THE HERASAGA

BOOK ONE: HERA, OR EMPATHY

BOOK TWO: THE PRIESTHOOD OF SCIENCE

BOOK THREE: HERA THE BUDDHA

NOTE TO THE READER:

This PDF file contains Chapter 1, "The Rupture in Historical Time in the Modern West," in the book entitled *Hera The Buddha*; the entire volume is available as an E-book on Amazon, as follows:

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Figure 1 Yucca brevifolia in bloom, Joshua Tree National Park, California (Photo: W. Leiss)

HERA THE BUDDHA

A WORK OF UTOPIAN FICTION

WILLIAM LEISS

$$e^{i\pi}+1=0$$

Figure 2 Euler's Identity

A CANGRANDE BOOK

A CANGRANDE BOOK
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This is a work of fiction. Names, characters, places, and incidents are products of the author's imagination or are used fictitiously. Any resemblance to actual persons, living or dead, is entirely coincidental.

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for HEIDEMARIE *and* THE DAUGHTER

EPIGRAPHS

What happens when machines become more intelligent than humans? One view is that this event will be followed by an explosion to ever-greater levels of intelligence, as each generation of machines creates more intelligent machines in turn. This intelligence explosion is now often known as the "singularity." …. If there is a singularity, it will be one of the most important events in the history of the planet. An intelligence explosion has enormous potential benefits: a cure for all known diseases, an end to poverty, extraordinary scientific advances, and much more. It also has enormous potential dangers: an end to the human race, an arms race of warring machines, the power to destroy the planet.

David Chalmers (2010)

As if somehow intelligence was the thing that mattered and not the quality of human experience. I think if we replaced ourselves with machines that as far as we know would have no conscious existence, no matter how many amazing things they invented, I think that would be the biggest possible tragedy. There are people who believe that if the machines are more intelligent than we are, then they should just have the planet and we should go away. Then there are people who say, 'Well, we'll upload ourselves into the machines, so we'll still have consciousness but we'll be machines.' Which I would find, well, completely implausible.

Stuart Russell (2017)

We are the first species capable of self-annihilation. Elon Musk (2017)

If you want a picture of A.I. gone wrong, don't imagine marching humanoid robots with glowing red eyes. Imagine tiny invisible synthetic bacteria made of diamond, with tiny onboard computers, hiding inside your bloodstream and everyone else's. And then, simultaneously, they release one microgram of botulinum toxin. Everyone just falls over dead. Only it won't actually happen like that. It's impossible for me to predict exactly how we'd lose, because the A.I. will be smarter than I am. When you're building something smarter than you, you have to get it right on the first try.

Eliezer Yudkowsky (2017)

[W]e need not worry about the forecast that, in the near future, a "really smart" digital computer/machine will supplant human nature or intelligence. In all likelihood, this day will never come because, in a more-than-convenient arrangement, our most intimate neural riddles seem to have been properly copyright-protected by the very evolutionary history that generated our brains, as well as the very complex emergent properties that make it tick. As such, neither evolution nor neurobiological complexity can be effectively simulated by digital computers and their limited logic.

Miguel Nicolelis (2014)

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Chapter 1: The Rupture in Historical Time in the Modern West

AFTER THE COLLAPSE OF THE ROMAN EMPIRE, the three Abrahamic religions – Judaism, Christianity, and Islam – dominated Western civilization from the fifth to the eighteenth centuries CE. One of their salient features is a specific and deliberately backward-looking perspective. For the Pentateuch (the Five Books of Moses or the Torah), the gaze is on the seven days of creation story, which marks the beginning of time for humankind; for Christianity's New Testament, it is the birth of Christ in 33 BCE; for the Qur'an, it is the dictation of Islam's holy book to the Prophet Mohammed during the seventh century CE. Even though for the latter two, Christianity and Islam, there is an ominous foretelling of a future catastrophe known as the End Times or the Day of

Judgement, the lineaments of that world-destroying episode were all unalterably set in motion by events in the far-distant past.

Despite a host of important technological innovations, such as in sea navigation, warfare, and agriculture, daily life for the common people had not changed or improved appreciably during that thirteen-hundred-year period. The Great Lisbon Earthquake of 1755, which also featured huge fires and a tsunami, killing tens of thousands, and which occurred on an important religious holiday, All Saints' Day (November 1), served as a reminder of humanity's helplessness before the traditional forces of untamed nature. Much more so, however, major catastrophes such as this one had always been interpreted in religious circles as signs of God's anger with persistent human transgressions against His commandments, again pulling attention back to an unchanging moral law and behavioral code set in stone so long ago.

