

This essay proposes the concept of existential technologies—technologies that alter evolutionary trajectories over long spans of time, operating beyond conventional epistemic and moral frameworks—through a close reading of Stanisław Lem’s *Summa Technologiae* (1964). Lem is mostly known as a science-fiction author, but this essay looks to his theoretical text as an understudied and philosophically rich account of long-term technological change. Lem’s speculative futurology anticipates today’s debates around artificial intelligence, biopolitics, and epistemic automation, but also the moral and epistemological dilemmas posed by uncontrollable technological change. In contrast to both techno-utopian and techno-dystopian narratives, *Summa Technologiae* offers a vision in which technology evolves alongside and sometimes against humanity, generating outcomes that exceed ethical planning. In dialogue with Lem, the essay introduces two key categories: gnostic technologies, which automate epistemic functions, and anthropoforming technologies, which alter embodiment and identity, together constituting the domain of existential technologies. Re-reading Lem’s work in the context of evolutionary amorality and Eastern European intellectual history—with its experiences of technological intrusion and historical catastrophe—this essay demonstrates how existential technologies transcend both human control and moral comprehension.

Bogna Konior is a writer and an academic, focusing on digital culture, philosophy of technology, and new media. She has a broad interest in the relationship between accelerating ecological and technological change, and its impact on digital culture. She is currently a research fellow at NYU Shanghai, Interactive Media Arts department and at the AI and Culture Research Centre.

EDITORIAL

Antikythera argues that planetary computation is an existential technology, but from where does this term originate? Bogna Konior explores the history and implications of this idea.

In the early 1960s, Polish writer Stanisław Lem penned *Summa Technologiae*, a book of futurology that explores the trajectory of technology. Lem argues that humans often project their present understanding onto the future and fail to grasp technology’s evolutionary nature. He questions the idea that technology is solely determined by human will and suggests that humanity might be just one phase in technology’s history.

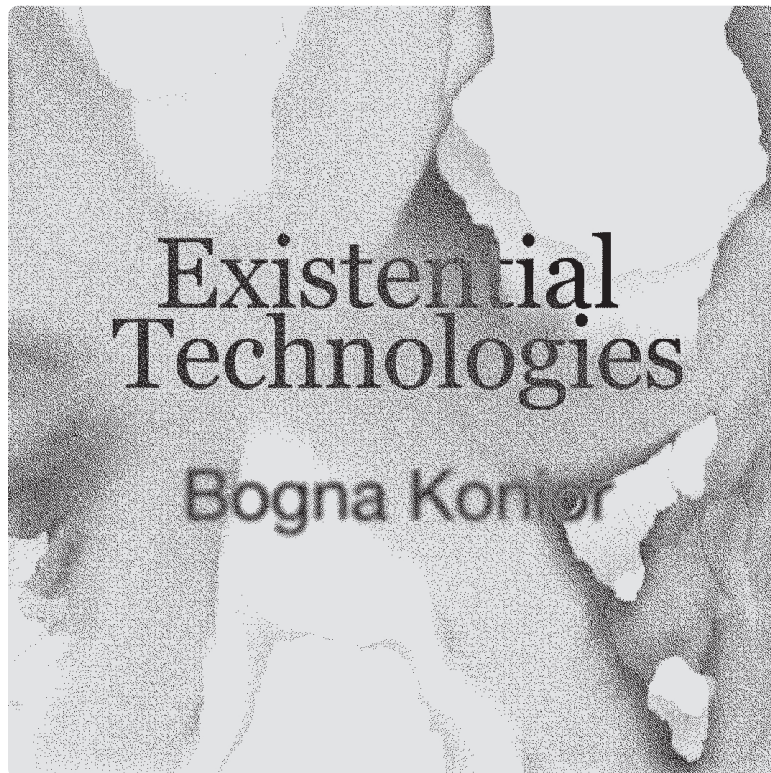
Lem draws a parallel between technological and biological evolution and suggests that technology should aim not only to imitate nature but also to create systems and materials that do not yet exist. He believes that human bodies and minds are crucial for technological advancement, but he questions whether humans are the drivers or instruments of this process.

Summa Technologiae addresses the challenges of predicting technological futures, such as humanity’s difficulty in imagining a world without computers, and the fact that each invention has unintended consequences. Lem stresses that a comprehensive theory of technological development must encompass everything from nature and the cosmos to human history.

While acknowledging that we have catalogued numerous technologies, Lem suggests that we lack a unifying theory, akin to Darwin’s theory of evolution, that explains how technology evolves. He attempts to address this by integrating natural science and cybernetics, viewing both natural and technical evolution as parallel, overlapping, and diverging processes. He also discusses the morality of technological evolution, noting that while biological evolution is amoral, humans are morally responsible for their technological choices.

Konior introduces the concept of *existential technologies*, which alter the evolutionary and civilizational trajectories of our species. These technologies, unlike “functional” technologies that primarily serve human needs, redefine what it means to be human. Examples include language and potential future technologies that manipulate cognition, reproduction, and embodiment.

Konior contrasts Lem’s perspective with “long-termist” philosophies that envision a controllable and morally legible future. Lem rejects the idea of linear progress and argues that morality is not static but changes over time. He believes that humans do not fully control the outcomes of their designs and that historical events are shaped by uncontrollable contingencies. She concludes by suggesting that Lem’s work, and Eastern European thought more broadly, offer a valuable counterpoint to utopian or dystopian visions of the future. Instead, they provide a view of technology as a force that is often alien and inhuman, and that progresses through a nonlinear path.



Who controls whom? Is technology controlling us, or are we controlling it? Does it lead us where it wants to, even to our ruin, or can we force it to yield to our intentions? But what else would our intentions be, if not some further technology? Is the humanity–technology relationship always the same or historically variable? Where is this unknown force heading?

Stanisław Lem, *Summa Technologiae*

present intact into the future

From *Future Mutation* by Anna Greenspan and Suzanne Livingston: Temporal dislocation blinds us to very processes within which we are engulfed—"manufactured normalcy." We absorb technological future, however shockingly revolutionary, by fabricating extended present that traps us in "crazed-familiarity" of the past. "Both science fiction and futurism seem to miss an important piece of how the future actually turns into the present... They fail to capture the way we don't seem to notice when the future actually arrives."

Quotes from "Welcome to the Future Nauseous" by Venkatesh Rao

natural and technological

As parallel, interlocking evolution of nature and technology in Samuel Butler's "The Book of Machines" (Erewhon, 1872).

In the early 1960s, Polish writer Stanisław Lem penned *Summa Technologiae*, a 600-page long book of futurology, whose overall purpose was "to present the general possibilities... as they determine the future in a specific way." [1] Describing technology's broad tendencies, rather than guessing at which futuristic tools might yet exist, is not a straightforward task. Absent a sufficient theory of technological change, we often helplessly project our **present intact into the future**. "What [kind of technology]," Lem asks, "would a caveman expect [to find in the] future? Huge, magnificently hewn stones." [2] In *His Master's Voice*, in many aspects a novelization of *Summa Technologiae*, one character complains that such linear imaginations of the future "disappoint in their homogeneity." [3] If we wish to see any "progress" on this front, he continues, it must be "epistemic," and strip us of "truisms, common truths, and stereotypes," which too often are "sufficiently embellished and made palatable to immerse us in safe wonder while we remain overall unshaken in our personal life philosophy." [4] Far from pursuing these safe wonders, if we truly aim to peek into the unveiling of a future world, we must think in a way that empties us of our confidences.

