The only futures that shape peoples lives are imaginary ones that can stir them into action.

J.M. Roberts, *Twentieth Century: A History of the World 1901 to the Present Day,* Allen Lane, 1999

Is the future just imaginary?

Preamble to *The Cosmology of People*

> *In reality, development for the vast majority of the peoples of the world has been a process in which the individual is torn from his past, propelled into an uncertain future, only to secure a place on the bottom rung of an economic ladder that goes nowhere.* – Wade Davis.

> *The important achievement of Apollo was demonstrating that humanity is not forever chained to this planet and our visions go rather further than that and our opportunities are unlimited.* – Neil Armstrong

The aim of this project is to develop a fresh schematic for the universe and humanity's place in it. A fresh cosmology, in fact. In spite of the apparently relevant – some might say mysteriously relevant – application of physics and mathematics to the workings of the universe, our traditional cosmology is still rooted in ideas about who we are and what we are doing here. Cosmology represents as much human 'society' as it does human 'physics'. So we will investigate this social human universe of physics and mathematics and logic to explain and garner support for a profound experiment into the nature of the universe and the workings of human consciousness. An experiment whose outcome will have, we hope, significant repercussions for the way human society will consider its cultural and political future as it faces its expansion into space.

Along the way there will be talk of resource depletion, coincidences, the search for extra terrestrial intelligences, dreams, narratives, languages and truth, multiverses, quantum mysteries, panpsychism, artificial intelligence, brains-in-vats, how probability enters the universe, creativity, proofs of gods, time travel kinships and much more.

There will be diversions that I hope will entertain as well as give us food for thought, since the intention of this experiment is, above all, to help us survive as an intelligence in the universe.

This book you are holding (or viewing) began as a series of notes about time and the universe riding on the back of my proposal in 1997 to the Millennium Commission in England to mount the experiment I simply called the Chronolith® for the one thousand year celebrations in the Millennium Dome in London. In the end conditions were not right to mount the project then; a millennium being an arbitrary divi-

sion, a date on a calendar. What is more important than a date, perhaps, is a moment in economic and cultural momentum suitable for the purposes of the experiment. Such a moment is here, embarking on the occupation of space, a threshold in the economic and psychological history of humans.

In 1997, however, outside of NASA and military missions, space was hardly used, not even by Russia. There was no Space X, no private rocket construction, no cube sats, no ISS (its first module was launched in 1998), hardly any exploration of Mars (the first robot rover had just landed), only three probes had gone beyond Mars, only three humans lived a life of anxiety in Earth orbit aboard Mir (first launched in 1986 and completed ten years later), mobile phones with GPS were yet to arrive (in 1998; personal GPS gadgets arrived in 2001), internet access via satellite was still 6 years away. Global warming was simply a controversy, and beliefs that humans faced severe environmental damage and global disruption to economies and whole societies were borderline cranky to many scientists and economists who considered notions like 'Peak Oil' (the end of growth in oil supplies) were put forward by marginalised 'malcontents'. The Club of Rome report on the *Limits to Growth* (1972) had been derided and forgotten. The idea of humans standing at some threshold was not at all clear to most, the evidence was partial at best.

The situation is very different now. There is a new space race developing and inevitably with it there is a new appreciation of an arms race in space to protect the assets placed there. It appears, however, that in spite of governments funding space activity and private money going into imaginative projects (like the Breakthrough Starshot proposal of Milner of 2016), the space development timetable is too slow to have any impact on the crises on Earth. If we do not alter our attitudes significantly, it may be the case that humans will not be going anywhere far from Earth.

By reflecting upon space development plans we begin to wonder quite for whom the investment will profit (the widespread belief that there is an economic multiplier coming from space investment disregards that fact that its actual value and merits are controversial). Extravagant ideas about colonising missions to Mars are completely obscuring the unsolved problems of not only space travel, but of the launching civilisation, us, as well. Elon Musk has claimed he wants to die on Mars, and his company, SpaceX, is apparently trying to monopolise

space expansion by being the first to develop a massive rocket essential for large scale space projects with which he can send a hundred colonists at a time to Mars as well as shooting high paying executives around the Earth in under two hours.

