A Treadmill Called Progress

“A short reflection on our faith that science will bring certainty”

Two fundamental discoveries paved the way for this new era of science in the 23rd century: the unification of quantum mechanics with general relativity, and a material understanding of consciousness. Long had physicists struggled to reconcile the strange behavior of matter at atomic scales with the mechanics of large gravitational bodies. Repeated failures to formulate an overarching physical theory had cast doubt on the power and scope of scientific models. Researchers finally triumphed over this stubborn problem with an imaginative new solution facilitated by sophisticated artificial intelligence, ushering in an unprecedented faith in the reach of science. Similarly, understanding how consciousness emerges from vast networks of basic chemical interactions put to rest any lingering notions that it was something immaterial, discrediting once and for all the religious and spiritual groups who stubbornly upheld a distinction between mind and matter. These breakthroughs demonstrated that all phenomena fit comfortably within the purview of scientific knowledge. This new paradigm was called “The Universal Theory.” With this new tool in hand, humankind quickly came to a peculiar conclusion: the project of theory development had ended. There were no new fundamental physical laws to discover. But this did not mean there were no problems left to solve.

In the centuries preceding these discoveries, continued technological development had brought companies and governments immense power. New technologies of control, surveillance, persuasion, entertainment, automation, and war continued to disrupt and disorient societies. Regulation was slow to respond, and often inadequate when it did–the problems that technology posed for human societies could not simply be regulated away. Technology changed how people related to society, culture, and nature. It had significant and unpredictable personal and political consequences. Though their effects were often multivalent, these technologies had one clear consequence: it became difficult for individuals and groups to find a firm footing in a world that changed so rapidly. Technological power outpaced humankind’s political and philosophical imagination. There was growing concern that the power humankind wielded was not matched by an understanding of its effects. So, in the early years of the 24th century, the focus of research moved definitively away from the development of fundamental theories, to building sophisticated models of large-scale systems. With no new laws to uncover, it was natural to investigate challenging applications of known physical laws. And motivated by the threat of technology’s power and caprice, scientists and engineers across the globe teamed up to undertake a modeling project of unprecedented ambition: to build a computational model of the entire world. Such a model would make the future accessible to humanity, and might help avoid cataclysms wrought by unwise political and technological decision-making.

With initial conditions which scientists imagined as being measured by future data collection centers all over the world, the Universal Theory would be used to evolve the state of the entire globe in time. Chemistry was a scaled-up version of the mechanics of elementary particles. The behavior of small biological systems could be predicted straightforwardly with an understanding of chemistry, and new understanding of the emergence of consciousness from biological substrates could be used to evolve the behavior of humans in time. The mechanics of groups such as companies and nations could be computed as a straightforward consequence of the agency of individuals. All the necessary theoretical ingredients to construct such a model were in place for the first time, and people were eager to preempt the catastrophic effects of technological prowess. A simulation of this sort could act as a kind of crystal ball, used to help wield power more wisely. It would be a tool not just of scientific interest, but for peace, stability, and human flourishing.

An international effort was undertaken to begin developing the hardware and software infrastructure to carry out the simulation. All the fundamental physical laws which could be used to predict the future were known, but mathematicians, physicists, computer scientists, and engineers needed to collaborate to construct efficient methods of solving these equations in computers. The first obstacle of the project was to construct data collection centers spanning the globe. Measurements of the physical state of the Earth, in addition to extensive census and psychological data, would be used to initialize the simulation. The computational model needed to have a starting point before it could be advanced to predict the future.

The next bottleneck of this project was the immense effort needed to write down and solve the governing equations which could model phenomena from quantum mechanics, to weather events, to revolutionary political movements. “The Model,” as it would come to be called, would be capable of making predictions about any and all aspects of life. In fact, it was clear that the future could not be predicted without understanding the seemingly minute details of the present, such as the chemical composition of the soil in Siberia, or the precise way in which a butterfly in Argentina flaps its wings. The equations needed to make sense of these phenomena were derivative of the Universal Theory in one way or another, and could be found spread throughout the scientific literature. But, never had they been synthesized in such a comprehensive way. New and sophisticated algorithms were required to efficiently solve massive systems of equations coming from the Universal Theory describing the evolution of the entire Earth system. Solutions to these systems relied on iterative search procedures, which took an indefinite number of steps to converge. Concerns around computational effort and run time were the final and most serious hurdle The Model needed to overcome.

A computational model of the future required staggering numbers of floating-point operations. Forming and operating on massive matrices approximating the evolution of the Earth system could not be avoided. It was known to mathematicians that there were hard theoretical limits on the extent to which these computations could be eliminated and/or simplified before the computational model failed to reproduce reality. Once the mathematical operations which constituted The Model could not be streamlined any further, it became possible to estimate the amount of computing infrastructure required to run it. But here too, there were hard upper limits on what was possible.

The size of transistors had stopped decreasing, and no new innovations in computing hardware had been introduced for centuries. And humanity’s current computing resources were not adequate–thus, the longest phase of the project was one of intensive infrastructure development. High-rise computing centers were built all over the world, and a fleet of computing machinery was sent into orbit. But, hardware could not be positioned arbitrarily far from Earth, as the finite speed of electromagnetic signals limited the ability to synchronize and orchestrate numerical computations. Similarly, the electric currents in chips produce heat, and scientists knew that the heat by-products of the simulation were large enough to measurably increase the temperature of the Earth. After a lengthy and arduous political process, an allowable temperature increase was agreed upon. This limited the number of terrestrial computing centers. Though the temperature rise would further destabilize Earth’s climate, it was believed that the benefits of the ability to predict the future would outweigh the harms of the environmental impacts. Humankind had faith in The Model as a tool for knowledge, and knowledge as emissary of harmony.

So as the Earth became replete with the machinery of computation, the mathematical structure of The Model was finalized. Thorough and varied studies indicated that the solution methods met accuracy requirements with optimal efficiency. Still, it was not possible to predict the exact computational demands of the model. But scientists were confident that predictions would outpace time itself. Thus, the future would be known. After decades of dedicated effort from universities and governments across the globe, the largest engineering project in human history came to a close. Small tests of The Model had been conducted along the way, but it eventually came time to run a full-scale simulation. Humankind eagerly awaited this deployment as a symbol of freedom from the vagaries of an unpredictable world. And just days before the year 2400, Earth's citizens assiduously tuned in to live broadcasts covering The Model's inaugural use.

And The Model's predictions agreed with reality, or so reported verification centers stationed all around the globe. But, as if a forgotten God had conspired against humankind, the simulation ran at exactly the speed of time. One second of simulated reality required exactly one second to compute. This trend, baffling in its consistency, continued tirelessly for hours, days, weeks, and months. Hopes for a utopian future free of uncertainty were dashed–reality, though knowable in theory, was indomitable in practice. A simulation which acted only as a mirror to the world was a useless tool. But so it was–the crown jewel of humankind's scientific endeavors had perfectly reproduced what was already in front of them, like a photograph, or a painting. And if anyone were to have gone looking for Wisdom in the artificial reality The Model had created, they would have seen only their own confused face looking back at them, struggling to cope with a world in which power and certainty do not go hand-in-hand.