For such an unnerving task, *Summa Technologiae* is a worthy interlocutor. On the surface, the book is merely symptomatic of all the intellectual excitements of the 1960s, bringing together the natural sciences and the emerging field of cybernetics within an overarching framework of two evolutions—**natural and technological**—paralleling each other, overlapping and diverging. Though Lem described *Summa* as "a dreadful text full of showing off," as if sheepishly aware that he bit off more than he could chew [5], biophysicist Peter Butko considers it equal to acclaimed books that engaged with evolutionary theory and complexity, such as Richard Dawkins's *The Selfish Gene* (1976) or Douglas Hofstadter's *Gödel, Escher, Bach* (1979), noting that it was *Summa* that first comprehensively addressed some of the topics that made these subsequent books so influential and widely read. [6] Below the surface—and this is more interesting—*Summa Technologiae* is also a peculiar morality tale, with an ambiguous stance on how we might orient ourselves toward the largely unpredictable force that is technological change. As a futurology, its guiding purpose is to discuss what the future might be, not necessarily what it should be. In fact, because of his unflinching examinations of technology as both serving and challenging human morality, Lem's works were often grist to the mill of technophobes. He was far from a socially engaged critic of technology, proclaiming that "I do not trust any promises, nor do I believe in assurances bolstered by so-called humanism. The only answer to technology is another technology." [7] Yet, neither was he a techno-utopian or a naive technocrat divorced from the ethical and philosophical questions that technology poses to us. "Bioevolution," he writes, "is beyond all doubt an amoral process, which cannot be said of technological evolution." [8]

1. Lem, *Summa Technologiae*, 250. All excerpts from Lem's works cited in this essay are my translations.
2. Lem, *Summa*, 79. In a sense, the caveman would be right. We are surrounded by magnificently hewn stones called *computers*. Yet, this is probably not what the caveman was imagining.
3. Lem, *Głos Pana*, 182.
4. Lem, *Głos Pana*, 182.
5. Lem's humorous letters to his friends are impossible to translate due to his playful language, but the gist of it is: "My *Summa Technologiae* has just come out. And so, in the spirit of our ancient friendship, I'm reaching out to you to ask to answer me honestly, from the bottom of your heart and the depths of your soul: do you want this book, or would it be completely useless to you? Because, you see, it's all very cybernetic and theoretical and full of showing off, so if you're not planning to actually read and chew your way through this dreadful text, but just want to stick it on a shelf as a token of our camaraderie—then what's the point?" Orliński, Lem, 399.
6. Butko, "Summa technologiae"; Dawkins, *Selfish Gene*; Hofstadter, *Gödel, Escher, Bach*.
7. Lem, *Summa*, 9.
8. Lem, *Summa*, 27.

humanity is but one chapter

Butler reflects on the planet's origin when the Earth was nothing more than a "hot round ball." From this "embryonic state" no one could have imagined that "life would one day sprout on Earth." Just as human consciousness emerged from dark matter, is it not possible that "a new phase of mind" could still arise that is "as different from all present known phases, as the mind of animals is from that of vegetables? It would be rash to say that no others can be developed, and that animal life is the end of all things..."

Quotes from "The Book of the Machines" (Erewhon, 1872).

phantomatics

Focusing on tendencies rather than tools. Lem's neologism for the virtual—phantomatics—echoes Chinese cybernetician Qian Xuesan's term for virtual reality, *lingjing*, which also suggests that technologies of simulation may open a portal into the world of ghosts and spirits. (Qian Xuesan in *Machine Decision is Not Final*).

why some exist and others do not

For technology, capitalism serves as the main environment and source of evolutionary pressure. The steady incrementalism of consumer desire undoubtedly plays a role in shaping what comes next, but far more important are the disruptive innovations in fundamental infrastructure and industrial automation, tending toward autonomous reproduction. Machines building other machines.

What, then, would be an adequate futurology, one that encompasses both the machinery and the morality of technology? If I look to *Summa Technologiae* to ponder this question, it is not only because it is a neglected historical source, whose cross-reading of biological sciences and computation would resonate in today's intellectual climate, where the questions of evolution and artifice, life and machines, biotechnology, or ecology and digital infrastructure are again coming to the fore. It is rather because, with its help, we can interrogate a certain truism about technology, namely that we can control it and that its development tends toward predefined and perpetually improving forms. Human activity, to borrow Lem's phrasing, can indeed "open up a new chapter in [the history of] Technology." [9] Indeed, human bodies and minds are a uniquely fertile soil for accelerated technological take-off mechanisms, unmatched by any other species on this planet. Our ability to facilitate ongoing technological change cannot be contested. Yet, the question remains: are we the conductors of this process, or its instruments? If we do shape it, can we see where it is headed? What if **humanity is but one chapter** in the history of technology, a story that is neither linear nor one that fits into conventional moral frameworks? These questions go beyond whether certain technologies are good or bad, or what social effects they might have, because technology is not mere utility. As an existential process, it alters the civilizational and evolutionary trajectory of our species. If we think about technology as an existential task, it cannot be assessed within any simple moralism. The concept of *existential technologies* that this essay proposes would operate across vast temporal scales and elude familiar ethical categories. Rather than moving us toward a better world in any straightforward sense, they would generate alienating or turbulent changes at the limits of our comprehension. With its sustained interest in evolutionary theory and long-term prognostication and its clear-eyed understanding of agency and control sharpened by the brutal twentieth-century history of Eastern Europe, *Summa Technologiae* becomes a compelling lens for thinking through this idea.

1. TWO EVOLUTIONS AND THE AMORALITY OF DEEP TIME

The history of our species is commonly charted through the tools we've developed. The agricultural revolution took off through ancient Anatolian farming techniques, Mesopotamian irrigation systems, and Egyptian plows. The Middle Ages saw warfare transformed by iron smelting in West Africa, while sciences were refashioned through algebra and astronomy in the Islamic world. Trade flourished thanks to the invention of the compass in China. Optical lenses, the printing press, and gunpowder defined the Renaissance across the world, and later, steam engines, cameras, and textile machines ushered in the Industrial Revolution. This familiar story clocks in at about now, with its electricity and energy infrastructures, automobiles, factories, and computers. Focusing on tendencies rather than on specific tools, Lem proposes multiple future trajectories, including space exploration and first contact with alien intelligence; *intellelectronics* (*intelektornika*), the engineering of intelligence; the changing relationship between science and religion from the vantage point of computation; the possibility of structuring the evolving relationship between chaos and information; **phantomatics** (*fantomatyka*) and cosmogenic engineering, which are the creation of beings and worlds in virtual realities or simulations; various forms of modeling; *cerebromatics* (*cerebromatyka*), which is the technological manipulation of thoughts, beliefs, and character traits; *teletaxy* and *phantoplication* (*teletaksja i fantomplikacja*), which are practices of cloning and consciousness-splitting; various methods of automating scientific and metaphysical knowledge production; creating synthetic and cognizant language; biotechnology; cyborgization; and technologies that impact love, genetics, and sexual reproduction. These tendencies are explored in lesser or greater detail, and with various degrees of consistency, but entire essays could be written about each.