Space X, and other private companies around the world are kept going by virtue of government contracts, so it is not surprising that space entrepreneurs like Musk try to keep the momentum with inspirational ideas. Plans to mine asteroids or the Moon's plains remain in imagination only. No one has any idea how metals are to be extracted on a large scale out of complex ores that are not present on Earth, smelted and fashioned into high integrity and high performance components for rockets or other structures in the space and microgravity environments. All this activity remains in space, not on Earth, and is destined for the further human exploration of the solar system. Market forces have yet to be created to pay for this activity far from Earth and returning so little to it. If the extravagant claims about the quantity of metals like platinum, boron, titanium and other useful industrial metals present in asteroids are true then capturing an asteroid and bringing it to Earth would depress the market price of such metals to nothing. How large would the Earth economy have to be before plans to capture solar power in space, for example, and beam it down to the surface of the Earth make economic sense? There is an expectation in the popular press that the first trillionaires will come from space exploitation. This may well occur but only if the Earth economy survives to consume at the highly elevated levels required to pay them.

It seems to be generally accepted that industry needs to be urged into space with stimulating dreams and bright scenarios. (Stephen Hawking played the opposite card of the threat of catastrophe.) Philanthropists are being asked to step up to the plate, but when it comes to our future in space, the elephant in the room is capital growth here on Earth, and no one has any idea where those market forces will come from or how they can be prevented from destroying the Earth if coherently deployed to occupy space.

Meanwhile Earth's environmental degradation increases. As a civilisation, at the start of the Anthropocene era, we still seem to have no way of understanding the significance of these facts. By the year 2050 (a generation away) there is serious environmental damage around the Earth whether or not solar power is installed on every roof-top, while the likely maximum numbers of humans off Earth (on the Moon, on

Mars, and in between) if current plans are realised, are likely to range between 50 – 70, but might just as easily be zero. Even with the United Launch Alliance published plans to have – incredibly – 1000 people in and around the Earth orbit and the Moon at the end of 30 years from now (*CisLunar-1000 Economy*, 2017), and reminiscent of the absurdly optimistic O'Neil/NASA plans from the 1970s, these numbers are still not much of a back-up in case many (it doesn't have to be all) humans end up dying on Earth for good and anticipated reasons (like pandemics or nuclear errors), and stopping growth in its tracks.

We do need some fresh perspectives on how we are to manage the next one hundred years because the exponential technological solution fallacy is emerging once again as the 'new hope'. Keeping the Earth from overheating with extravagant geo-engineered solutions, for example, does nothing for sustainable economics and for the maintenance of biological diversity. Yet space activities are now the lead realm to drive broad economic development, and overall, technological success is looked upon as our destiny (e.g. The Singularity, now being claimed to arrive around 2029 by Kurzweil, and fully dominant AI expected by those in the field by 2060). Automation and machine intelligence are expected to usher in an entirely new phase of human development releasing fresh potentials for growth and expansion. The fact that this growth has to be sustainable, if humans are to survive, is ignored by the 1900 or so billionaires on the planet who control virtually all of the readily utilisable wealth of it. The optimists dominate the argument. Certainly there is a lot of cross-pollination between innovations and no one can predict what solutions might be found because of it, but all the same it is worth considering what (partial) exponential growth has brought us so far, and it is worth recognising, too, that there are other developmental forces to economic growth that just as easily hinder the ideal result or obscure the potential of discoveries. Need it be said once again that at the turn of the 20th century there were more electric vehicles than gasoline vehicles. The world land speed record was held by an electric car. Yet development in electric vehicles and batteries remained moribund for a century while the petroleum industry took over as the engine of growth.