But the Great Lisbon Earthquake also inspired one of that century's most famous tomes, Voltaire's *Candide* (1759), which mercilessly mocked this tradition. It was a sign, one of many, that during the eighteenth century a radically-different, comprehensive challenge to established ways of thinking and acting was being mounted. We came to know this new intellectual force as the French Enlightenment. Although named for one nation, this revolutionary international movement also embraced Scots such as Adam Smith and David Hume, Englishmen such as Joseph Priestley, Germans such as Immanuel Kant and Johann Fichte, and French thinkers such as d'Alembert, Condorcet, Diderot, Voltaire, Rousseau, and Montesquieu; their signature collective work was the *Encyclopédie,* edited by Diderot and d'Alembert. All of them also looked back for inspiration to a set of somewhat earlier and equally influential English thinkers – Francis Bacon, Thomas Hobbes, John Locke, and Isaac Newton. And to the heroic Italian Galileo Galilei, of course, who as an old man had paid for his defense of his "new science" with house-arrest and the threat of torture by the Papacy's Tribunal of the Holy Office of the Inquisition.

In constructing their new world-view, Enlightenment thinkers had one powerful adversary in mind: Christianity, and more particularly, the Catholic Church. Their named their enemy "superstition," which they identified with organized religion, and to replace it they championed what we would today call evidence-based reasoning – or, more simply, modern science. In the eyes of many of them, most especially people like

Condorcet, what was needed was for the type of reasoning implicit in the new natural sciences to gradually diffuse through modes of reasoning and behavior in the larger society. And in spawning both a continuing series of new technologies as well as industrialization, modern science eventually revolutionized not only thinking but everyday life to such a degree that it is hard to imagine anymore what life-conditions in the past actually represented for most people.

Gradually, however, science and its supporting mathematics became vastly more complex in purely intellectual terms. In general, the revolutionary insights achieved by the modern natural sciences unfolded in three historical stages – first chemistry, then physics, and finally biology. The eighteenth-century chemistry experiments by Antoine Lavoisier, Joseph Priestley and Henry Cavendish, as well as the earlier work of Robert Boyle, had already begun to have an impact on industrial production by the middle of the nineteenth century. Physics was next, its development accelerating in the late nineteen-hundreds and then exploding in the first quarter of the twentieth century with atomic and subatomic theory, radioactivity, relativity, cosmology, and quantum mechanics. Biology followed, with great breakthroughs in evolution, molecular biology, and genetics, and at this point the deeper connections between these foundational natural-science disciplines also began to appear.

But as these sciences mapped out vast, previously-unknown dimensions of the natural world, their growing intellectual complexity gradually pushed all of them well beyond the capacities of ordinary human intelligence. In other words, the nature of the evidence they rely on to support competing theories and to verify experimental results defy easy explanation in terms of common-sense understanding. Beginning in the early 19th century there were frequent public lectures by scientists, but the most popular venues were such things as the theatrical demonstrations using electricity and magnetism, which fascinated audiences. Inevitably the natural sciences became over time less significant as a potential influence on popular thinking. Instead, what dazzled the popular imagination was the continuing outpouring of new technologies for the home, the workshop, and the factory. The machine age was upon us, first in mechanical form and later in electric and electronic.

The advantages of the new technologies of the machine age were so obvious, in terms of improving the general standard of living and reducing backbreaking labor, that the early forms of resistance to them – such as those of the Luddites – were easily overcome. When the consumer culture began to arrive, towards the end of the nineteenth century, bringing access to countless, helpful household devices for the majority of the population, continuous technological innovation became a key feature of everyday life. (This was the same period when advances in medicine meant that the treatments of physicians and hospitals started to become a net benefit rather than an incremental harm.) Once portable electronic devices arrived on the scene, daily life would never be the same again.

There is a strong interdependence between advances in modern science and in modern technology. This has been true since at least the time in the early seventeenth century when the new lenses developed by Dutch technicians were used in telescopes by Galileo and others to make startling discoveries about our solar system. This immensely productive interplay, where scientific discovery goes hand-in-hand with advances in measurement and detection instrumentation, continues to the present day: The extraordinarily complex technologies used in the Large Hadron Collider make possible the ongoing scientific discoveries in subatomic physics, most famously the experimental proof of the existence of the Higgs boson, which had been predicted by scientific theory. In a sense, this very fruitful interplay between science and technology goes as far back as their beginnings in ancient Greece. The best testimony to this is the remarkable "Antikythera" mechanism – called by some experts an analogue computer – dating to the period 150-100 BCE – an instrument with 30 meshing bronze gears, and designed for astronomical calculations; nothing rivalling its complexity would be constructed again until the 14th century in Europe. And yet the fateful nature of this interplay has been too little understood for far too long.