Yet, even though the task of futurology is to map out the future, Lem begins *Summa Technologiae* by listing the many challenges of this kind of prognostication. We have, for example, great difficulty determining how long a specific technological tendency will last, while momentous discoveries are often made by accident rather than intentionally. We also struggle with controlling the long-term consequences of our designs—each invention is double-edged and exceeds its own starting condition. [10] Acknowledging these difficulties, Lem asks, "Isn't it at the very least inappropriate to discuss future roses while ourselves being lost in the flammable forests of the present?" [11] Throughout the book, he wrestles with the realization that a scientifically grounded theory of technological development must be a theory of everything. Technology unveils itself within "nature" and the cosmos, alongside human history and civilization. As we begin to examine the borders between these terms, they blur, urging us to seek frameworks that can account for them as a unified whole. Technology indeed seems to us inseparable from its implementation in specific objects and tools, not unlike evolution, which can be thought of through its specific manifestations in individual organisms, species, and ecosystems. Yet, while we have comprehensive theories of evolution, in the case of technology, we cannot see the forest for the trees. While we can name countless examples (written texts, roads, aqueducts, computers, gene-editing tools, cameras), a comprehensive theory of technology as an ongoing process, one that explains why certain forms emerge and persist, is still in the making. We arguably lack a work like Darwin's *On the Origin of Species*, a theory that would account for how technology produces specific things in the world, and **why some exist and others do not**. [12]

9. Lem, *Summa*, 129.
10. Lem, *Summa*, 5–13.
11. Lem, *Summa*, 5.
12. For some notable contenders re: the evolution of technology, see Simondon et al., *Mode of Existence*; Stiegler, *Technics and Time*; Hayles, *Unthought*, and, recently, Hayles, *Bacteria to AI*; Gille, "Histoire des techniques"; Arthur, *Nature of Technology*; Kapp, *Philosophy of Technology*.

The relationship between technology and evolution is one of the most discussed subjects in scholarship on *Summa Technologiae*. [13] To formulate a theory of existential technologies, let us highlight that Lem was drawn to the idea that evolution, poetically described by Richard Dawkins as “the blind watchmaker,” is an impersonal designer, which makes its achievements all the more impressive. [14] He describes a cell, for example, as “a blind designer, working by trial and error, [therefore] its initial farsightedness astonishes and overwhelms us all the more.” [15] Contrary to that of the cell, human farsightedness is too often strangled by thought, which cannot help but appeal to subjectivity. The closing paragraph of *Summa Technologiae* beautifully captures this difference between human confidences and evolution’s unthinking designs:

From twenty amino acid letters, Nature has built a language “in its pure state,” which spells out—in slight rearrangements of nucleotide syllables—phages, viruses, bacteria, tyrannosaurs, termites, hummingbirds, forests, and nations, given enough time. This language, so perfectly atheoretical, anticipates not only the conditions of ocean floors and mountain peaks but also the quantization of light, thermodynamics, electrochemistry, echolocation, hydrostatics—and God knows what else, of which we so far cannot know! It does so only “practically,” because by creating everything, it understands nothing. Yet, its lack of understanding is far more efficient compared to all our wisdom. An unreliable steward of synthetic assertions about the properties of reality, it knows the world’s statistical nature and acts accordingly, attaching no importance to individual assertions, but only to the entirety of its billion-year expression. Truly, it is worth mastering such a language, which creates philosophies, while ours can only create philosophies. [16]

Yet, it is precisely this difference that makes humans morally accountable, while evolution “buries hecatombs of victims [in its] million-years long trials and errors,” continuously testing what works and what does not, without an end point in mind. [17] Where evolution might, without a second thought, annihilate whole populations or condemn individuals to torturous disabilities, humans cannot pretend that if we were to make similar decisions, such as killing off a species or sentencing other people to prolonged torture, they would not bear moral weight:

One cannot simultaneously make discoveries and avoid taking responsibility for their consequences. We are familiar with the effects of such behavior in nonbiological fields. They are pathetic. In vain may a scholar attempt to narrow their work so that it only involves gathering information, walled away from the questions of application. Evolution, as we have already shown explicitly and implicitly, operates ruthlessly. A person gradually learning about its constructive processes cannot pretend that they are merely accumulating theoretical knowledge. The one who understands the consequences of decisions, who gains the power to make them, will bear the burden of responsibility—a burden that Evolution, as an impersonal constructor, handled so easily, because for it, such responsibility did not exist. [18]

This is why the question of technology, and its role in the drama of existence, becomes so prescient. Is it subservient to human moral action or to evolution’s unthinking designs? William MacAskill’s *What We Owe the Future*, one of the most popular and influential books on the subject of technology’s long-term trajectories, advocates the former. His “long-termist” philosophy not only invites us to pace the length of millennia and picture the world 500 million years ahead, but also to personify it, bringing to mind everyone who might potentially be affected by our actions in the present. [19] It describes current humans as “imprudent teenagers” who have not yet learned how to make correct, altruistic choices that would benefit our future selves and implores us to act well today for the benefit of the generations to come. In such a narrative, future events and ethics are imagined as legible and within our power to influence, and technological progress should by default make the world better. [20] The assumption that we can already see which technologies have good or bad outcomes for civilization, and we simply need to decide which way we would like to go, underlies many authoritative imaginations today, from critiques of technology as inherently harmful to utopian imaginations of technical solutions to social ills.

Yet, alongside *Summa Technologiae*, we can articulate a different perspective, while not abandoning the task of long-term technological prognostication. To begin, though life-forms on this planet 500 million years from now may act in accordance with instrumental values such as efficiency, adaptability, and strategic survival, it is likely they will not **share our present moral or ethical commitments**. Though on the surface, we can think far ahead, we remain suspended in a great void, because real futurism cannot preempt its own ethics. [21] Given the uncertain trajectories of evolution over such long spans of time, it is impossible to predict a shared morality or map out which choices are correct, even on much smaller scales:

There is no ahistorical morality. Phenomena differ in duration but eventually, even mountain ranges fall, reduced to sand, because that is the nature of the world . . . Morality changes slowly, but it does change, and therefore it is more difficult to compare two ethical codes the greater the chasm of time that separates them. We are somewhat similar to the Sumerians [of 5,000 years ago], but the morality of the Levalloisians [of 30,000–300,000 years ago] would terrify us. [22]

13. See, for example, Swirski, Stanislaw Lem.
14. Dawkins, *Blind Watchmaker*. On the one hand, mechanistic metaphors are increasingly challenged in contemporary evolutionary theory, which emphasizes not only the role of contingency but also patterns of convergence, the independent emergence of similar forms across distinct lineages. These suggest that while evolution lacks teleology or a moral orientation, it is not wholly directionless; rather, it is shaped by the constraints and affordances of environments and developmental pathways. Evolution does not aim at perfection, but it often returns to familiar solutions.
15. Lem, *Summa*, 33.
16. Lem, *Summa*, 508.
17. Lem, *Summa*, 38.
18. Lem, *Summa*, 471.
19. MacAskill, *What We Owe*.
20. For an excellent in-depth discussion, see Wolfendale, “Weight of Forever.”
21. Konior, “Non-Philosophy.”
22. Lem, *Summa*, 44.

share our present moral or ethical commitments

Roko’s Basilisk, in which future artificial Intelligence imposes ethical injunctions retrochronically, further intensifies problem of projecting present moral values into unknowable future, linearly conceived.

we do not fully understand

Benjamin Labatut's wondrous first essay in *When We Cease to Understand the World* on deeply ambiguous morality of interconnected discoveries: the pain inflicted by cyanide, the aesthetic beauty of Prussian Blue, the horrors of Zyklon B and the miracle of artificial nitrogen that resulted in the dramatic productivity of vegetative growth necessary to feed the planet's population.

Max Weber

Consider the temporal dimensions of Weber's hypothesis. If Protestantism shapes the future of technocapitalism, what does this imply for the strict determinism—or providence—of Calvinism, in which the future is preordained?