Growth has produced immense gains for many of the inhabitants of the globe. The work time needed to earn enough to purchase many goods has fallen dramatically, and people work fewer hours in general and have more holiday time. Domestic life in the developed world is

easier and more comfortable. Public places are cleaner and many social activities are safer. Around the world, more people are educated and very many fewer people labour in the fields or in dangerous and debilitating industries. Developments in travel have allowed vast numbers of individuals to move about the globe, and cultures and ethnicities mix relatively freely. It is generally considered that innovation and ideas have been the engine of the ever-rising rate of growth in the world economy since 1800 AD and artificial intelligence appears to be on the verge of offering industry simple learning algorithms that can be applied in automation across many processes. But not everything is as rosy as it seems, and what seems to be 'modern' in the externalities may not actually represent true advances on what has gone before. Clearly one's experience of growth depends upon where in the cycles of expansion one is. Around 1000AD life was relatively benign. Not so 300 years later when feudalism came to an end and the monetary economy took flight. No doubt the opening years of Manchester's growth were optimistic, but fifty years on the slum dwellers may have been more pessimistic about what growth had brought them. Mysteries of growth abound and inequalities still remain. For many people around the world it is fair to ask, why aren't the consequences of the exponential growth in science, first captured by Derek de Solla Price in his 1961 book, *Science Since Babylon,* and continuing today (even though growth in numbers of scientists may have stagnated somewhat since 1970, in 2001, scientists and engineers formed 23% of the work force), even more dramatic and comprehensive than they are?

A cursory glance through industrial processes reveals curious negations of innovative effects or hidden archaisms. For example, telephony, arising originally from efforts to teach deaf people language, is now very technologically advanced yet telephone companies make more money from people writing to each other on their phone than speaking into it. Fresh technical advances often retain previous generation systems at their heart, or are advances only in degree and not principle. Nuclear power plants hide within them 200-year old steam turbines. In a basic industry like steel manufacture, it is a foreman's lifetime experience that looks into the fire of the furnace and decides when the molten mass is ready to be poured. Skyscrapers are made from frames of bolted together iron pieces in ways the early Victorian engineers would easily recognise. Surfaces and supports are cast in the poorer version of a material (producing 6% of the World's carbon di-

oxide emissions and with less durability than hard wood) that the Romans pioneered and used everywhere, namely concrete. Roads are still paved with bitumen dug out of tar pits (although more asphalt from oil production waste is now used). Agriculture industry has not added an animal to its repertoire since the Stone Ages. In spite of the exploratory push in the 15th century, 2/3 of the world still get their principal carbohydrates from just three plants (wheat, rice and potatoes) and even the new fruits and vegetables we see on our shelves mostly come from trade with other parts of the world rather than through innovation (some notable exceptions like the tomato and high yield cereals have come through old fashioned plant breeding rather than through genetic modification, and which is introducing new problems).

Let us consider the computer. Clearly there have been innovations of key importance in the growth of the economy and it is generally considered that the pace of innovation has been remarkable in recent decades. We have taken the famous observation of Moore (rather erroneously given as a 'Law') as being some indicator of general advancement. The lower chip cost and faster speeds of computers which have allowed the amassing and analysis of vast data sets to dominate the methods of controlling all manner of systems seem to reflect this law, yet the skyrocketing power needs of such computing (such as that needed by Google) do not reflect a similar efficiency, and the industry is closing in on the physical limitations of such devices rapidly. In spite of advanced computer chip manufacturing techniques still the preferred way to store this data is with magnetic tape, invented in 1928 and first used for computers storage in 1951.

Innovations in computing in specialist industrial applications along with improvements in satellite communications have advanced automation considerably, and progress in machine learning with the access to vast data sets has brought automatic operations to all spheres of resource exploitation and delivery, while bringing language translation, image recognition and personal voice activated search facilities to internet users and to the service of the consumer economy. Where before research into artificial intelligence and cybernetics had become almost moribund, now robotic expert systems diagnose health issues and devise drug programs for patients, and automated systems teach courses, act as lawyers, plan advertising campaigns, edit Wikipedia, trade in securities, sentence criminal offenders, credit credit profiles and solve consumer on-line disputes. They do not, however, solve

questions of truth and honesty of the information at their interfaces between system and human (automated social media bots spread false news, disrupt genuine support for public programs, and pollute conversations just like partisan historians of old), and the benefit of these innovations at the household or individual level are not so easily seen.