The thesis I wish to advance here is a simple one. It is this: The modern natural sciences, and more specifically their dependence on evidence-based reasoning, have been an unambiguous good for humanity and will remain so. But their closely-related phenomena, modern technologies and industrial society, are not. The future welfare of humanity depends on understanding this basic proposition as well as its practical consequences.

This thesis can be easily misunderstood, in part because the interdependence between science and technology is so obvious and significant. But that all or most technologies have a double aspect should be equally obvious. In their link to the sciences, technologies of observation and measurement are an indispensable part of humanity's insatiable desire *to know*. Their second aspect is the equally powerful drive *to act in the world*. The same or similar technologies are of course often found in both: For example, the new lenses crafted by Dutchmen in the 17^{th} century, and used by Galileo to make his revolutionary observations of the solar system, were also a huge aid to sea navigation. But the two uses are not logically linked in any respect. Quite apart from their employment in scientific knowing, technologies of action enter the social world – the "life-world" in Edmund Husserl's terminology – and are subordinated to the eternal quest for material prosperity, political power, and domination.

The first proposition – that the emergence of the modern natural sciences represents an ongoing, unambiguous good for humanity as a whole – was, of course, rejected by the Catholic Church in the seventeenth century. This is why Galileo was threatened with torture by the minions of the Inquisition. Scientific evidence remains unconvincing to many of those imbued with religious faith down to the present day. But this is largely a function of the needs of organized religions – fearing a reduction in their cash-flow prospects – to protect their own crass worldly interests, rather than the existential situation of individual believers, who are quite free to retain their beliefs no matter what the sciences say. And many billions of people apparently do just this; furthermore, they are likely to continue to do so, no matter what new scientific discoveries emerge in the future.

Modern science has never challenged religious faith directly (many competent scientists have been and are still religious believers of one sort or another). What it did challenge were various intellectual platforms – such as the opposition to heliocentric models – which various religious institutions had determined to be essential to the maintenance of their *secular* power. Gradually, many (but not all) of the church potentates realized that they did not have to fight this battle in order to ensure a flow of new believers across generations. Despite the emergence and ongoing successes of the modern natural sciences, various faiths in both East and West, including late novelties such as Scientology, have proved themselves to be the longest-running successful business proposition in world civilization.

Nevertheless, I hold onto the proposition that modern science is and will remain an unambiguous good for humanity. For it alone has – finally, after an immense collective effort and not a little courage – bestowed enlightenment on the human mind with respect to our understanding of the *purely natural* processes that brought us humans into existence on our lovely planet. As the great scientist Laplace once said to the Emperor Napoleon, "I have no need of the hypothesis" which posits a creator-god. Natural chemical, physical, and biological processes, working together for Mother Earth, created first the eukaryotic cell and then all later life-forms, every one of which, from the very beginning, over a period of at least 3.5 billion years, has shared the same four nucleotides making up the DNA molecule. It is a truly amazing story – a *true* story, based on a huge trove of evidence developed by our amazing reasoning brain. And it is and will remain true for all time, whether or not anyone alive on earth accepts it as such.

To be sure, this great adventure began with the ancient Greeks: In Plato's *Theaetetus* Socrates notes, "The only beginning in philosophy is wonder," and in opening of his *Metaphysics* Aristotle remarked, "All men by nature desire to know." But for many centuries thereafter the remarkable Greek heritage in mathematics and the natural sciences languished, except in some of the early Islamic societies, until it began to revive again during the Italian Renaissance, a "rebirth," in the fifteenth century, where the great figure is Leonardo da Vinci, and where this adventure was reborn, unsurprisingly and quite literally, with new translations of many of the ancient Greek scientific and mathematical manuscripts.

Three more centuries passed before leading figures were able to state clearly what was distinctively "new" about the reborn mathematics and natural sciences; here the classic works are Francis Bacon's *Novum Organum Scientiarum* [*New Instrument of Science*] (1620), Galileo's *Discourse on Mathematical Demonstrations relating to Two New Sciences* (1638), and Giambattista Vico's *The New Science* (1725). Another two more centuries of intense intellectual labor were needed before it could be said with assurance that there would no longer be any viable competition for modern science, whether from theology or any other source, as an explanation of the workings of the natural world.

It goes without saying that this science will be incomplete to some extent, quite possibly indefinitely into the future. But it is also the case that, whatever further theories and experimental findings are established, they will result from exactly the same (gradually refined) methods that produced the earlier ones. One of the greatest accomplishments of the new science was its steady incrementalism, over centuries and generations of practitioners, wherein earlier syntheses are incorporated into newer and wider ones – an ongoing development not necessarily in a straight line, but rather often with some twists and turns. Newton's cosmology was not cancelled by Einstein's, but rather incorporated as a special case within the later one, just as, one day, Einstein's will be subordinated, but not cancelled, within a later and wider "theory of everything."