To complicate things further, Lem observes that human agency is not like that of a god—we cannot simply say “Let there be light” and expect reality to match our design. [23] We may believe that moral action in the present causes good outcomes in the future, but there is no hard proof for such calculations. The main caveat is that we do not control the outcomes of our decisions and designs but rather work alongside emergent phenomena and structures **we do not fully understand**: “Civilization encompasses both everything that a society has collectively desired and what was never anyone's intention... Civilization does not function as it wishes, but as it must.” [24] It seems both obvious and pointless to admit that we do not know the outcome of the actions we undertake, or that we have no guarantee that good intentions lead to good effects. Events that seem terrifying to us in the present might yield paradoxically beneficial results in the future, or the opposite. A classic example of moral design gone “wrong” is **Max Weber**'s observation of Protestant asceticism: early Christians saved money to reject material indulgence, yet this behavior enabled the very conditions (capital accumulation, investment, labor structures) that gave birth to consumer capitalism. What began as a moral practice against the world effectively launched a world defined by the very materialism it sought to resist. In this sense, value drift is not only a historical curiosity but a pattern, often catalyzed or accelerated by technology. [25]

Some fields of inquiry, Lem suggests, can at least grasp this limitation: “Mathematicians know perfectly well that they do not know what they are doing. ‘Mathematics,’ said a very competent person, namely Bertrand Russell, ‘can be described as a subject in which we never know what we are talking about or whether what we are saying is true.’” [26] This should challenge the popular idea of a human inventor as “someone who, besides a divine spark, common sense, perseverance, pliers, and a hammer, needs nothing else to achieve her goal.” [27] Yet, so much effort is spent on carefully phrasing desires—outlining what should happen, and how things ought to be—that it's easy to forget how every action gives rise to uncontrollable contingencies. There are always forces at play other than human intent, and even if technology is marching forward toward some teleological goal (such as automation), we are moving alongside it like moles in the dark, digging one step at a time. Humans work in tandem with an incomplete corpus of knowledge, because both our internal motivations and the world itself remain ungraspable: “When doing anything, a person almost never knows what they are actually doing—at least not fully.” [28]

2. A MORALLY OPAQUE PURSUIT: FUNCTIONAL AND EXISTENTIAL TECHNOLOGIES

Given this inherent unknowability of both ourselves and the world, how can we contemplate the deep, unthinkable future of technology and conceive of a moral orientation toward it? To be clear, *Summa Technologiae* does not reject utilitarianism but describes it as merely one category of human technological activity. The book does address common ethical concerns, such as deferring too much responsibility to machines (*kryptokracja*), human suffering under economic and political injustice, the excesses of consumerist culture, or how easily our minds fall prey to biases. The deployment of technology to provide shelter and security, for example, is “mandatory... , only a preparation for the maturity exam; it is the beginning, not the end.” [29] Meeting utilitarian goals is simply what a mature civilization should be able to achieve. However complex and urgent, the challenges of altering our environment to benefit both humanity and the biosphere, or of maintaining planetary homeostasis, remain the early questions of a young civilization. They concern our very survival, and without addressing them we remain as helpless as our most distant ancestors:

Homeostatic human activity, using technologies as its unique organs, has made humans the masters of Earth—powerful, though primarily in the eyes of their own apologists, which is themselves. In the face of climate disruptions, earthquakes, and the rare but real danger of large meteor impacts, humanity is fundamentally as helpless as it was during the last glacial period. True, we have developed techniques for aiding victims of various disasters, and some can even be predicted—though not with precision. But we are still far from achieving planetary-scale homeostasis, let alone homeostasis on a stellar scale. [30]

Is it possible that an advanced civilization is defined not by maximum energy [expenditure], but by optimal regulation? [31]

Yet, if our theory of existential technologies hinges at any specific passage in *Summa Technologiae*, it is one where the relationship between morality and technology is far stranger. Early on in the introduction, Lem suggests, in passing, an idea with great potential, but one might blink and miss it:

Could there one day, even in the most distant future, emerge a technology for remotely controlling internal solar processes, so that [we], infinitely small in comparison to the mass of the sun, could somehow manipulate its billion-year blaze at will? I think it's possible, and I say this not to praise the already sufficiently celebrated human genius, but rather to open up the possibility of contrast. *Up until now, humans have not yet grown. Only their capacity for good and evil has expanded.* [32]

23. Lem, *Summa*, 6.
24. Lem, *Summa*, 6, 55.
25. Weber, *Protestant Ethic*. Thank you to Tom Moynihan for pointing out this example to me.
26. Lem, *Summa*, 243.
27. Lem, *Summa*, 38.
28. Lem, *Summa*, 6.
29. Lem, *Summa*, 332.
30. Lem, *Summa*, 8.
31. Lem, *Summa*, 80.
32. Lem, *Summa*, 8–9, emphasis added.

present moral categories

Idea that intelligence explosion singularity involves an incomprehensible, unrecognizable morality, is strictly perceived.

This phrase, “man has not yet grown” (*jak dotąd, człowiek nie wygromniał*) is tinged with a moral orientation in the original Polish. The verb means “to grow in stature,” not in the sense of acquiring more power but rather becoming noble and worthy of one’s purpose. “We have not yet grown in stature, only our capacity for doing good and evil has expanded.” Though Lem does not return to this thought, let us linger here a bit longer. How could it be that the technologies that make humans grow, that make us noble, are not the ones that we use to do good or harm to one another? A more obvious argument would be that humans become noble precisely through technologies that increase the capacity for good and evil. Yet the idea that there can be a morally opaque but noble pursuit of technology is where we can begin to elaborate the concept of an existential technology. High moral opacity, high existential payoff.

Let us label these technologies that mainly concern interpersonal relationships between humans, and transparently increase our capacity for good and evil, as *functional*. We use them on other people to either harm or help them. We accomplish both great and terrifying things with medication, weapons, mass media, monitoring and transportation systems, construction materials, or energy infrastructures, which also make computation possible. There is no human civilization as we know it without these functional technologies; they also provide the basis for other types of technologies to exist. Existential technologies, on the other hand, are about civilization as we do not yet know it. By altering evolutionary trajectories, they determine not only whether we live well or continue to survive on this planet but also as what we live and survive, and whether that can be still called “us” at all. They may not fit within our **present moral categories**, because their ability to disrupt our basic civilizational ideals is so extensive that it risks abolishing them. Language, both spoken and written, is the most notable example of an existential technology, having changed everything about selfhood, thought, and memory. Whether a technology is functional or existential might be seen only retrospectively or over the span of millennia. One might be also nested inside the other—perhaps it depends on perspective. As we develop technologies that are seemingly mundane and “for us,” their long-term effects might alienate us from whatever definition of humanity had previously been us or seemed natural to us. Ideals so solid that we may not even have names for them could melt into air.

3. EXISTENTIAL TOOLS FOR MINDS AND BODIES

Rereading *Summa Technologiae*, or any work of futurology, through such a framework is a somewhat arbitrary task. The book presents numerous hypotheses about the trajectories of future technologies, some explored in detail, others mentioned only in passing, and the decision of which to foreground is selective by nature. Let us zoom in on where technology’s potential to alienate us and disrupt long-term evolutionary trajectories is most pronounced: first, in epistemology (how we know the world), and second, in ontology (what exists in the world).