While computers manage more and more of our lives by recognising more and more abstruse patterns with which they can make decisions, they cannot produce true innovation for which there is no example (even as they recognise patterns that humans miss). Although artificial intelligence systems can beat human players in every game including poker, and can train themselves to respond effectively to relatively novel situations, they still do not think like humans (specialised game playing machines teach themselves over millions of trial and error repetitions, many more than a human could conceivably experience for comparable success and while humans are also processing sight, sound, sensory input and physical coordinations in 3-D space) and they are far from being able to make many kinds of expert decisions, especially those with moral overtones, or act upon their own intentions where there is little information available. The idea that computing power (as distinct to industrial automation) is the means by which sectors of the population become emancipated is exaggerated. We have seen a powerful communication device put into the hands of half the world's population enabling them to coordinate their political protests through the internet (e.g. the 'Arab Spring') that still did not lead to increased representative democracy (although the studies of Chenoweth and Stephan, albeit with a small sample of events, appear to show that peaceful protests can be successful about half the time as long as the numbers of participants rise above a threshold *and* the military does not get involve, although overall, mass protests create less change than before). Such success, however, is as far from true emancipation as say, the London apprentices of old racing through the streets to rouse the mob to protest against injustices were from taking power. Rather the opposite in fact. Oligarchic rule is triumphing over parliamentary-style democracy in almost every corner of the globe, and a 'post-truth' world sows doubt and mistrust on all organs of representative government and pushes propaganda to disguise the intentions of its leaders. Reflect upon the events in Hong Kong in 2019 to see how limited the power of these 'freedoms' actually are.

Modern computing is extremely sophisticated and compute results in many fields that would have been impossible even a few decades ago, yet even so much of modern computing capability goes into simulations of processes. In terms of generating ideas, they are still primitive, and with regards to personal computing, it is hard to pin down in what conceptual sense the technological advances are actually advances for the general public. In fact, the personal computer never helped modernise the home and has now been rejected as an assistant by Millennials who prefer to use their phone. The reason is not hard to see. Mass computing was driven by the need to sell processors and hardware which made operating systems and the apps that run on them bloated way beyond what is necessary and disguising the actual amount of computation required to do any task. Compatibility issues were like a ball and chain on the development of new software. Even Microsoft and its thousands of programmers struggled to produce an effective updated operating system in part because of their obligation to maintain older versions that still exist around the world. Apple has severely curtailed the scope of its own computers (like restricting the way they handle communications like Bluetooth) in order to keep them within their high-earning 'Apple-verse'. (In fact, Apple upgrades are a good example of the trend for cosmetic changes to disguise lack of or restraint in genuine innovation.) The significant jumps in personal computing power only occurred at the intervals where the processing chips moved from 8-bit, to 16-bit, to 32-bit to 64-bit units of computation and not with the purpose of programs.

It has been said many times that if computer operating systems could be produced from scratch today, they would be completely different and very much more efficient (the RISC chipset and even Linux are certainly attempts in that direction). In a sense today's bloated programs are rather like inherited DNA, in which only a portion of its genes function. As a simple example, in 2000, I wrote and compiled a program in the BASIC language to turn large text files into a series of linked HTML files to upload on a web site. The entire program took up eventually just 70KB, and I was a lazy programmer. Later programs, however, doing the same easy task took up several *megabytes* of RAM, due, in part, to modern computers having larger addresses and larger unit blocks of memory. This hardware excess over need in the consumer realm, and the bloated software, can be inferred from many of your laptop programs that are just over-dressed primitive designs

dating from the early years of computers and lacking any kind of conceptual innovation even while the hardware became more efficient and its UI easier to use. This is true of all the core 'work' programs on your computer (like Excel or Word). For example, Bricklin and Frankston designed a computerised spread sheet at Harvard in 1978 called VisiCalc, the foundation to the spreadsheets of today, but which was actually a computerised implementation of business tabulation and calculation methods in use for hundreds of years. Your word processor, when it comes to the handling and editing of documents is no better, conceptually, than the first one developed for Microsoft's MS-DOS operating system, WordStar, based, in turn on centuries-old typesetting practices. The creator of hypertext, Ted Nelson, who thought of documents in a new way, produced his designs in 1965(!), and still laments the failures of designers to fully understand how to take the written word beyond the world wide web implementation of embedded links, and is still trying, along with dedicated volunteers, to further his vision in the (unfunded) Xanadu project. Even the introduction of a computing advance like neural networks into your iPhoto app for reading faces in images may sort your thousands of people-pictures (that you never look at) by individual, but has this any impact on freedoms you may need or want? Much touted 'artificial intelligence' computing may exist for some advanced applications but is nowhere in sight for personal computing which still is riddled with errors, imperfections and absurd complexities, and can hardly update themselves without causing a great deal of disruption. Algorithms in your mobile phone may take great pictures (even though most of the processing power goes into making icons bounce prettily), they are still way behind the abilities of the optics and film of sophisticated cameras of just a few decades ago. Mass photography has been enabled certainly, but better photographs...?