For a creature that has been gifted by nature with a thinking brain such as ours, *this* knowledge – the knowledge about the evolution of the universe over almost 14 billion years, and the evolution of *homo sapiens* over the past 3.5 (or so) of those 14 billion years – is precious beyond all reckoning. (This is most certainly not a claim that this entire evolutionary story necessarily led to the end-point of human intelligence, or that our intelligence is somehow worthier than any other end-point. We are fated to disappear once and for all, along with our lovely planet, sometime in the future, as our knowledge of astrophysics assures us.) If we count the time from the ancient Greek thinkers down to our own age, attainment of this knowledge required more than twenty-five centuries of hard intellectual effort by tens of thousands of individuals.

It is a treasure to be preserved at all costs, for there is no certainty that, once lost, it could ever be recreated. It stands alongside the other treasures we have inherited, our fine arts, our history, our architectural wonders, and the modern technologies that make our lives comfortable and our minds able to enjoy all these treasures. We have a sacred duty to preserve and protect them for the enjoyment and enlightenment of all future generations.

To reiterate the thesis: Modern science and its evidence-based methodologies represent a permanent, unambiguous good for humanity. Not so with its closely-allied forces, technology and industrialization. This distinction may be puzzling to many, for the simple reason that the three allied forces seem to be so deeply, and seemingly irrevocably, interconnected as to rise or fall in tandem. And, in a sense, that is precisely the problem! When a scientific discovery is married to an emergent technology which together promise great new benefits to humankind, and then this duo is successfully scaled-up so as to be mass-produced at a price affordable to many people – as has been demonstrated countless times – why would the overall end result not share the status of an unambiguous good with the initial discovery itself?

The answer is, once a wide-ranging discovery/technology enters the social world as one or a series of commercial products that better satisfy human needs and wants, its character inevitably changes. It is no longer a simple increase in the accumulated human understanding of how nature works; rather, it has become an intervention in the social world *whose wider effects cannot easily be predicted or controlled*. To take a few well-known examples: Zyklon A was invented in Germany in the early nineteentwenties as a cyanide-based pesticide for insect control on the basis of general scientific discoveries in chemistry as well as technologies that would make its use cost-effective in commercial quantities. A later product, Zyklon B, was a similarly cost-effective product when used to kill millions of prisoners in the Nazi extermination camps, an application not remotely foreseen by the developers of the earlier one.

The German chemist Fritz Haber, whose lab devised Zyklon A, earlier won a Nobel Prize for his great breakthrough in fixing nitrogen from air to create ammonia; his colleague, Carl Bosch, worked out the method to scale up its production and mass-produce synthetic fertilizer. This application vastly increased the capacity of agriculture to produce food, resulting in huge increases in the human population. But ammonia also was used to make high-explosive material for shells and bombs, vastly increasing the death tolls in World Wars I and II. Or, one later example: The science and technology of gene therapy is approaching the point where medical interventions during embryo development could eliminate entirely, or reduce the frequency of, the occurrence of certain inherited diseases that have truly devastating impacts on human life. As soon as this prospect was on the horizon, other calls were heard to allow gene enhancement by the same means, whereby those who could pay for the treatment might receive significant advantages over untreated individuals in the competition for wealth and success in society.

Similar examples could be multiplied endlessly. But perhaps it would be better to step back from specific examples and look at the broader picture. At the level of pure scientific discovery, atomic and subatomic physics was recognized as a marvel of conceptual and applied human intelligence by the end of the 1930s. But by the middle of the twentieth century, the science-technology-industry-economy-military nexus related to atomic physics had arrived at the point where it was possible to imagine two utterly opposed future scenarios simultaneously: one, where the technology of nuclear fission would produce electricity for industrial and home uses that would be "too cheap to measure," ushering in period of boundless human prosperity the world over; the other, where nuclear war promised the complete destruction of all advanced societies – of human civilization "as we knew it" – a function of that larger nexus that was, and to some extent remains, a looming disaster, a truly catastrophic risk scenario.

Some may take comfort in the argument that, since the worst-case scenario never happened, we can put the whole business out of mind. Yet there were some very near misses in those days, when the threat suddenly came closer to realization, and not only during the Cuban Missile Crisis of 1962. And in fact, although most people would not have realized it, the risk of nuclear war between these two superpowers actually increased after the Cold War ended, because one of them, Russia, had been significantly weakened militarily, in terms of its overall capabilities, after the disintegration of the Soviet Union, leaving it more heavily reliant on its nuclear arsenal if a new world war had erupted.

