The Origins of Prediction

Before the written word, before towns and villages or formal structure of law and leadership, humanity and its ancestors were hunter-gatherers. It is impossible to know for sure how our ancient forebears came to learn when and where best to harvest fruit and vegetables or hunt animals. Or if they even understood the effects of rain or sun on the fruition of trees or congregation of animals.

Around 12,000 years ago, humans began to cease wandering plains, savannahs and forests, and started to settle. They built homesteads and farms, developed techniques for growing particular crops. A more dependable source of food was established. At the same time they experienced the impact of previously minor or even non-existent problems. New diseases (of both people, animals and plants – sometimes one and the same) spread more vociferously than ever before. Bodies had to adapt to previously ‘unnatural’ diets that were now based more around crops and a few, easier to domesticate animal species.

Survival in this world was paradoxically both more reliable and also more precarious. Whilst the attraction of rejecting the nomadic life meant greater control over when and where food would come from, it also increased the all-or-nothing risk. Too much rain or sun, a ferocious storm or natural disaster could destroy a harvest. Two bad harvests in a row or a virulent wave of illness could see a whole village die or be forced to move, potentially bringing conflict with neighbours. Over the centuries the skills required to survive outside of a settlement were lost. The Agricultural Revolution, like every revolution since, brought benefits, problems, and unintended consequences.

On the upside, humanity started to develop skills from house building to baking (it now being possible to grow, harvest, store and process wheat and grains). Tools could now be made with more care and precision, rather than cobbled together quickly on the move. Skills became valued; the highly skilled individual, a significant asset to a settlement.

One of these newly developed skills was the ability to spot patterns; to understand cause and effect. Of fundamental importance to the human dominance over the world was the ability to see not just that heavy rainfall could damage crops, but what conditions might foreshadow heavy rainfall. Forewarned is forearmed. They could plan and pre-empt, they could take precautions, storing more food, harvesting earlier, or move animals to other plains.

The more homesteads, food stores and skilled workers a settlement accumulated, the more others envied them. Defending your hard worked land and produce meant the rise of a warrior class. As a population grew, order was required. People started to ask questions that demanded answers. Decisions on disputes and plans for the future were required and so leaders were sought. Perhaps most significantly, rules of behaviour and ownership, and of payment for labour and goods, became necessary to avoid or to settle disagreements. To deal effectively with this challenge, records were created and with records came administrators and bureaucracy.

After around 5,000 years of non-nomadic living, writing and counting emerged in the human story. From South America to Asia, there are ancient forms of record keeping the meaning of which is now largely lost. The global growth of fixed populations, authorities and hierarchy, and rules also saw the development of learning, measurement and early science. With them came the rise in importance of an elite, learned few that could record numbers and later laws, stories, names, dates and facts. They would guard their knowledge, pass it on to a select few, and offer their wisdom to those deemed most deserving, useful or profitable.
It is likely that there were select individuals that could better answer questions, impart wisdom, make decisions, and understand (or at least appear to) the world around those few hundred people that made up the village. They rose to influence through ways that cannot know be known, but we can speculate that, in those early times, some element of meritocracy existed. Physical strength may have played some part, especially in times of conflict, but strength alone could not hold a village together and guide it to success. It is just as likely that the clever, the hard working, the capable and those adept at making alliances rose to positions of influence. That this would eventually lead to forms of class structure, closed elites, nepotism and corruption is unfortunate. But those early leaders could, generally, be assumed to have displayed the attributes (not necessarily the attributes we would see in leaders today) that made them best suited within their group to lead.

Over time, those leaders (presumably through trial and error) realised the importance of taking advice. The wisdom of not relying solely on their own instincts, experiences or ideas. They realised that they could be more effective leaders by learning from those around them, and, in some cases, delegating responsibility (and blame). The more effective the leader, the more secure their position and the more the village would flourish. It would grow, repel invaders, conquer other villages, and become a town. The leaders would be more powerful and more secure. However, that success would only come if effectively advised; advised in the ways of war, legislation, agriculture, social order, taxation, and popular opinion. Advised on what we would call luck, fate or fortune. The leaders would make the ultimate decision, of course, but invariably under the influence of various ranks of counsel.