The first category is concerned with epistemology, science, and knowledge, as well as the abstract capacities of human civilization, primarily concerned with enabling the continued development of science and technology. Knowledge appears to us, Lem writes, as a grand, beautiful temple that humanity has perfected brick by brick. Only here and there, scattered around the tables like pieces of paper, lay yet unsolved riddles, which we set out to reasonably address in the future. “We leave this temple convinced that these puzzles will be solved sooner or later... It doesn’t even occur to us that solving these riddles might entail the demolition of half the building.” [33] Yet, like evolution, knowledge does not progress in a predictable and linear manner but moves through losses, regressions, and eruptions. One of Lem’s primary concerns—what he viewed as an existential risk—was that human civilization might struggle to manage the sheer volume of information uncovered by science. He feared that we would be unable to synthesize it effectively, leading to a plateau and eventual decline over time. [34] He predicted that the future will bring a broadscale slowing down of discoveries and then stagnation, with science splitting into microfilter bubbles, isolated intellectual communities that reinforce their own assumptions, unable to create a coherent knowledge corpus... [35]

This embarrassment of riches, this flood of information, thrust upon humanity by its cognitive greed, must be mastered. We must learn to regulate even the progress of knowledge; otherwise, the randomness of subsequent development stages will increase. Successes—suddenly opened areas of new, wonderful activity—will overwhelm us with their vastness, thus preventing us from noticing other, perhaps even more valuable possibilities in the long term. The goal is for civilization to gain the freedom for strategic development maneuvers, so it can steer its own path. [36]

Lem suggests that the advancement of science and technology may depend on decoupling them from human comprehension [37]. In two short passages, he briefly mentions a “gnostic machine”:

A gnostic machine must take into account, for the purpose of creating a theory of complexity, a huge number of variables, such that the algorithms of contemporary science cannot produce... At the outset we would receive a

33. Lem, *Summa*, 233.

34. See more in Lem, *Bomba megabitowa*.

35. This is somewhat in line with contemporary ideas about technological stagnation, see Hanlon, “Golden Quarter.”

36. Lem, *Summa*, 119, 332.

37. For more, see Konior, “Gnostic Machine.”

detachment from human cognition

Are there connections between Lem's gnostic epistemology and esoteric tradition of occult theology? Reference: Philip K. Dick's Valis.

theory, coded as, let's say, a whole system of equations. Would humans be able to do anything with these equations? [38]

How much of the matter is under human control is—let's admit it—a matter of perspective. That man can swim does not mean that he can swim the ocean on his own without a ship, not to mention an analogous situation with jets and space rockets. A similar evolution is now taking place, somewhat in parallel, in the information universe. A human might direct a gnostic machine toward a problem that he—or his descendants—might be able to eventually solve on their own, but during its work, the machine might open his eyes to problems he had not even suspected. In the last instance, who has the agency here? [39]

Following Lem's own terminology, we can call these technologies *gnostic*. Their goal is the automation of science through an at least partial **detachment from human cognition**. [40] This is no small task, because it requires that we understand how science operates, which is also one of the main themes of Lem's oeuvre. He predicts that increasingly, scholars and scientists will rely on gnostic technologies to generate knowledge through methods that remain somewhat obscure—"building theories not from empirical facts, but from frameworks devised by gnostic machines." [41] This will have implications for how we think about knowledge as such—no longer something explainable according to the scientific method perfected over the last few hundred years.

Many of Lem's descriptions throughout *Summa* are substrate-agnostic, yet from our perspective, computers seem like prime candidates for gnostic technologies. Arguably, gnostic machines already exist in the form of black-boxed, noninterpretable deep learning. These technologies produce knowledge, while their internal operations remain obscure. AlphaFold, an advanced AI system developed by DeepMind, has revolutionized the field of biology by accurately predicting the three-dimensional structures of proteins based solely on their amino acid sequences, opening new avenues for drug discovery and disease research. [42] In the quest to uncover signs of extraterrestrial life, SETI researchers are increasingly turning to artificial intelligence for analyzing vast amounts of data collected from radio telescopes. [43] AIs are also analyzing animal communication and finding patterns in bird and whale songs, with researchers already positing that nonhuman animals have alphabets and their own languages, disrupting previous beliefs about human exceptionalism. [44] Though this merits a whole essay of its own, these technologies operate outside the principles of causal explanation. In their internal, high-dimensional vector spaces, they process concepts in an entangled, noninterpretable manner. They contribute to knowledge without making it intelligible. [45]

Lem's vision encompasses not only scientific progress but also the use of machine gnosis for the production of future philosophical and metaphysical theories. Throughout various chapters of *Summa*, he envisions new forms of modeling and simulations whose referents would not be empirical worlds but rather concepts and ideas. Technologies of phantomatics, for example, could enable us to simulate whole worlds based on propositions of specific philosophies. This form of revealed knowledge would be philosophical or metaphysical. We are yet to invent gnostic technologies for these purposes.

A second category of technologies is concerned with what exists in the world, with ontology, identity, and bodies. Let us call them *anthropoforming technologies*. [46] They manipulate cognition, reproduction, and embodiment, challenging current ideas about freedom, selfhood, or agency. Cloning, for instance, would introduce the issue of "existential relativity," similar to the concept of relativity in physics, where identity and selfhood become entirely relative to the original and its copies. [47] Anthropoforming could also happen on the scale of populations, such as in "a plan to create the 'next model of Homo sapiens' spread out over time, perhaps over centuries or even millennia, not through a sudden leap, but through a gradual and slow process of change, which would smooth out intergenerational differences." [48] This might include the use of "machine matchmakers" to engineer human love and sexual reproduction toward specific trajectories, xenowombs, or in vitro creation of life using sperm preserved for centuries. [49] Speculating on each option, Lem is quite interested in exploring these outrageous possibilities, pondering the meaning of outsourcing supposedly "human" processes and instincts to machines, who themselves possess no interiority:

I am not demonizing these impersonal regulators at all; I am merely presenting the astonishing situation in which, as if in Polyphemus's cave, it is Nobody who approaches us—but this time, for our own good. [50]

In the 1960s, such technologies were mostly hypothetical: "Technology is more aggressive than we usually think," Lem writes, "its interventions into mental life, the issues related to the synthesis and metamorphosis of personality... are currently a class of phenomena that remains empty." [51] Yet, this is no longer the case. The number of people who meet their partners through algorithmic matchmaking on dating apps is growing, along with the rising trend of humans entering into romantic relationships with artificial agents, such as chatbots. Consider also nascent technologies of reproduction, such as IVG (in vitro gametogenesis), which permits the creation of eggs and sperm from ordinary body tissue, such as skin cells. Through IVG, "men could become genetic mothers, women could be fathers,

38. Lem, *Summa*, 207.

39. Lem, *Summa*, 391.

40. Lem, *Summa*, 340.

41. Lem, *Summa*, 340.

42. Jumper et al., "Protein Structure Prediction."

43. Woollacott, "How AI Is Helping."

44. Ryan and Bossert, "Dr. Doolittle Uses AI."

45. Whether AlphaFold produces knowledge depends on how one defines knowledge. In the strict sense, AlphaFold does not "know" what a protein is; it does not understand, justify, or verify its outputs. Knowledge emerges only when humans interpret, test, and validate the results. However, from a nonanthropocentric, instrumentalist, or posthumanist perspective, knowledge is not confined to human cognition but emerges through assemblages of humans, tools, and infrastructures. In this view, AlphaFold functions as a nonhuman epistemic agent within a broader network of discovery.

46. I borrow the term *anthropoforming*, which is analogous to *terraforming*, from a talk by Helen Hester. While terraforming involves modifying a hostile environment to make it habitable for humans, anthropoforming focuses on altering our own bodies to adapt to adverse conditions. An example of "natural" anthropoforming is pregnancy, during which the body changes to protect itself from a potentially hostile life-form. Without these adaptations, the fetus could invade the uterus and harm its host. Since the fetus is genetically distinct from the mother, it could trigger a maternal immune response similar to how the body reacts to parasites or foreign tissue. However, the mother's immune system undergoes complex adaptations to tolerate the fetus. Hester, "TTF 2020 – Keynote."