Technology and industry, as opposed to the pure sciences, represent in their very nature a double-edged sword. This much is not new, of course, and one often hears the rejoinder that goes something like, "Well, we have to encourage the good outcomes and prohibit or control the bad ones." Indeed. In the bigger picture, however, two evident facts expose the silliness of that rejoinder. First, the overall potency of modern human technologies gradually was enlarged to the point where failing to control the downside had potentially adverse consequences, in terms of death and destruction, on a gigantic scale. Second, efforts to control the downside risk by formulating enforceable international agreements simply could not keep pace with the escalating threats. Some notable successes, for example the convention on biological and chemical warfare, were more than offset by other notable failures, particularly in the areas of climate change and nuclear disarmament. Carrying out widespread genetic manipulation of physical and especially brain function, done in the germline so that one-time alterations would be heritable indefinitely into the future, was a certainty once it had become reasonably reliable in achieving the intended effects.

And then there was perhaps the most bizarre innovation program of all, namely the wish to create a "super-intelligent" entity, the sheer thinking power of which would dwarf the abilities of ordinary human brains, including the most creative intellects known to us: One overenthusiastic proponent referred to the possibility of creating endless numbers of "Einsteins and Beethovens"! Quite apart from the inherent vulgarity of the idea of manufacturing such figures by the dozens, the author overlooked the complementary possibility of our instead encountering endless numbers of Hitlers and Tamerlanes. There were various tracks laid out for realizing this objective, one of which (genetic enhancement of brain functions) has already been mentioned. But this was the least-favored option, because of the length of time needed to carry out the manipulations over a number of human generations. So, the fondest hopes of its champions were placed in two other initiatives, first, perfecting "whole-brain emulation," whereby a living brain would be digitally imaged and scanned, whose functions could then be manipulated at will to increase its capacities.

And second, forging a purely mechanical construct combining steady advances in computer processing speed and power, artificial intelligence or AI (mimicking the brain's neural nets), and software-based emulation of the neural processes that occur in the brain's limbic system. (The limbic system – including the hippocampus, thalamus, amygdala, cingulate gyrus, and other regions – is the interface between the brain's subcortical and cortical regions and regulates important functions such as emotion, behavior, memory, and decision-making.) Then, having created super-intelligent entities of this kind, which had integrated their mastery of the full range of human emotional states with their vastly superior data-processing skills, the remaining pathetic, backward, and under-powered representatives of *homo sapiens* would see clearly the benefits of being “merged” with their benevolent mechanical *doppelgängers,* becoming human-machine chimeras – surpassing the ancient human fantasies about animal-human hybrids – and live happily ever after. “We will merge with our technology, … [the] future superintelligent A.I.s,” promised Ray Kurzweil, one of the chief dreamers. Perhaps one might have even labeled the new species *pan*, after Pan, the goat-man, the Greek god of the wild realm, were it not already reserved for the name of our nearest cousins, the chimpanzees (*pan troglodytes*) and bonobos (*pan paniscus*).

The partisans of this beautiful idea enjoyed pointing out the superiority of AI in terms of simple information-processing speed, with electronic signals traveling at just below the speed of light (about 300 million mps, or meters per second), whereas our pathetic brains can only manage about 120mps. Among the partisans who were afraid of missing its coming into being during their own allotted time on earth, the fond hope was that the evolution of these mechanical entities would arrive at a point of recursive exponential growth, completing their own triumph much sooner than otherwise expected. The most astonishing claims made for this constructed entity were that it might develop an autonomous will, uncontrolled and uncontrollable by human agents, and moreover that it would be clever enough to conceal the growing capacity of its own will, deceiving the humans who had originally created it – including an ability to infiltrate networked electrical power delivery systems and network-control mechanisms – until it was no longer possible for any human agent to use a “kill switch” to shut it off or seek to destroy it.

I will have more to say about the quest for superintelligence later, in Section Two. For now, I just wish to focus on the curious way in which some of the proponents of this initiative presented it to the wider public. In essence they said, “It’s coming, get ready, it will be great, and by the way, resistance is futile, you couldn’t stop it even if you tried.” They were appealing to an old idea, sometimes called “the technological imperative,” which held that advances in mechanical systems, once painfully slow in human societies, and then steadily accelerating in the science-technology-industry-economy-military nexus, were unstoppable so long as that larger nexus remained robust.

Its proponents readily conceded the point that all technologies had the capacity to result in bad as well as good outcomes, and that society would be challenged to find the ways of preventing or minimizing the bad (the downside) while reaping the benefits of the good (the upside). But what they would not concede was that it might be quite appropriate to say, "No, we should just stop here, we have enough in terms of a capacity to provide a reasonable level of goods and services for a satisfying human life." The proponents refused to recognize the argument that technologies had arrived which would have catastrophic outcomes if the downside risks simply could not be managed – or that humanity might only discover that the international community was unable to manage the most serious downside risks, those that threatened the future of civilization itself, until it was too late to avoid them.