Farmsteads and settlements became villages, and villages became towns and cities. With this expansion war and conflict with neighbours emerged. Conflict would come about usually through the ambition of leaders seeking to increase their power and legacy; for economic reasons to increase wealth or access to resources such as food, metals and so on, especially in conditions of shortage; or to expand the influence of their religion, often under the influence religious figures.
International trade

Having found a way to trade effectively with trusted partners, in effective markets, only one barrier to development remained. Fundamentally trade occurs when there is a geographic separation between production and consumption. Although it would, in times of scarcity, be necessary to trade, few ancient populations would rely exclusively on something they did not produce themselves. Trade often started out as a luxury, for the wealthy and privileged. As a state increased its wealth and that of its population, those luxuries would become ever more accessible to more and more people. Demand, and the supply to meet that demand, would dictate trade and prices. This had a profound effect on a population, changing tastes, necessitating new skills, pushing certain individuals to take great risks to find new ways to meet demand.

In the first century CE large Roman garrisons insisted on some home comforts as compensation for being stationed in the bleak north of Britain. The importing of their preferred produce left its mark forever. Wine, pork and oils from the Mediterranean replaced the mutton, mead and misery of this newly conquered (or in some cases stubbornly unconquered) land. In time this changed tastes and established a market; wealthy people willing to pay for products they did not need but wanted. With enough demand, and enough money to pay, the difficulty and cost in transporting items hundreds of miles became worthwhile.

This also demonstrates the impact of specialisation, something that would go on to shape states and populations over the centuries. With money and trade came the ability for certain individuals, and then entire settlements, to focus on doing one or two things really well rather than trying to be self-sufficient. Why produce really high-quality leather goods but only average meat when you could instead focus more of your efforts and resources on the former, improving and producing more. You could then sell more of your leather for more money, and then buy more and better meat from a village that has the land and expertise to specialise in that?

The complexity of trade gives some indication why some believe it to be the single greatest achievement of humanity alongside language, writing and the making of tools. It has had such a wide-ranging and fundamental impact. It took centuries to realise, and, like language, evolved often independently amongst populations that had not intermingled for millennia.

Trade became the principal influence over the development of local economies, buying and selling between towns and villages. For all its obvious advantages and uses, however, trade on an international level remained limited in its wider influence. Although some cities thrived as hubs of wider trade, the wealth of nations depended principally on the acquisition and protection of land and the sustenance of its peoples. Through war and treaty, people, natural resources, treasure and crops were brought under a single ruler. Thus empires were constructed.

As the populations of towns and cities grew, there was a greater demand for food and shelter within a small area. But more people also brought greater production of tools, food, goods, and ultimately wealth. It brought larger armies and provided them with more and better weapons. It developed new skills and new inventions.

Yet the economic and social order remained relatively simple. People largely did as priests and the representatives of the ruling classes ordered them. The success of any enterprise depended simply on human endeavour, the weather and good fortune (as controlled by the gods and understood by
those that spoke for them or interpreted their whims). The lives of most people were largely immune to the actions of other nations and populations thousands of miles away.

In trade, Ancient China was something of rarity, especially for its size. Its provinces and regions, more usually rivals or even outright enemies, were finally (more or less) unified around 220BCE into what would be seen as a centrally governed country with borders similar to modern China. Shortly afterwards the ruling Han dynasty established the so-called Silk Road, a trade route running through Asia and Arabia to Europe. A lucrative trade in silk and horses ran along this path with wealthy elites throughout these regions paying well. The nascent Chinese state grew rich and influential. The wealth derived from this international trade enabled China to fortify itself and subsume smaller kingdoms.

Trade along the Road expanded with ceramics and foodstuffs, and China became the leading trading nation of the world through most of the Middle Ages. Despite wars and internal strife it maintained that status. Its wealth enabled new innovations that served to further secure its place as a hub of trade and a magnet to people from all over Asia and Europe. This mix of people in turn served to create a virtuous cycle of income growth and further innovation.

Meanwhile in Europe, a continent slowly but increasingly comfortable with trading overseas, the resultant population shift towards cities and towns combined with trade in one particularly devastating event, or series of events; the Black Death. As larger and larger groups of people moved closer and closer to each other, first in villages, and then towns as cities, so disease spread much more quickly, affecting many more people. At the start of the Agricultural Revolution the threat was from diseases originating from newly domesticated livestock. With the growth of trade, ports in particular were open to new diseases from abroad. A large, condensed population were exposed to diseases they had no immunity to and no understanding of how to treat. In just one of many examples of complex, unintended or unforeseeable consequences of trade, it would also provide a turning point in who would dominate global trade.