Computers are often considered to be highly sophisticated because they are connected to advanced projects, but often the foundation to such sophistication lies not in the computer but elsewhere. Automated cars seem very advanced but they are only possible at all where highly accurate maps of roads and streets exist. (GPS satellite systems are direct descendants of the U2 aircraft mapping flights of the 1960s that created accurate maps of untriangulated Russia for the US ICBMS). It is their environmental perceptual apparatus which is failing to bring these vehicles into widespread use. As a computing problem, the de-

cision-making and mechanical operations of such cars is relatively trivial (situational perception is more difficult). For example, powered self-steering units for sail-boats are no bigger than a battery-powered drill yet they do a better job handling the tiller in average circumstances than a human.

The hollow egg syndrome of technological advancement can be found in the broader aspects of economic growth and world trade. The GDP of developed countries has been declining steadily in the last decades, some segments of their societies have not seen wage increases for 40 years. World poverty rates are falling around the world where China's growth is included, but some figures have almost half the world still living under $2.50 per day. While some economists point to the successive leaps forward in economic progress over the last century and still others claim that innovation is declining, it is not at all clear what the latter-day core nature of the progress in human civilisation terms actually is. Expanding education has liberated many, but what explains the amazing fact that literacy is *falling* in the world's greatest economy, the US, which is only 86% literate now (2017). In the developed world vast agricultural concerns impress us with their productivity but the reality is that the majority of people on the planet feed themselves on farms of less than two hectares in size. The biological revolution in growing crops (mostly due to the efforts of one man, Norman Borlaug) has halved the deaths due to famine at the same time dislocating many who used to live on the land while the misuse of fertiliser that it requires poisons the water supplies and the oceans, even as 1/3 of all agricultural produce is wasted.

While the success of innovation stems from capital deployment there are subtleties that defy analysis. For example, in shipping, while technical advances like GPS allow ships to travel more efficiently and with fewer crew, the single most important contribution to global trade has not come from science but from the standardisation of the boxes cargoes are shipped in (reminiscent of the standardisations in history like axel widths in ancient China or railway gauges around the world).

Even in the developed world, we can see that as far as the ordinary practicality of daily life is concerned, the 'frantic' pace of innovation has little touched it in recent years, and the innovations over the last decades have tended to introduce changes of degree rather than of kind. The domestic environment albeit with more efficiencies has hardly changed since the introduction of the first automatic washing

machine in 1937 (the first hand-cranked drum washing machine was created in 1851). Entertainment centres are perhaps the principal difference to the home environment of the past, although we forget that pianos and home-spun music and song were ubiquitous until the second World War. As far as the external or internal arrangements of a house goes anyone who does DIY knows how imperfect our 'machines for living' are still. Houses need continuous maintenance; they still leak when it rains; plumbing and electricity all have failure points, drafts still leach heat out of a house, locks do not protect houses from thievery, fuel needs to be delivered to them, and they still catch fire and kill their occupants.

The coming smart house, it has been suggested, will be a real social advance where investment returns can be made more precise and with less waste of energy. It will, on the other hand, return us to a more ancient social arrangement, namely that of feudalism, where the individual consumer will cease to have control over his environment or manage his goods as he sees fit. Anyone who owns an Epson domestic computer printer or a Tesla car or an earlier model of an Apple iPhone can already get a glimpse of this future, where these manufacturers build in inhibitions to the functions of their products if you use alternative ink supplies in the case of Epson, or buy a cheaper model in the case of Tesla (who restrict through its software the power delivered by the car batteries by model), or try and get a third party reparation for your iPhone in the case of Apple. While the 'Internet of Things' appears to be little different in terms of social structure to having someone at home (like a spouse or family member) turning things on and off or checking the fridge to see if there is milk for tomorrow, it will in fact be a step back into a world of determined consumer obligation and it will not be free-ing or free. In fact, the electricity required to manage its data needs (the internet of things) and that of the modern consumer will grow to perhaps 1/5 of the world's electricity supply by 2025, and requiring management, maintenance and upgrading all of which will be out of the consumer's control. As far as capital is concerned, the IOT will be an unparalleled means of trapping consumers into specific expenditures, and yet what actual social *advance* does it represent?