The idea of the "technological imperative" is an old idea, originating long ago in the mind of the philosopher Francis Bacon, who understood early on that if the "new instrument of science" were to win the day (which it did, eventually), it would create a desire for "the effecting of all things possible," that is, an endless growth in the capacity of human society to manipulate and control natural processes. Just before his death he wrote a charming utopian fantasy, *New Atlantis,* first published in 1627, in which he imagined a society that was ruled by a scientific and technological élite, who were unopposed by their fellow-citizens because of the continuous stream of benefits derived from their innovations. He inspired a long tradition of thinkers for whom any attempt to dam this stream was regarded as morally wrong or even perverse. If as a result certain types of problems (adverse outcomes) arose, as they inevitably would, they could be fixed – usually by devising even newer technological solutions.

And throughout the history of modern industrialized society such problems often were fixed by means of new technologies, as, say, less polluting solutions were found for energy and goods production. But as the technologies became intrinsically more powerful, entailing severe catastrophic risks as unintended by-products, the solutions proved inadequate to the task (as in the cases of climate change, nuclear weapons, and genetic manipulation). Thus, there arose a kind of "terror of the technological imperative," a sense that humanity had become locked into a path of development that was out of control, one where dominant social and economic interests steadily raised the ante in the game of seeking enhanced powers of manipulation over natural processes as a solution to intractable issues raised by earlier bets placed in that game. At some point the music accompanying this merry-go-round was bound to stop, and it did, when climate-change denial finally reaped the whirlwind, and billions of impoverished people fleeing the rising seas and ever-more-destructive storms brought industrial society – and its unshakeable belief in the mantra that every problem had a technological solution – crashing down in much of the world.

In the end, the idea of a technological imperative was exposed as being nothing more than an article of faith, a secular religion, despite its veneer of scientism. Like the monotheistic creeds, it told of an inescapable fate for humanity; no questions were allowed, only submission; it was, in other words, a form of voluntary servitude. Great benefits were assumed, the risks largely ignored, the net-benefit calculus obscure. In its historical evolution, this imperative (famously called the "iron cage" of rational action by Max Weber) had been born in a bitter struggle against an archaic concept of nature as seen through the religious lens of the Abrahamic creation story. This is why, in one of the most famous episodes in the emergence of the "new science," the Catholic Church had come to regard Galileo's defense of the heliocentric model of our solar system as a grave threat to its faith-based worldview, wherein the earth that God had created for humankind necessarily must be at the "center" of everything, both cosmologically and metaphorically.

Ultimately the new science vanquished its opponent, asking only, without presupposition: How does nature *work*? It had sought thereby to simply bypass the religious idea that there was an intrinsic *moral* meaning in the conception of how nature operates. But in the process of doing so, it had fought so long and so strenuously to exclude any consideration of intrinsic value in its operational concept of nature, that it was left without any ethical anchor for itself – that is, any way to judge the worth of yet another increment in instrumental power as measured against some notion of a truly "human" life.

Once the old value-laden shackles had been cast off, there was, it was felt, no need to forge new ones. After we have "merged" our brain with the artificial superintelligence apparatus, there will be – apparently – no limit to our computational wizardry. Is it just silly to inquire: Will we be *happy* in this new state of being? Or will we all turn out to be living with an extreme, permanent form of bipolar disorder, with our attached signal-processing units, operating near the speed of light, impatiently, maniacally overriding our antiquated neural circuitry in order to handle the incoming stream of data inputs more efficiently? What does *happiness* have to do with anything, anyway? On the other hand, forget happiness, that may be asking for far too much; how about just a little peaceful *sleep*, before full-blown psychosis sets in?

Already in the first half of the nineteenth century, the end-result of the future trajectory implied by the new science-driven technologies, made possible by steam-power, was clear to many: the complete mechanization of labor, the coming of the "age of machinery," whereby humans would be reduced to nothing more than the servants – or indeed, the slaves – of their own creations. *This* was perceived as a great rupture in human affairs, ominous and terrifying in its implications. (*The reader will discover in the next chapter an essay on this topic, entitled "Sublime Machine," written almost a century ago but still worth reading*.) The unsettling implications in the age of machinery were assimilated into the transition from utopian to dystopian literature at the outset of the twentieth century with the publication of the great short story by E. M. Forster, "The Machine Stops," in 1909.