47. Lem, *Summa*, 316.

48. Lem, *Summa*, 422.

49. Trained as a doctor of medicine, Lem was interested in questions of sex and reproduction throughout his career, for example in the rather provocative Lem, *Sex Wars*. Although Lem does not directly mention, for example, American geneticist H.J. Muller or his attempt in the 1920s and 1930s to establish a sperm bank stocked with the seed of geniuses—including, reportedly, an invitation to Stalin—his writing nonetheless reveals an awareness of these ideas.

50. Lem, *Summa*, 218.

51. Lem, *Summa*, 44.

and people could be the offspring of one, three, four or any number of parents.” [52] While the past two decades have been characterized by the image of the computer nerd and the company CEO, the near future might be focused on anthropoforming or hacking bodies, selves, nervous systems, emotions, and identities. People are already creating digital replicas of deceased loved ones [53], producing voice clones of themselves for automated interactions with advertisers [54], and sending deepfakes to engage in sex work [55]. The barrier to adaptation here is not scientific but social. Although these developments seem isolated now, they might signal nascent social readiness for significant identity manipulation through technologies such as CRISPR, a gene-editing tool that allows precise modifications to DNA. On a long enough timeline, such anthropoforming might point toward truly existential changes for human civilization or even the human species.

We can propose many other kinds of technologies, other categories, other possible tools. Taken together, gnostic and anthropoforming technologies can exemplify what existential technologies are: not merely tools for treating each other well or badly, but processes that unsettle the foundations of how we know the world and what exists in it. Gnostic technologies displace human cognition as the central site of epistemic authority, gesturing toward a future in which knowledge is generated through inhuman, often unintelligible processes. Anthropoforming technologies, in turn, destabilize what it means to be human by intervening in embodiment, reproduction, and desire, reframing selfhood as something artificial and contingent. Both suggest that the most significant technological shifts are not necessarily those that directly relate to human needs but those that change what counts as knowledge of existence or as existence itself. In this way, *Summa Technologiae* remains not only prescient but also indispensable for any futurology that wants to grasp what lies beyond immediate social priorities.

4. SEEING THE FUTURE, EASTWARD

Deprioritizing human sensemaking and aspirational social change, *Summa Technologiae* stood in sharp contrast to both Promethean Soviet science fiction and state-sanctioned Marxist “science” of the time, where humans as the custodians and captains of the ship called *History* tame the turbulent waters of Nature, sailing toward ever more robust forms of progress and justice. [56] Unlike political teleology or other utopian convictions that the world is or should be getting “better” over time, evolution shows itself as adaptive, cunning, messy, and indifferent. [57] Life assembles itself in a haphazard and opportunistic manner; it pays no heed to our noble intentions or moral claims. And just like life-forms, technologies do not simply “progress” toward better forms, but meander and mutate. No matter how tightly woven our conceptual nets might be, the world is resistant to our efforts, while also intruding on concepts that just yesterday might have been set in stone. While it is much easier to think about technology as a pliant tool for social change, this is a convenient delusion befitting an ideologue, but not someone who wants to think in parallel to the currents of history and evolution.

Nevertheless, ideas come into sharper focus when mirrored in the arc of experience. Intellectuals living through momentous historical events might more readily notice certain patterns that govern history as such, which sooner or later happen on other timelines too. What they discover is not culturally relative but only temporarily inaccessible to those who have not yet found themselves in turbulence, where the logic of amoral selection and experimentation with all that exists is laid bare. Though some insights are only graspable through historical contingency, they pertain to all humans. Hence, to revisit some events of Lem’s life is to underscore their universal resonance, and their relevance to a theory of existential technologies. If evolution and history do not move toward perfection on a linear timeline, we would do well to listen to those on the backswing of the pendulum while we’re moving forward: they are not “behind” in their insights, only at a different point of the path that unfolds multilaterally.

That Lem authored *Summa Technologiae* is no surprise—in the 1960s, at the peak of his literary career, he already said that he’d like to abandon science fiction, which he described as a genre lacking rigor, for science writing. [58] Though he can be a fantastic storyteller, in some of his erudite fictions, it is clearly visible that he’d rather be doing philosophy or science instead—several of his novels quickly devolve into a series of essayistic lectures that barely mask a plot. In the early 1960s, when he worked on *Summa*, trips to Moscow and conversations with astronomers and physicists such as Iosif Shklovsky and Piotr Kapica, who treated him as a peer, rekindled his fantasies of a scientific career. With the help of his Russian translators, Adriana Gromova and Dmitri Bruskin, and with the Khrushchev Thaw easing access to anglophone scientific publications in the USSR, Lem was able to access the hotly debated books pertaining to cybernetics, which in turn made writing *Summa* possible. Unlike in the Stalinist years, during the Thaw cybernetics was no longer considered a reactionary bourgeois science [59]. In its language, Lem was able to find ideas about technology that paralleled those he studied in the natural sciences:

These ideas [in cybernetics] were tied to a specific worldview, in which social bonds are formed through the exchange of information subject to entropy. Norbert Wiener, like Darwin, abandoned the notion that evolution was a

52. Schulman, “World Isn’t Ready.”
53. Fagone, “Jessica Simulation.”
54. Ratliff, *Shell Game*.
55. Brennan, “Byström Deepfakes.”
56. This is somewhat of a generalization, and the question of nature is a large and complex topic. Despite state censorship, Marxist approaches to this subject, even during the Soviet era, were not necessarily monolithic. See, for example, Bakhurst, “Political Emancipation.”
57. In *Summa*, Lem refers to what he describes as an “explicatory monomania” (171) in psychoanalysis, which he also associates with frameworks such as poststructuralism and Marxism, although he can express his views on the latter only indirectly, due to censorship. He criticizes the tendency of these frameworks to reduce complex phenomena to a predetermined set of explanations, providing their users with cognitive shortcuts. While *Summa* touches on technological accidents and their consequences, Lem’s *Filozofia przypadku. Literatura w świetle empirii* (Philosophy of accident: Literature in light of empiricism) explores chance and randomness in culture and literature. In it, he challenges the focus on authorial intent, using game theory, mathematics, and other approaches.
58. Lem, “Science-Fiction.”
59. Gerovitch, “InterNyet.”

His masterpiece, *Solaris*

"The sublime alterity of the *Solaris* ocean is one of cinema's great images of the unknown"—Mark Fisher on *Solaris* in *The Weird and the Eerie*.

gradual progression toward ever higher and better forms. Instead, he pointed out that living beings have an inherent tendency for multidirectional development, while simultaneously imitating their ancestors, which ultimately helps them adapt to their environment. [60]

Lem was uniquely positioned to contribute to these efforts. While he is mostly known as a science-fiction writer and the author of the acclaimed novel *Solaris* (1961), he trained as a medical doctor, worked as a scientific book reviewer, authored scholarly monographs on empiricism in literature, and was an autodidact of the highest caliber, whose nonfiction works were like guides to scientific and technological changes in the world for Polish readers. Although he is renowned for tales of space travel and alien planets, his interest in the biological sciences remained evident across his roughly twenty novels, dozens of short stories, and hundreds of essays. Throughout *Summa Technologiae*, he speculates on technological trajectories through the prism of long-term possibilities, rather than through the five- or ten-year social, economic, and political development plans. The Soviet Communist Party much preferred Lem's earlier socialist realist works for their uncomplicated progressive ideas about technology as a tool for social progress. [61] **His masterpiece, *Solaris***—where a mysterious ocean planet resists all human attempts at comprehension, and where technology is more of a metaphysical than a social problem—came under fire and censorship for being mystical and nihilist. [62] Yet, technology is useful and interesting precisely because it cannot be reduced to human designs. Its value lies in its alienating character, which should be embraced. Having lived through the collapse of utopian projects for a better society, Lem's favorite themes were technological accidents and human hubris, or the inability to comprehend alterity and our place in the cosmos. His novel *Eden* opens with this simple line: "There was a miscalculation." [63]

