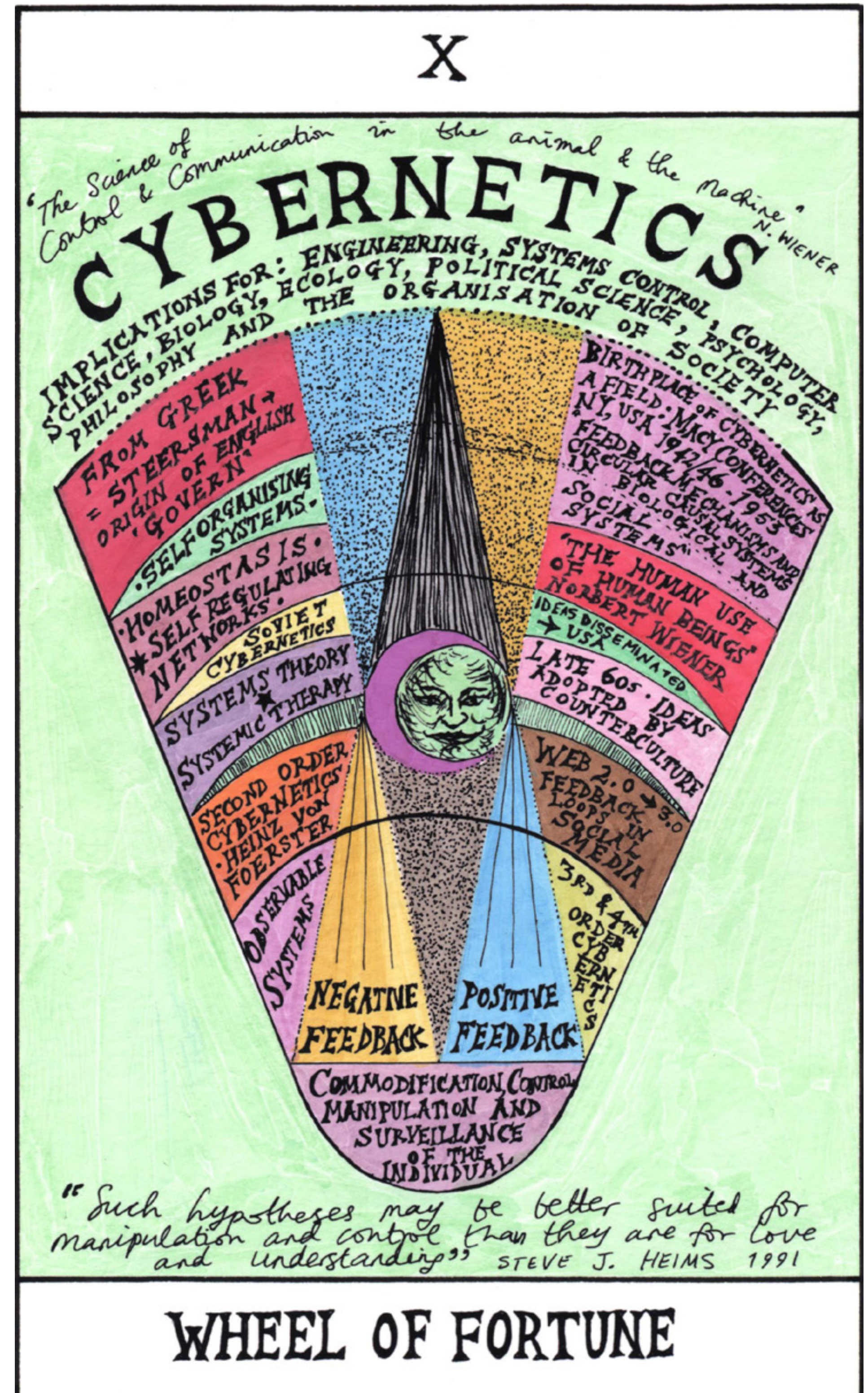


Illustration: Suzanne Treister, HEXEN 2.0/Tarot/X Wheel of Fortune – Cybernetics. Courtesy the artist, Annely Juda Fine Art, London and P.P.O.W., New York

Listen to more voices, not fewer. We're going to need to bring different voices into the room than would find themselves there naturally. Having conversations across disciplinary, sectoral and cultural boundaries is critical;[30] we're going to have to find ways to coordinate and curate those conversations. Cybernetics reminds us how fruitful it can be to invite debate and difficult discussions across fields of knowledge, while the rise of the artificial intelligence agenda shows how much easier it can feel to shut them out. And we're going to have to find ways to imagine that the consequence of those conversations will be not what we intended, but that they will create all these new spaces.

Find people who excel at working between existing disciplines and structures. Systems are more than the sum of their parts; the way the human, technological and ecological parts interact, how they can be influenced, the emergence of new system properties, change over time, and the context in which they are operating all require attention. Accommodating people who can think about these pieces in the context of a Great Redesign means recognising new types of practitioner who fall outside of traditional areas of expertise and employment category, who are comfortable operating in an ambiguous environment where multiple definitions can flourish and no one way of seeing the world needs to dominate.

Anticipate that you will constantly need to learn, and that it will feel uncomfortable for a time. The many interacting systems in which we live are never static, and there is always more to learn. The Macy's Conferences were a series of moments in which every participant was open to learning from others, where they held their knowledge lightly and permitted it to be shaped by others' expertise. They were not trying to out-compete each other, or talk each other around to their own ways of thinking, but instead listen to each other and collaborate on something bigger than all of them. They learned to be comfortable in a space of deep ambiguity and did not rush to conclusions or stability. Cybernetics invites us to work on ourselves, to practice the humility to listen, reflect, and say, "I've encountered something new, I have welcomed exploring a place of multiple possibilities, and I have learned and changed my position." Imagine that it might take shape beyond your original impulse. If you're innovating an idea, you need to build it with enough grace that it will hold its shape long after it leaves your hands, and perhaps a few guardrails to ensure it does not travel in directions that may cause harm. You have to be generous and hopeful

that in making that idea and inviting other people into the conversation with you, that idea will find new forms and new critics and new life because you have not held onto it so tightly that no one else can change it. What you have done instead is made room for countless others to take your idea and carry it forward in new and unexpected ways.

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