Domestic energy use around the world hasn't changed much for centuries. If you have a Sci-Fi imagination and think of galactic civilisations, how would you classify Humans for whom, in 2015, 41% of

its electricity was still got from burning a black carbon rock dug out the ground (in some places still by hand) and many of the poorest among them have to resort to the burning of animal dung or charcoal, killing 1.5 million people a year from indoor pollution and taking much needed fertiliser from crops? Gas seems an absurdly antiquated source of energy (domestic coal gas, derived from that same carbon rock, was introduced in England around 1812 and after 1820 in Europe: conversions to natural gas took place after the 1950s), not to say dangerous, and yet 21% of the world's population use it for cooking and heating. Electricity distribution to households became the norm by the second World War in the developed world but city-wide street lighting had been installed before the turn of the 20th century. Even so, while half the world still lacks a reliable electrical supply, energy production and transport pollution is creating cognitive decline in developing countries. Solar power investment is slowing in advanced economies because no one has yet solved the problem of locally storing passively produced surpluses for times of need. (Germany's recent costly experience in this effort is instructive, namely having killed their nuclear plants they were forced to use coal to make up the shortfall from renewables even as solar power installations grew). While many think that the batteries of the world's fleet of electric vehicles will eventually even out the market fluctuations by acting as a reservoir, the practicalities of this suggestion (e.g. stretching networks across many time zones) have not been solved.

Advancement is often synonymous with improvements in health and longevity. Longevity may have improved in many countries but it has *fallen* in the world's greatest economy, the United States (in 2016), who is now ranked 31st in world rankings and who, incredibly, has rising maternal death rates, the highest in the developed world. The greatest long term effect on public health around the world, however, despite the eradication of smallpox and polio and the immense improvement in child mortality through vaccinations that have made epidemics of childhood diseases a thing of the past (and whose protection is now declining as anti-vaccination protesters resist its logic), has come from improved sanitation, clean water and food preparation (nearly 1.5 million children still die each each from poor water and sanitation and almost half of all health problems in developing countries come from poor water and lack of sanitation). In the developed world, in spite of significant progress made in advanced health care, especially in

genetics, where the prospect looms of easy genetic editing curing many diseases and eventually giving rise to an altered human genome, many basic drug treatments range from neutral to harmful for patients and the benefits of some widespread surgical interventions are illusory. In this modern epoch, 10% of the US population is hospitalised each year and between 1/4 and 1/2 million of those patients die just from medical errors (≈10% of all US deaths). Yet most chronic sickness in people arises from eating too much of the wrong food (recent studies suggest that globally one in five deaths are due to poor diet) or drinking alcohol, and one of the biggest causes of death is not a specific viral or bacterial agent at all but smoking. Consider that your dentist may take an x-ray of your teeth but he still finds likely cavities by looking for stains and using the ancient technique of probing them with a point to see if you wince. Infection at the root of a tooth is dealt with the way teeth have been dealt with for centuries, by yanking it out. Still the most effective pain killers in use today come from opium which was traded around the Mediterranean in poppy bud shaped amphorae since the start of civilisation. The antibiotic revolution which has saved countless lives has not definitively solved the problem of infections and after just 60 years of use medical researchers are now having to race to find a solution to the evolving antibiotic resistance in dangerous bacteria like gonorrhoea, without which future mortality around the world will soar.

The advances in medical technology are beginning to look purposeless since still the biggest burden on health care comes not from diseases but from those older than 65 years, who will rise to 16% of the world's population by 2050 (on average; it will be 30% in Japan for example, and 40% of Germans will be over 60), for whom palliative care will be most required.