In letters to friends and when possible, Lem spoke about the realities of writing under Soviet occupation. Describing daily life in communist Poland in 1955, when paper was rationed alongside other goods, he joked: "Writing is the darkest part of my life. My whole creative process is a litany of vile swindles. For years now, just so I can write, I've been blackmailing state officials, exploiting nepotistic connections, lying, cheating and demoralizing." [64] Among shortages of food and heating, writers scribbled their work on envelopes or packaging paper discarded by the post office. Ironically, they also saved paper left over from articles commissioned by the Party, pertaining to progress and morality:

[We are all waxing lyrical] about the vocation of the writer, this conscience of the nation. And then with a little blackmail, a little groveling, one dodgy little essay, a quick phone call to a friend on the editorial board, the most beautiful morality play can be ready. [65]

Lem's actual views on morality, progress, and technology were complex and increasingly focused on exploring the idea of technology as a tendency toward the inhuman and as something that reveals the workings of contingency in our daily lives. In *Summa*, he notes that science is what lets us peek at the "the essence of a perfectly indifferent world," [66] which remains unmoved by human hopes and fears. Or, as he puts it in one of his novels:

[It is] science that is precisely the transcendence of experience, grinding yesterday's categories of thought into dust; seemingly a day ago, absolute space and time collapsed, today the seemingly eternal difference between... determinism and randomness may burst apart. [67]

At the bottom of philosophy—which always wants to say more than is possible at a given time, because it represents an effort to "capture the world" in a closed conceptual net—even in the works of the most illustrious thinkers, there lies hidden an acute fragility. Man's quest for knowledge is an expanding task whose limit is infinity, but philosophy seeks to attain that limit in one blow, [attempting] a short circuit into certain, complete, and inalterable truth. Science meanwhile advances at its gradual pace, often slowing to a crawl, at times even stepping in place, but eventually it reaches the various ultimate trenches dug by philosophical thought, and, quite heedless of the fact that it is not supposed to be able to cross those final barriers to the intellect, goes right through. [68]

These are defiant thoughts for someone who lived under a political system that wanted to proclaim everything, from the psyche to the cosmos, as submissive to human ideologies. Lem's resignation to the incessant onslaught of history might have stripped him of illusions and naivete, but not of respect for the unknown that lies perpetually in the waiting. Futurology must show us what lies beyond human sensemaking, a task we may achieve both through novels and art and with attention to transformations in science. Lem dramatically titled his final novel *Fiasco*, reflecting his profound skepticism about humanity's ability to grapple with this task. [69] He spent the remaining two decades of his life publishing nonfiction essays on science, technology, and politics.

Lem's growing pessimism stemmed not only from his interpretation of evolution and history but also his own life. As a young Jewish man growing up in Lviv in the 1920s, he came of age in a city still reeling from the Polish-Ukrainian War of

60. Gajewska, Stanisław Lem, 362.
61. Gajewska, Stanisław Lem, 334–56.
62. Lem, *Solaris*.
63. Lem, *Eden*, 1.
64. Gajewska, Stanisław Lem, 258.
65. Gajewska, Stanisław Lem, 259.
66. Gajewska, Stanisław Lem, 259.
67. Lem, *Głos Pana*, 53–54.
68. Lem, *Głos Pana*, 52–53.
69. Lem, *Fiasco*.

Intellectuals in Eastern Europe

There's a disproportionate influence of East European thinkers on understanding technology: The Golem by Gustav Meyrink, Rossum's Universal Robots by Karel Čapek, Norbert Wiener (a descendant of East European scholars and rabbis).

1918–1919. His medical studies and scientific ambitions were disrupted by the Soviet occupation in 1939, and then the Nazi invasion in 1941, which his family narrowly escaped under harrowing circumstances. These traumas haunted his writing. [70] Having lived through the Holocaust, Soviet imperial expansion, communist authoritarianism, and fast-tracked transitions to capitalism, he knew well what it meant for the world to dissolve and take shape anew. In his novels, human characters often participate in events they do not control, as if they are scraps of paper carried by the tumultuous winds of history. The majority of Lem's adult life took place during the Cold War, when Ukraine and Poland were regarded as merely geopolitical buffer zones. Bulldozed by various techniques of both psychological and physical violence, twentieth-century Eastern Europe was sifted through the curse of history, marred by war and cruelty, and aptly christened "the Bloodlands," where "the good people died first" and "closure is a false harmony, a siren song masquerading as a swan song." [71]

The intellectual rift between the so-called Eastern and Western sides of Europe has not been bridged or even acknowledged, even less so with regard to technology, and this task cannot be mended by a short essay such as this one. Alongside experiences of occupation and a diminished sense of agency, **Intellectuals in Eastern Europe**—or any territory that modernized under occupation—were able to grasp technology as an invasion, or a logic coming from without. Yet, in my estimation, in contrast to numerous postcolonial, postimperial territories, many Eastern European intellectuals have not rejected technology but rather understood it as an inhuman vector beyond the confines of human cruelties, virtues, and the authoritarian ideologies they had to live under. [72] Under Soviet governance, and as is often true of regions under occupation, seized territories were like "free zones of technological and social experimentation, laboratories where modernisation happened with dazzling speed," an "imperial future shock . . . at a speed that made resistance futile." [73] In response, multiple intellectual avant-gardes emerged whose disjointed style paralleled the disintegration of "normal" human perception. [74] This disjointing of perception—stemming from being caught in cruel webs of history and swept along by waves of change—reveals the nonlinear nature of history: not a path toward progress but a cycle that continually loops back into disintegration. As Tomasz Szerszeń puts it, looking at war, for example, requires adopting fractured, simultaneous points of view: "A sort of double exposure [that] allows one to capture the image of history while simultaneously escaping its destructive force." [75] The experience of externality, lack of agency, or being intruded on by an "outside" can refer not only to the tangible political event of war and occupation but also to an inhuman order of history that transcends human control.

If Lem's *Summa Technologiae* is a worthy interlocutor for a theory of existential technologies, it is not only because it makes claims that resonate with today's intellectual climate of cross-reading the natural and technical sciences. What we may find in Lem—and, perhaps, in the whole of the Eastern European past and present intellectual legacy—is an antidote to the "long-termist" vision of the future as simplistically tending toward either utopia or disaster, both wholly submissive to human sensemaking. Even if we cannot foresee the precise forms or tools technology will take or create, we can begin to articulate a moral orientation toward what is unknown and inhuman. Rather than recoiling, we may learn to lean into our fatalism but keep stubbornly pushing toward alienation, artificiality, the unknown, and the inhuman, and toward all processes that cannot be fully captured or domesticated by human ideologies, which have proven themselves faulty over and over again. Existential technologies as a framework give us a basic language for describing the progressing detachment of technology from human cognition and morality, while also capturing our sensation of living within a split history, which seems to move forward and backward at the same time rather than tending toward some teleological goal. They capture both the collapse of the ideal of linear progress and a commitment to the continued surfing of technology's unpredictable trajectories.

70. For more, see Gajewska, *Zagłada i gwiazdy*.

71. Snyder, *Bloodlands*, 387.

72. For further discussion, see Konior, "Impersonal Within Us."

73. Csicsery-Ronay, "Lem, Central Europe," 133.

74. Biberstein, "To Watch the War."

75. Szerszeń, *Być gościem*, 75.

BIBLIOGRAPHY

Arthur, W. Brian. *The Nature of Technology: What It Is and How It Evolves*. Simon and Schuster, 2009.