By the mid-1300s a feudal system was well entrenched in much of Europe. A landed elite owned most of the productive agricultural land. Uneducated, semi-skilled peasants made up much of the population and they lived on the land at the munificence of powerful landlords. They swore loyalty to the landowners who set and enforced laws and taxes at the behest of the monarch. At the same time the Persian and Chinese Empires were much more advanced and diverse; they had greater cities, greater learning, and dealt more in international trade, finance, ideas and art.

Climate change in remote parts of northern Asia killed crops and pushed rodents into more populated areas. With them came fleas carrying bubonic plague. The plague travelled along the Silk Road around the mid-1300s devastating the Persian Middle East as well as parts of Europe as it went. Naturally centred on trading cities and ports, the epidemic primarily affected urban areas, leaving rural communities relatively unscathed. Despite the death of tens of millions across Asia and Europe the population densities meant the more rural, less advanced Europe was less affected and could rebuild more rapidly in the wake of the plague.

The aftermath of the Black Death saw European populations move to repopulate the cities. The killing off of a lot of people meant fewer workers, which meant higher wages for those that survived, whether rural or urban. This shifted somewhat the balance of power (albeit temporarily and in a limited manner) away from the landed classes, who in those times wielded political as well as social and commercial power. This shift weakened the powerful elites, and gave some of the working
classes disposable income for the first time. This meant a new market for imported goods, and a healthier, better fed, more productive population.

A fatal plague realised by weather conditions and spread by trade had decimated the trading nations of the Middle East but set the lesser-trading nations of Europe on a path which would ultimately lead it to dominance.

It is not easy to rule a country as large as China, and many Chinese emperors were ruthless and authoritarian, aided by a bureaucratic culture born of the rationalist philosophy of Confucianism. In the late 1300s, Emperor Zhu Yuanzhang, founder of the Ming dynasty, sought to enforce a model of rural self-sufficiency and a rigid military structure throughout the nation. This included significant improvements to the navy. As part of his revolution he also broke down the existing and, as he saw it, entrenched bureaucratic structures. He deployed his relations throughout the country to rule, giving each a personal army, but imposing rule centrally.

Zhu Yuanzhang’s successor, Zhu Yunwen, attempted to undo some of these regional structures leading ultimately to a revolt and his overthrow. Zhu Di, the third Ming Emperor restored order, a part of which meant rebuilding the bureaucracy around, amongst others, a class of Confucian scholar-bureaucrats, including one, Zheng He. With decades of investment and innovation in shipbuilding to call on, an adventurous and influential Zheng led explorations of the oceans around China. He travelled to Arabia and East Africa, even, it is thought, to Australia. Each ship in his fleet incredibly advanced, fast, well-built, and carrying thousands of crew. A formidable Chinese armada of exploration travelled far and wide.

Chinese power, ideas and culture were exported all over the eastern world establishing the country’s primacy in the region. However, internal disputes, shifting priorities and conflicts with neighbouring kingdoms saw the bureaucrats judge expeditions like Zheng’s a waste of treasure and manpower (some of which was diverted to reinforcing the Great Wall). By the 1430s China had all but stopped their overseas expansion and the navy fell into disuse. Shipbuilding and seafaring skills waned and China looked inwards.

The prevailing opinion was that this mattered little. China had contacted many of the ruling elites overseas, in some cases the first foreigners ever to do so, and their place as the local superpower was firmly established. Other nations came to them to trade goods; expeditions to far-off lands were now an expensive and unnecessary indulgence.

By now, 6,000 miles away in Europe, the Portuguese and Italians were strengthening their sea legs and started to sail across the oceans. They started to expand their powerbases, and more important than any cultural influence or reputation, their trade routes. Perhaps, had the Chinese known that the Americas lay the same distance to their east as Europe did to their west, they might not have been so quick to withdraw from international exploration. But withdraw they did and the effects of that decision would resonate for the next seven centuries and beyond.

Following the paths first cut by ancient Greeks and Roman, and later by the likes of Marco Polo, Europeans started to turn up in increasing numbers on the shores of China seeking to trade. By the 16th century European trade routes over land and sea were firmly established, and well protected, both to the east and to the west.

The links to China were prized for the supply of spices, silks and foods and the Chinese economy started to flourish again. With few European products that the Chinese wanted, trade relied largely
on silver, which fundamentally changed their economy. With the country increasingly reliant on selling and exporting its goods, a combination of crop failures and natural disasters (and a failure of priests and astrologers to foresee such bad fortune and weather) saw a collapse which brought about the end of the Ming dynasty. An entire royal household brought down by trade, poor planning, and a policy of insularity.