By the early part of the twenty-first century it had become crystal-clear, to all those who had eyes to see, that there never was, and would never be, any *unambiguous* good for humanity in the advanced technologies and mechanization laid at its feet by the modern natural sciences. By no means does this suggest that no good at all is to be found there! There are, first, the simply incalculable benefits we derive from an abundant supply of four necessities: safe water, electricity, heat, and air conditioning. Then there is the relief from suffering through medicine and dentistry; the mental, physical and longevity advantages of increased nutrition and the control of infectious diseases; the possibility of an end to onerous, backbreaking labor, as well as child labor; sufficient leisure for contemplation and education; safety and security of the person, especially for women: All these supremely important benefits, and many more, potentially available to everyone, everywhere on the planet, cannot be had without modern technologies, adequate energy resources, and plentiful machines.

Many of the most important benefits had begun to be widely available in economically-advanced nations by the turn of the twentieth century, and others were already on the horizon. But soon the turn came, and the remainder of that century combined the most destructive wars in human history along with, in their aftermath, the threat of nuclear annihilation. The total destructive power of the competing nuclear-missile arsenals was sufficient to obliterate all modern cities many times over, to deposit enough long-lived radioactivity to make their locales permanently uninhabitable thereafter, and to bring about a "nuclear winter," spreading widespread misery around the globe perhaps for centuries to follow. No one ever explained what was the point of this massive overkill capacity.

But it is a peculiarity of the human mind that threats narrowly averted, however dire, barely register in the thinking about future risks. Many experts caution us against excessive risk-aversion, but few seem averse to reckless risk-taking, such as in the run-up to the global financial crisis in 2008, the actual adverse effects of which were bad enough, but also another case where far worse downside scenarios were just barely avoided.

Well before the first half of the twenty-first century was "in the books," so to speak, it had become obvious that this recklessness had to stop. It was obvious that, taken as a whole, the collective authority of the world's nation-states was unable to safely manage the prevailing risk-risk and risk-benefit trade-offs spawned by the fecund nexus of science, technology, industry, economy, and the military. The clearest sign that a tipping-point had been reached, a point where the idea of the technological imperative finally revealed its profoundly irrational and self-destructive core, was to be found in the delusional hopes placed in superintelligence and gene enhancement.

For the fans of these solutions had openly embraced a future for humanity in which what was "human" – as examined and articulated across 2,500 years since the ancient Greeks – was to be casually and unceremoniously dumped into the trash-can of history. And there would be no going back, no occasion for remorse and reconsideration, once the experiment had been launched, at least not without the slim chance that, *homo sapiens* having self-destructed, we would be allowed by Mother Nature to try again, with a new branching off the old hominid line, as had happened five million or so years ago, a branching off that evolutionary line where those clever bonobos, *pan paniscus*, reside. Alas, there was a greater likelihood that we would have already wiped out the bonobos once and for all.

These two looming catastrophes arising out of a technological *hubris*, a colossal failure of imagination in which an expiry date had been affixed to the human essence, or species-being (*Gattungswesen*, to recall Marx's nice formulation), apparently had become inevitable because a final solution to past mistakes in submitting to the technological imperative could be found only in making yet another and far more serious one. Some of us concluded that this "solution" had to be averted at all costs.

So, responding to the collapse of major institutions in industrial societies, a handful of small like-minded groups resolved to strike out on an entirely new path, as described in the two earlier volumes of this trilogy. That route will be laid out systematically in Section Two, "Pathways to Utopia"; here I wish only to complete my brief account of the historical rupture that took place in the modern West, contrasting the true one (modern science itself) with its misleading counterpart (the science/technology/industry/economy/military nexus).

Science appears in both perceived forms of the rupture because it has carried a dual meaning for its champions ever since its seventeenth-century beginnings. The first was, simply put, an insight into a method which could unveil the inner workings of natural processes – not at once, immediately, in a single flash of comprehension, as the alchemists had hoped – but over time, laboriously, patiently, collectively, incrementally, slowly sifting confirmable evidence from mere speculation, slowly building up a "weight of evidence" rather than cherry-picking pieces of evidence to advance a preselected theory. Francis Bacon, as usual, gave us a whimsical but accurate simplification of this method: Just follow nature by careful observation and experimental trials, focusing on what is repeatable and ignoring extrinsic details, until you have seen how specific initial conditions lead to specific results or end-points via specific processes, and then you (or anyone else) can reproduce the results – say, the discovery of the elements hydrogen and oxygen in the eighteenth century – at will. And then, having found these very intriguing substances, you can put them to use in the service of human needs.

The second perception of science's meaning arose simultaneously with the first, and Bacon was the primary author of this one too. It held that this scientific method would bestow on humanity "power over nature." This was always a curious formulation and at first glance makes little sense: How does following and reproducing the results of natural processes grant us power over them? The solution to the apparent conundrum is that by being able to reproduce a desired result, for example, a useful chemical reaction, at will, we have increased human operational capacity in the world, that is, the ability to turn knowledge into the power to make new things and new ways of making things (technologies). This represented a power – actually, in cooperation with, not over, nature – to enlarge human agency and therewith human resources, desires, and populations. Ultimately, it was hoped, we could find some way to do anything we wished to do, from flying, eating more meat, or more efficiently slaughtering other people, to teleportation, time travel, waging intergalactic warfare, freezing our brains for later revival, or living forever.