As we can see, in the mix of apparently advanced technologies, are antiquated systems from earlier epochs exposing significant differential rates of development, and also apparent are the effects of the difference between need pull and need push at the domestic level in the modern consumer economy. Both automation and the need for higher skill sets put basically educated people out of jobs rather than in them (for the short term and perhaps forever) but broadly speaking, the effect of most innovations at the individual level revolve around leisure rather than emancipation and that in many areas of activity innovation is functionally cosmetic; no longer emancipating but simply whim-

sical (think gaming consoles). In December 2016, Forbes produced a list of the top 30 innovations of the last 30 years, most of which have had little direct impact on daily life or whose benefits, like Social Media (20th on the list), are extremely mixed. The only innovations that might pertain to the domestic environment on that list are LED bulbs and the Internet, and, in fact, if you look back say 70 years, then the invention most significant by far to humans, emancipating women and radically altering the promise and outcomes of human relationships has not been a technological device at all, but the contraceptive pill (introduced in 1960), a way of regulating a woman's level of hormones by delivering precisely calculated quantities of natural hormones into a woman's body. On the social consequences of sex, one might reflect upon the growing acceptance of the idea that humans belong to a sex spectrum rather than a binary sex designation having an emancipating momentum well outside technology.

I have chosen a mixed bag of examples but many can be found across the world. All beg many questions. While improvements in working conditions, health, food and sanitation are expected from growth why has it not addressed many of the more significant features of our social existence? Think of education. Not only is much of it denied the poor, its benefits can still be a matter of luck, even for the bourgeois, where incompetent or vindictive teachers can blight entire lives. Think of justice and why the world's greatest economy imprisons more of its citizens than any other country. Think of the puzzle of chronic violence around the world. One's pessimism or optimism about the advances of technological civilisation is going to depend upon where you are placed in it, but a more fundamental question remains. Why do technological 'advances' so often retain or recapitulate ancient power structures. The answer is two words, capital growth.

The beginnings of the modern industrial revolution is generally marked in England by the self-taught, though illiterate (he once demonstrated to a Parliament committee his design for an aqueduct carrying his canal carved in cheese), engineer James Brindley's building of a canal (1759-1761) for the Duke of Bridgewater so that the Duke could ship coal from the mine on his estate into the centre of Manchester to find a bigger market. Parliament, compensating for creating a Bill compelling landowners along the route to sell to the Duke, set by law the price of coal to be sold in Manchester at almost half the price it had been sold at previously and unwittingly provided the con-

ditions for industrial growth. Cheaper coal stimulated the expansion of the country town of Manchester into a slum-ridden industrial metropolis within 50 years, the inspiration for Engels and Marx's forays in communist ideology. Bridgewater built improved housing for his workers and didn't see a profit for twenty years, but such early benevolence to the poorest from the subsequent waves of innovation could not be sustained in the relationship between capital owners and labour. (Even the canals, originally boon highways, were the preserve of landowners who were able to resist the building and spread of railways for quite some time, and the railway interests in turn tried to prevent steam carriages on roads.) One might speculate here about what the discovery of any cheap energy supply (a possible candidate is fusion) would do to human society given this history (or if, for example, Aliens bestow new energy sources on us, a point we will examine further on).

The original concept of material innovation as the means of improving our world and the lot of workers, stemming from Benjamin Franklin (who lived in England for many years, although Adam Smith's *Wealth of Nations,* giving substance to this theory was not published until 1776) and his circle of innovators (to which Bridgewater had been introduced), has turned out to have had a limited life. It has been replaced by the single purpose of improving the lot of capital owners (legislative bodies around the world are still reducing the tax burden of asset owners, in 2017). The suspicion arises that as the share of wealth continues to rise among the capital owners, as noted by Thomas Piketty, there is correspondingly less pressure for innovation to create wealth for them.