China’s withdrawal from the world, in the circumstances quite sensible, would go on to affect it for centuries to come. It would arguably miss out on becoming the pre-eminent global economic power (all the necessary elements were in place ahead of most European rivals). Instead it would become a pawn in the trade wars of other nations.
The Age of Enlightenment saw science and reason gradually start to replace religion and faith in many areas of understanding. It was ultimately a revolution of science, philosophy, and politics. Whilst religion would continue to hold sway over questions of morality, law and behaviour, its ability to fully explain the world was increasingly questioned, especially by many educated people. In some cases this questioning of God and nature was seen as sacrilegious. Elsewhere it was little more than the eccentric preoccupations of a privileged few. Some Enlightenment thinkers saw their challenging of received ideas of humanity and the natural world as vital in order for society to progress. Others saw it as the God-given duty of humanity to learn and to examine the workings of His incredibly complex creation.

Throughout the 1700s science was increasingly trusted to explain, or at least have a good attempt at explaining, the mysteries of the world. Science was demonstrably improving understanding of the human body and medicine, physical phenomena and chemistry. The scientific method was increasing in its importance and power. Methods of empirical examination, the rigorous testing of theories, repeatable experiments and peer reviews were vital to anything seeking credibility in this new era of reason.

Rationality, empiricism and scientific method delivered results - repeatable and repeated results. In medicine in particular, science saved lives and tangibly limited the spread of disease. This age of reason also affected prediction. Theories and models were tested and tested again, and eventually adopted as ways to predict the physical effects of an action.

As Albert Einstein would observe 200 years later, a theory could only ever be proven wrong. Science embraced this challenge early. Whilst theories could and would be debunked by new evidence, the scientific community simply adapted its work to account for it. If a theory seemed to explain something satisfactorily, it would be adopted until something disproved it. Upon which this new finding would be examined and a new theory presented. Certainty was no longer required for credibility. Adaption and flexibility were the new, sensible approaches. Learning never stopped.

With this newfound willingness to question and view certainty with caveats, scientific prediction was limited. It always carried the proviso that what could reasonably be expected to happen in a certain set of circumstances would probably, but not certainly happen again. Science, underpinned as it was by logic and mathematics, would seek conditions where a theory could be wrong, or to put a value on the likelihood that something would or would not happen. Science accepts that it could always be wrong. Science, by its very nature, was robust enough to be challenged.

This lack of certainty meant science was not in the business of predicting the outcomes of wars or politics, or of individual lives. Even thought it would affect them it would do so in unpredictable ways. It would contribute to new ways of fighting, new sources of wealth, and great advances in medicine and welfare. It would not offer reassurance or support to a particular agenda. It would undermine many of the predictions of religion and faith. It would also influence the approach of other disciplines, like philosophy, that consider what is and what is not certain.
Aside from weather the other great challenge to efficient, safe ocean-going passage was reliable navigation. Whilst cartographers and explorers had been able to map coastlines with some accuracy, it was hard to judge the speed of a ship, so it was hard to judge distances. Even with a reliable map, precise measurements of speed and distance at sea were almost impossible, and even a small error could become huge when travelling over thousands of miles. It all came down to accurate timekeeping.

Whilst science sought to explain how the world works, those whose concerns was more pragmatic pursued ways to use science to their own particular ends. International trade required safe passage, accurate navigation, and a strong navy to protect its sea-going interests. In the early 1700s there was a series of accidents that saw British naval vessels wrecked on the Scilly Isles off Cornwall. These accidents were put down to navigators being unable to accurately judge their ships’ positions. The British Parliament, along with private individuals, set up a series of prizes to tempt the country’s scientists to solve the problem of longitude. The prize to the winner was equivalent to over a £1m today. The prize to the nation and its merchants was a decisive advantage in both trade and war.

Timekeeping has been an obsession for humans certainly since the Agricultural Revolution, possibly before. Those early astrologers and mathematicians measured the degrees by which astral bodies moved day by day. They measured the passing of time by the burning of uniform candles or draining of water or sand through an aperture, or by tracking the movement of the sun. The development of mechanics made instruments that oscillated at a regular rate, an attribute applied to timekeeping. All of these clocks, however, relied on mechanisms moved for a limited period, either by weights slowly pulling a clockwork movement or by winding and then releasing that stored energy through springs.

As important as it was to measure time accurately on land, the country that could accurately measure the passage of time at sea would navigate more accurately, and travel more directly and more safely. Importantly, they would win the global trade contest.