Bakhurst, David. "Political Emancipation and the Domination of Nature: The Rise and Fall of Soviet Prometheism." *International Studies in the Philosophy of Science* 5, no. 3 (1991): 215–26. <https://doi.org/10.1080/02698599108573395>.

Biberstein, Sandra. "To Watch the War: An Interview with Olexii Kuchkanskyi and Oleksiy Radynski." *Crisis and Communitas*, October 24, 2022. <https://crisisand-communitas.com/?crisis=to-watch-the-war-an-interview-mit-olexii-kuchkanskyi-and-oleksiy-radynski>.

Brennan, Orla. "Artist Arvida Byström Deepfakes Her Own Nudes." *AnOther*, April 3, 2024. <https://www.anothermag.com/art-photography/15550/arvida-bystrom-ai-deepfake-nudes-artist-in-the-clouds-book>.

Butko, Peter. "Summa technologiae: Looking Back and Ahead." In *The Art and Science of Stanisław Lem*, edited by Peter Swirski. McGill-Queen's University Press, 2006. <https://doi.org/10.1515/9780773575073-006>.

Csicsery-Ronay, Istvan. "Lem, Central Europe, and the Genre of Technological Empire." In *The Art and Science of Stanisław Lem*, edited by Peter Swirski. McGill-Queen's University Press, 2006. <https://doi.org/10.1515/9780773575073-009>.

Dawkins, Richard. *The Blind Watchmaker: Why the Evidence of Evolution Reveals a Universe Without Design*. W. W. Norton & Company, 1996.

———. *The Selfish Gene*. Oxford University Press, 1976.

Fagone, Jason. "The Jessica Simulation," *San Francisco Chronicle*, 2021 <https://www.sfchronicle.com/projects/2021/jessica-simulation-artificial-intelligence/>.

Gajewska, Agnieszka. Stanisław Lem. *Wypędzony z wysokiego zamku*. Wydawnictwo Literackie, 2021.

———. *Zagłada i gwiazdy. Przeszłość w prozie Stanisława Lema*. Wydawnictwo Naukowe UAM, 2016.

Gerovitch, Slava. "InterNyet: Why the Soviet Union did not build a nationwide computer network." *History and Technology* 24, no. 4 (2008): 335–50. <https://doi.org/10.1080/07341510802044736>.

Gille, Bertrand. "Histoire des techniques." *Annuaire de l'École pratique des hautes études* 109, no. 1 (1977): 723–86.

Hanlon, Michael. "The Golden Quarter." *Aeon*, December 3 2014. <https://aeon.co/essays/has-progress-in-science-and-technology-come-to-a-halt>.

Hayles, N. Katherine. *Bacteria to AI: Human Futures with our Nonhuman Symbionts*. University of Chicago Press, 2025.

———. *Unthought: The Power of the Cognitive Nonconscious*. University of Chicago Press, 2017.

Hester, Helen. "TTF 2020 – Keynote by Helen Hester. Posted July 7, 2020, by Strelka Institute. YouTube, 29:50. <https://www.youtube.com/watch?v=Y1fnG9iA5RA>.

Hofstadter, Douglas R. *Gödel, Escher, Bach: An Eternal Golden Braid*. Basic Books, 1979.

Jumper, John, Richard Evans, Alexander Pritzel, et al. "Highly Accurate Protein Structure Prediction with AlphaFold." *Nature* 596 (2021): 583–89. <https://doi.org/10.1038/s41586-021-03819-2>.

Kapp, Ernst. *Elements of a Philosophy of Technology: On the Evolutionary History of Culture*. University of Minnesota Press, 2018.

Konior, Bogna. "The Gnostic Machine: Artificial Intelligence in Stanisław Lem's Summa Technologiae." In *Imagining AI: How the World Sees Intelligent Machines*, edited by Stephen Cave and Kanta Dihal. Oxford University Press, 2023. <https://doi.org/10.1093/oso/9780192865366.003.0006>.

———. "The Impersonal Within Us: A Conversation with Bogna Konior." Interview by Filippo Scafi and Tommaso Garavaglia. *Chaosmotics: Thinking Unbound*, December 29, 2022. <https://www.chaosmotics.com/en/featured/the-impersonal-within-us>.

———. "Non-Philosophy and Speculative Posthumanism: A Conversation with David Roden." *Oraxiom: A Journal of Non-Philosophy* 1 (2020), 158–67.

Lem, Stanisław. *Bomba megabitowa*. Wydawnictwo Literackie, 1999.

———. *Eden*. Translated by Marc E. Heine. Harcourt Brace Jovanovich, 1989. First published in Polish in 1959.

———. *Fiasco*. Translated by Michael Kandel. Harcourt Brace Jovanovich, 1987. First published in German translation in 1986.

———. *Filozofia przypadku*. Literatura w świetle empirii. Wydawnictwo Literackie, 1968.

———. *Głos pana*. Wydawnictwo Literackie, 2016, 53-54.

———. *His Master's Voice*. MIT Press, 2020.

———. *A Perfect Vacuum*. Northwestern University Press, 1999.

———. "Science-Fiction: A Hopeless Case—with Exceptions." In *Microworlds: Writings on Science-Fiction and Fantasy*, edited by Franz Rottensteiner. Harcourt, Brace and Company, 1984.

———. *Sex Wars*. Warszawa: Wydawnictwo Nowa, 1996.

———. *Solaris*. Translated by Bill Johnston. Conversation Tree Press, 2024. First published in Polish in 1961.

———. *Summa Technologiae*, Kraków: Wydawnictwo Literackie, 2020.

MacAskill, William. *What We Owe The Future*. Simon and Schuster, 2022.

Orliński, Wojciech. *Lem: Życie nie z tej ziemi*. Wydawnictwo Czarne, 2017.

Ratliff, Evan, host. *Shell Game*. Podcast, 2024—. <https://www.shellgame.co/>.

Ryan, Mark, and Leonie N. Bossert. "Dr. Doolittle Uses AI: Ethical Challenges of Trying to Speak Whale." *Biological Conservation* 295 (2024): 110648. <https://doi.org/10.1016/j.biocon.2024.110648>.

Schulman, Ari. "The World Isn't Ready for What Comes After I.V.F." *New York Times*, September 9, 2024. <https://www.nytimes.com/2024/09/09/opinion/ivf-debate.html>.

Simondon, Gilbert, Ninian Mellamphy, and John Hart. *On the Mode of Existence of Technical Objects*. University of Western Ontario, 1980.

Snyder, Timothy. *Bloodlands: Europe between Hitler and Stalin*. Random House, 2011.

Stiegler, Bernard. *Technics and Time, 1: The Fault of Epimetheus*. Stanford University Press, 1998.

Swirski, Peter. *Stanislaw Lem: Philosopher of the Future*. Oxford University Press, 2015.

Szerszeń, Tomasz. *Być gościem w katastrofie*. Wydawnictwo Czarne, 2024.

Weber, Max. *The Protestant Ethic and the Spirit of Capitalism*. Translated and edited by Stephen Kalberg. Routledge, 2001.

Wolfendale, Peter. "The Weight of Forever: Peter Wolfendale Reviews What We Owe the Future by William MacAskill." *The Philosopher*, November 18, 2024, <https://www.thephilosopher1923.org/post/the-weight-of-forever>.

Woollacott, Emma. "How AI is Helping the Search for Extraterrestrial Life." *BBC News*, February 22, 2024. <https://www.bbc.com/news/business-68346015>.