Not everything anyone wishes to do is *ipso facto* a worthy objective, obviously, so long as we are willing to apply some value-framework, however minimal – say, the Golden Rule – before carrying it out. In other words, not every wish to exercise a power we are able to deploy in the world is intrinsically worthy. And that is in my estimation the simple difference between science as the true understanding or nature and science as the enabler of new technologies of power in the world. The first is and always will be intrinsically good; the second cannot ever be (although any particular application of it *may* be so, if it occurs in an appropriate values-context).

The first is both a collective and an individual good. It is a collective good because, as the Enlightenment thinkers argued, it mitigates the unfortunate propensities of humans to torment each other on the basis of superstitions. It can be an individual good for at least some individuals, for it bolsters the pattern-seeking proclivities in our cerebral cortex by uncovering the regularities and causal structures hidden behind the world of appearances. For those individuals who cannot accept it because it conflicts with the story of faith, they are entitled to go their own way, so long as neither group seeks to impose its convictions on the other.

It should occasion no surprise that, some five hundred years after the new science first took hold in Western Europe, its adherents are far outnumbered by those of the religious communities (although, as has been noted, there are some who live by both). For this new science represents a truly radical rupture with the understanding of nature that preceded it and that had flourished in different forms for many millennia since permanent human settlements were first established. In the early years of its development it spread its tentacles through its social host so unobtrusively that dominant institutions were slow to realize what was happening; by the time that its subversive method openly launched challenges to long-established beliefs, in the second half of the nineteenth century, this genie (as an integral part of a larger nexus), was delivering far too many concrete benefits for anyone to seriously suggest that it be put back in the box again – at least not until, during the first half of the twentieth century, a powerful and horrifying reaction to Enlightenment philosophy arose, a story that is told in a later chapter.

The philosopher Hegel coined a powerful metaphor to explain this subtle, subterranean infiltration of reason in history which, he said, operates "behind the backs" of individuals and societies. What he meant is that the true significance of important historical transitions is not grasped until long after they have established themselves. The rupture represented by modern science is a classic instance of this type.

But it represents something else, too, in which it is unique: The mathematics and geometry of ancient Greece was the first true universal in human thought, and when modern science revealed its dependence on mathematics – for the first time, in a systematic way, in Galileo's summation of his life's work, *The Discourses and Mathematical Demonstrations Relating to Two New Sciences* (1638), it became the second. On the other hand, despite their pretentions to universality, major world-religions, especially the proselytizing ones such as Christianity and Islam, never succeeded in conquering the globe, and almost certainly never will. But anyone, anywhere, at any time, who wishes to grasp how nature works, on the planet earth as well as in the vastness of time and space across the universe, must use the method of the new science – a method still evolving, to be sure, but one that has always built incrementally on its earlier stages in order to advance.

But what happened to the original Enlightenment promise of the broad increase in *public* understanding that would result from the deployment of the new instrument of science? The answer to that question is: twentieth-century physics (as we shall see in chapter 3).

Sources and References

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Figure 1, *Euler's Identity*: https://en.wikipedia.org/wiki/Euler%27s_identity
Leonhard Euler (1707-1783) was a Swiss mathematician and physicist, and this has been described as "the world's most beautiful equation." It was one of the formulae shown to fifteen mathematicians in a neuroscience study using MRI scanning of the brain. The study found that in the subjects' brains the medial orbitofrontal cortex

was stimulated; this is part of the 'emotional brain' in which we experience aesthetic pleasure such as music: S. Zeki *et al.*, "The experience of mathematical beauty and its neural correlates," *Frontiers in Human Neuroscience,* vol. 8 (February 2014), pp. 1-12. The quotation from Dirac in Chapter 8 will be found towards the end of this article:
http://journal.frontiersin.org/article/10.3389/fnhum.2014.00068/full

Results of voting: BBC survey asking what was the most beautiful equation ever written:

- The Dirac equation, 22,913 votes, 34%
- Euler's identity, 11,383 votes, 17%
- Pi, 9,060 votes, 13%
- Riemann's formula, 3,615 votes, 5%
- The [Schrödinger] wave equation, 3,318 votes, 5%
- The Euler-Lagrange equation, 2,663 votes, 4%
- Bayes' theorem, 2,590 votes, 4%
- The Yang-Baxter equation, 1,382 votes, 2%

The Dirac equation (in natural units): https://en.wikipedia.org/wiki/Dirac_equation

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PART ONE: THE MIND UNHINGED

CHAPTER 1.
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