At sea, you could not rely on weights and pendulums. The method that drove the most accurate clocks of the time was rendered useless by the relentless movement of the ship. Wound clockwork was unreliable and imprecise, certainly when it came to using time to measure how far a ship had travelled. British clockmaker and carpenter John Harrison solved the challenge first and best with his marine chronometer, produced in 1735. It took him over 30 years but his pioneering achievement, though expensive to produce, gave British shipping an early advantage, reinforcing its front-running position.

Science had enabled trade, particularly British trade, to improve vastly by analysing, understanding and creating tools in chronology and meteorology. In turn, merchants, and therefore governments, saw value in science and invested in it, seeking commercial developments, new products, and new efficiencies. Trade’s international scope also brought new ideas into play, advancing science with new perspectives, new materials not found domestically, and ideas advanced by different cultures.

The trade in ideas was and remains arguably far more profitable, and more significant, than that of sugar, salt or cotton, even oil and gold. Whilst money could be made directly (if shorter-term) from the buying and selling of commodities, ideas could completely and irrevocably alter entire industries and populations. Scientific advances also produced new technologies; technologies made more money, which funded more science and so a virtuous cycle developed.
Importantly science was not just revealing exciting, important and practical new information about how the world worked, it also provided a new way of thinking. It questioned, experimented, theorised, revised, and challenged. It sought evidence and proof, and remarkably it tried to prove itself wrong. Far from being a sign of being impermanent or unreliable, science - true, empirical science - derived its strength from its willingness to adapt when presented with new information. Both flexible and robust, science resists change until new ideas are thoroughly tested, but once they are, science adapts. Science predicts based on its prevailing theories but knows that those predictions are only as valid as the theories, that is, until new evidence emerges.

As it had since the 1500s, science was used by the powerful for their own advantage; a return on their investment, risk-taking and faith in its research, but they would also come to be threatened by it. Although funded by politicians and merchants with political, social and commercial aims, science continued an overall trajectory of benefiting humanity with unbiased, apolitical progress. Those with an ulterior motive might twist science, or ignore inconvenient parts of it, in order to prove their point. However science chipped away at those claiming power over others through divine intervention, and it gave more power to those lower down the class structure.

Religion in particular would use its political and social leverage to both fight its own corner against science and to protect its influence amongst the elite. It would not have modern science come along and undermine its loftier, millennia-old, spiritual authority. But it was not alone in being threatened by scientific thinking. If everything people assumed about the most basic workings of nature was now being questioned why not also social constructs?

Just as spiritual leaders valued their position of influence over the powerful, so scientists started to do the same. Just as their priestly forebears denounced ideas that threatened their privileges so science’s established elite would come to fight to protect their role as holders of knowledge and influence. They themselves would come under the influence of power and money. It would compromise their independence and see them develop theories that were aligned to certain unscientific priorities. In the long-term, however, the rational won out.

Scientific method, its spirit of enquiry, could be applied to explaining how something moved or changed. Did that mean it could also be applied to other part of life, including the non-physical? Could it explain or evaluate ideas of morality and social order? Could it control or make sense of this new, complex industrial world it had helped to create? This thinking combined with contact with other societies and cultures to generate new political and philosophical ideas, particularly around human nature and the freedom of the individual.
"Foreknowledge of the future makes it possible to manipulate both enemies and supporters." - Raymond Aron, The Opium of the Intellectuals

From the ultimate nature of the economy and society like Smith and Marx, to a detailed analysis of inflation rates, trade surpluses and currency values, economists moved from the very big to the very detailed. The complexities of 20th century economies and the increasingly huge, slow-reacting businesses that underpinned them, demanded planning and preparation. Understanding what will happen could be the difference between prosperity and poverty, or for a democratic government, being in power or in opposition.

Having looked to physics and science for inspiration to create models of economic behaviour, the latter increasingly involved itself with ever more complex predictions of ever-finer details. Individual companies as well as governments looked to economists to inform their strategy, globally, domestically, even within local regions. Economists started to specialise in industry sectors, in specifics like wages, property or retail. Economics as a discipline took on a life of its own, such was the demand for their knowledge and foresight.

Whilst governments still obsessed with economics as the foundation of their national wellbeing, they wanted other perspectives on the future too. They wanted to know what their strategies should be beyond the purely economic. How should they prepare militarily or socially, in areas of infrastructure or education, healthcare or technology? How could they be sure, or as sure as possible, their policies were solid, reliable, and the best solution for the years ahead?