Personal fulfilment is now a by-product of the economic realities and not the purpose of them. The core purpose of innovation being to make capital even more productive by controlling and reducing costs; by converting costs directly into the environment through entropy, and by so doing, using the entire biosphere (or more succinctly, everyone's back yard) as a sink to absorb the wastes from the relentless acquisition of wealth. The fact that innovation improves our lives is only a function of us as growing consumers, and until there are sufficient consumers for an innovation it will not happen. The innovation engine looks only for the most profitable effect and the greatest marginal profit extractable from new techniques. In our epoch, this is found in information processing and which is the sole impetus behind recent economic growth around the world. The purpose behind the innova-

tions in information processing is so far from emancipating individuals or from freeing them from exploitation and slavery that it is used in the opposite direction.

Our focus, however, is on the space economy rather than on the lack of emancipating innovation in general industry because activities in Space mark a psychological threshold to cross represented in an economic paradox. The space economy beyond Earth's environment has no consumers. There will be no real markets for space products for probably a century and thus no real return on investment in space. How, then, do we choose and pay for space activities while environmental programs are failing? Governments will continue to fund space science, and there will be, as a result, an Earth-based economy of innovators reaping the rewards of government interventions but since there is little income-producing capital growth in these artificial markets, what can we say *is* the space economy? Whom does it serve? There is no doubt that useful avenues of research march hand in hand with technological development, but the dilemma before us is, will innovation actually save us *in time*, save the Earth for future generations, or are we destined to use the *excuse* of mastering a hostile, inhospitable environment of Space to encourage the capital growth on Earth such that it ruins the very system that raised us?

Space exploration so far seems justified. It has turned out to be highly valuable to humans. Space activities are so well integrated into everyday life that today's society could not function without them. Weather prediction, environmental monitoring, national security, materials science, solar energy production, medical advances, personal and corporate communications, global banking, mass entertainment, geographical and voyage information and safety are some of the most obvious everyday benefits to the world's citizens, but industrial processes that involve imaging, drug fabrication, solar energy production, robotics, computer software and economic data monitoring have also taken a boost from space exploration. But all these benefits arise solely from communication and information. They are the direct result of satellites, their sensors, their transmitters and antennae, not from any broad front of industrialisation. Space inspires scientists and stimulate our curiosity about the nature of our universe. How could it go wrong?

With the growth of artificial intelligence, we are certainly poised at the threshold where we need to make sure that humans and not ma-

chines answer this question. An intelligent machine, whether or not it is sentient and however 'smart' it may be, will have to solve problems of resource allocation and use in human society as well as fit in with other systems and their needs, and without some kind of moral dimension or duty to human life in its reasoning, may perfectly well think that destroying the Earth in order to get into space is an acceptable strategy for growth. There may even be humans who believe this now. Certainly humanity has given over control of orbital space to the political entities that exploit it. The space agenda is not humanity's to decide any longer. How do we ensure that these machines (and humans) understand that destroying the Earth (either actively or through inattention) to get into Space is not an option for us?

To answer these questions I will try and throw some new light on what it means to be human, conscious now in this universe, and confronted by extinction. In particular I will examine what the 'now' actually means and whether our memories contain more information than we expect. I will show that we can, in fact, travel some way into the future and extract more information from the potentials of what is to come. I will end the story with the description of a particular human kinship stretching through time. This kinship, or cosmology, forms the unsung backdrop to human society and with which we can initiate a sociological experiment that may help us derive solutions to the extinction threats humans face and take humans on their voyages to the stars.

The Chronolith® Observatory

Given the inevitable paradoxes of compound growth needed for humans to populate the galaxy,the Chronolith® Observatory may be the only way human civilisation can examine the future, try to reduce unknowns in the decision making process, to avoid traps in the development process (like genetic manipulation introducing unexpected outcomes) leading to economic collapse and the destruction of Earth, and to discover the kinds of humans who will be able to take us on our space explorations.

Given the vast distances of ordinary space between potential landfalls in the Universe, the observatory may be the only means we have to connect to other regions of time and space.

The Observatory is a live experiment in which anyone can participate. It is designed to investigate the natural link between events, and to probe the boundaries of possible movements between them.

The discussion of journeys in Time, however, is not about distorting vacuum fluctuations, wormhole tunnels opened by microscopic massive black holes, voyages around cosmic strings, or hyperspace and imaginary time axes, or even about Casimir Effect boxes. The physical mechanism of time travel, while vaguely interesting, is not what matters. What matters is understanding what is fixed and what is flexible about the usual narrative progression of events.