In the aftermath of the Second World War the world faced what seemed to be a new set of rules. People and government struggled with the horrors of a war that affected so many civilians as well as soldiers and destroyed so many towns and cities. Leaders revised their long-held assumptions in light of the carving up of what had been the world’s most politically, ideologically and physically powerful continent. The holocaust, nuclear weapons, American supremacy, new technologies, women in the workplace, welfare, national debt – a terrifying to-do list faced modern politicians and their advisors. Many felt the need to try to prepare for a future which had never seemed more uncertain. Others felt the need to imagine, and to build, a better future on the rubble of the old certainties.

If market economics has taught the world anything, it is that where there is a need, someone will try to fulfill it. The need to understand this new political and social dynamic inspired the study of the future. Applying multidisciplinary academic methodology akin to that of areas of history, universities started producing students and experts in what the future will look like; what patterns in the past can be applied and extrapolated for today.
By the 1950s, the serious, academic study of the future, previously a high-minded but indulgent preoccupation, had become important with the rise of the USSR as a nuclear power. Strategies were formed. Scenarios were built. What would a government do in the event of half the population dying in a nuclear attack? Who would most likely die and who would survive? What would that mean? How could a country be rebuilt? Naturally the US, the prime target of such any such attack, took a lead in this area of study.

During the Second World War, and for the first time in conflict, numbers played a vital role. The period 1939-45 saw many incredible and terrible developments, but one of the less famous was the rise of war by numbers. There was a new role for mathematics: as a weapon of war and as a means of analysing the success or failure of a strategy.

In Europe, the Germans and British fought a now famous battle of code-breaking and encryption. The Allied efforts were centered on Bletchley Park, the mathematician Alan Turing and his colleagues, and the nascent computing array known as Colossus. The Bletchley team created formulae of such complexity, and that required so much data, that whole new systems - of mathematics, of machinery - had to be invented.

For the US Army, in order to minimise risk and the potential for human error, field combat was increasingly a scientific matter. With ever more powerful and potentially accurate weapons, it was no longer a case of pointing at the target, firing and hoping for the best. Science took over some of what was once the sole concern of human instinct or skill. US artillery required extensive calibration charts. These charts indicated where to aim for given the variables of ammunition weight, weather and climate, geography and so on. Those in the field needed the best possible chance of getting a result from firing a weapon. In order to do so, numbers were calculated thousands of miles from the arena of combat, in offices in America, by hundreds of women. They became known as ‘computers’ and they worked on calculations for field artillery, aircraft and other areas of military research. Their groundbreaking work, done manually and with mechanical calculators, led to electronic computing and a drive towards statistical analysis of real world variables and outcomes.

After the War the US tended towards a technical, analytic approach to future planning. In Europe, including the USSR, it was more focused on the long-term outlook for societies, the environment and abstract ideas of language and thought. Over time scientists and inventors started to collaborate with political thinkers, economists and other social scientists such as psychologists, historians and sociologists.

Government and business started to put ever more emphasis on what the future would look like and what their role in it would or could be. They would, inevitably, seek to put themselves at the centre of any portrait of the future. As such those groups of researchers and thinkers that could put those
organisations that were commissioning the forecast at the centre of a predicted future, reassuring them of their relevance, were the ones that were in demand. Consequently, those groups became part of an established ruling elite that would influence the very future they were employed to objectively predict.

In Europe, one such predictive organisation was The Club of Rome. The Club drew together former politicians and public servants, businesspeople, scientists and economists “who share a common concern for the future of humanity and strive to make a difference”.

In 1972, The Club of Rome published its first report. It was a prediction, based on computer simulations, which stated the current rate of natural resource usage would bring about an end to global economic growth. That alarming warning was followed two years later by the publication of The Club’s Mankind at the Turning Point. This time the report incorporated the regional and the social as well as technical data into a model that used 200,000 equations to conclude that, whilst catastrophe was on its way, it was not inevitable, and that human intervention could avert disaster. Fortunately, that was the limit of the Club’s remit; designing and implementing that intervention was the responsibility of others.

Another, more influential, organisation was founded in America 25 years earlier. The Douglas Aircraft Company was founded in 1921 and by the time America entered the Second World War it was already a key supplier to the US military. Its business flourished in the early days of commercial flight with its DC series of planes, and between 1942 and 1945 the company produced 30,000 aircraft for the armed forces. The fifth largest recipient of government contracts during the War, the end of conflict saw the company facing serious financial challenges. The military decided to charge Douglas with a new role; one that had never really been considered before. Douglas would take many of their thinkers and engineers; those whose understanding of physics and complex mathematical analysis had helped produce not just brilliant aircraft and weapons, but had solved big strategic problems, and assign them to Project RAND.

RAND, a name derived from Research And Development, was charged with preparing the US for an uncertain future. A future where global nuclear conflict was possible, perhaps even likely, and in which science and technology would have an important role in the outcome. RAND would be a bridge between military planning and government policy making. It would look at the economic, social, political and military factors and develop robust, comprehensive plans and programmes.

Eventually, due to conflicts of interest between what Douglas manufactured and the issues it was advising on, RAND was separated from its parent company. It became independent and non-profit, predominantly funded by the foundation run by Henry Ford’s family. It provided in-depth analysis for the US military. Using the expertise of scientists, economists, engineers, psychologists and military figures it built scenarios, calculated probabilities, assigned numerical assessments of risk and considered the options for responding and their consequences.
In the Cold War years of Soviet threat, both real and perceived, much of RAND’s resources were focused on the likelihood of nuclear war. It famously developed the MAD (Mutually Assured Destruction) doctrine which asserted that neither actor in a potential nuclear conflict would strike first as to do so would ensure the ultimate obliteration of both attacker and target.

Amongst many other theories RAND developed to inform policy and strategy decisions was work on Game Theory. It was Game Theory that influenced the MAD doctrine as well as policy on the nuclear arms race and the Space Race.

Game Theory is a multifaceted set of ideas that, broadly speaking, propose that humans will frequently act in ways that are not to their advantage but do so for reasons we can all understand - that is, assuming we are not psychopaths. Although applied in many situations, financial transactions are the most readily used illustrations.

One common example uses the notion of fairness. If person A is given £10, but only on conditions they share it with person B and that person B accepts the deal, both get to keep the money. If A gives B £1, B will reject the offer, despite it being free money, and neither will get anything. B sees the deal as unfair and is willing to turn down free money to teach A a lesson. Experiments suggest that B will continue to reject any offer, more often than not, until the money is shared equally. B is willing to harm their own interests for the sake of a principle with no logical basis. Game Theory expanded various ideas around opposing groups acting against their own long-term interests if one side was seen to take an advantage in some field or another. What was true of research subjects in university would be true in boardrooms and government offices.

RAND’s work applying ideas like Game Theory stretched to take in areas of American life including welfare, health and the use of digital and computer technologies. RAND sought to reduce everything to cold logic, even the illogical reactions set out in Game Theory. A utilitarian form of thinking designed to take emotion out of key decision-making. Like the modern economist, RAND would predict enemy actions, and therefore inform potential American reactions. They assumed that any opponent would always act in a manner that could be rationally assessed and predicted.

RAND became something of a target for satire, its shadowy, unaccountable influence, particularly during the Cold War a source of conspiracy theories. It would also become well known because of one of its strategists in particular, Herman Kahn. Kahn’s ideas around how the US could win a nuclear war were controversial at best - as one might expect from any policy that allowed for an ‘acceptable’ number of causalities - but he found wider fame as chief inspiration for Dr Strangelove, the eponymous character of the Stanley Kubrick film, played by Peter Sellers.

Having built a reputation for thinking the unthinkable, RAND’s work moved into education, justice and welfare. During the Vietnam War RAND had been involved in the controversial ‘body count’ measure of the War’s success. Without a conventional frontline that would advance into enemy
territory, it was decided that the only logical way to track US and allied forces’ progress was how many enemies were being killed. With little or no appreciation for the realities of that particular conflict, the results were horrific. Soldiers were tacitly pressured into shooting first and asking no questions later. It was a policy which only reinforced North Vietnamese resistance and made the War arguably America’s worst foreign policy action in its history.

RAND’s scientific and engineering background perhaps explained their fondness for blunt, statistical analysis. It started to reduce more and more aspects of the world to data-driven, analytical solutions. This would see RAND develop and increase in influence as computing science advanced. Ever greater processing power was required in order to build scenarios, estimate probabilities and create policy options of unimpeachable mathematical logic.

RAND also played a key role in the fundamentals of satellite communications and the internet. Originally conceived as a way of maintaining communications in the event of a nuclear strike, telephone company AT&T refused to be a part of the internet, leaving the Pentagon to take it up. As a result, government, not a commercial company, laid the foundations for the world wide web and, arguably, ensured its open access to all. RAND would also employ an array of lauded economists, mathematician and political figures including numerous future Secretaries of State and Defence, and also many other powerfully influential figures. It would become an established part of US policy making and advice.

A problem remained for government and business. Prediction remained notoriously hard to get right, especially when it really mattered. Even with all of this data and clever people and expensive computers that RAND and their ilk gathered together. What made it tougher was the timeframe. Planning 10, 20 or 50 years ahead had serious limitations. The Communist bloc had their own long-term plans based around production and social order. A regime which saw itself as immutable for decades into the future had no problem announcing what was required for the future success of the state. The problem was what they were willing to do to achieve those aims (or for the appearance of achieving them).

In the democratic West, however, governments rarely lasted beyond five years, and certainly not more than ten. Forecasts looking at a world in fifteen or fifty years held little policy sway beyond rhetoric, usually around election time. Plans for schools or energy or healthcare or even the military often needed generational timeframes. But elections demanded popular, short-term, quickly implemented ideas. Voters could not be trusted to think long-term; they seemed to assume that everything would just work out.

In a world of ever-advancing science, technological progress, growing populations, international trade, and new products, business also had to find a way to deal with this complexity. The pressure to make ever more profit saw them take ever-greater risks. But no sensible business wants to take a leap into the unknown. Business was also coming to terms with the risk of not getting the future
right. Business history is littered with examples of poor judgements that could have finished the company off. The Western Union memo that said telephones were of no value to the company. The Warner brothers predicting little public appetite for talking pictures. Yet getting these predictions right was increasing not just a matter for the future survival of the business, but also of its current success.
Reading Minds

As humans formed settlements and moved from nomadic to static populations, in common with all revolutions, the Agricultural Revolution brought unintended consequences. As well as the physical ones such as new and more virulent diseases, there came something different; something that for millennia would remain a mystery. Like all of these pre-historic and ancient mysteries, humans would flounder around looking for explanations in spirits and religion until they had the mental and physical means to truly start to understand it.

Living together changed humans. Humans, uniquely amongst primates, established a co-operative, social method of raising children, rather than exclusively by a parent. As humans evolved, human children required too much care and too many resources for just one person to adequately provide. Living in larger, static groups created a diversity of influences on the early formation of personalities. Slowly, unknowingly, human behaviour changed, adapting to living amongst others and the social orders that started to appear amongst ever-larger populations. People became subject to new influences like peer pressure and social status.

As well as physical weaknesses from disease and changes of diet that the settlement life brought, there were also social fragilities. Someone’s place in a group could be influenced by many traits; their inclinations, education, and expectations combined with their physical and inherited characteristics. Previously a tall, strong person might see their life, to some degree, shaped by that. Now their personality would also come into play. They may be physically strong, but displaying qualities of patience or bravery would affect whether they should apply that strength to farming or fighting. Success in their occupation would affect their social status and that too would influence them. Equally, success in one area would mean they ignored others. Displaying the physical and personal traits to make someone a good miller might mean they never bother to pursue other skills or talents.

The settlement would also introduce competition; not just in a commercial sense where one’s livelihood might depend on it, but in a social sense. Measuring oneself and one’s achievement against those of others in the settlement, or even in neighbouring settlements. Success would influence confidence, which could bring about yet more success, or potentially lead to hubris and humiliation when failure inevitably struck. What would success or failure inspire in someone? Would they be generous or selfish, gracious or mocking? Human strengths and failings were seen as beyond human understanding.

The relationship between body and mind or soul, the nature of good and evil, who a person really is, preoccupied ancient thought around the world. Of course, at the time, the nature of a person,
whether they were good or evil, wise of foolish, was invariably a gift (or curse) of the gods in some way. It was more a case of understanding who they were, or predicting who they would be, than changing or influencing it.

Once social conventions had been established, they were hard to break. Families of farmers tended to be farmers for generations, until they had to move off their land or a son went to war. For others, usually higher up the social order, there may be more choice.

To deduce what talents and traits the gods had bestowed on a person, the experts were consulted. From the earliest records there is evidence of priests, shamans, mystics and sages entering trance-like or meditative states in order to commune with the gods. As well as making representations and receiving predictions, they claimed to gain insight into the nature of an individual.

For those believing in the importance of astrology, the alignment of stars and planets when a person was born or came of age would influence their talents. This was vital in order to extrapolate what sort of a personality they were and what roles in life there were suited to. The stars would indicate if someone was wily or empathetic, studious or active, and as such whether they should be a soldier or a scholar, whether two people should marry or undertake a business venture.

In China, India and elsewhere, science (including medicine), religion and philosophy were intertwined for millennia. It was understood that the physical and non-physical were innately linked, and so the study of one necessitated the study of them all. The divine created the conditions for the earthly and it was the duty of special, learned people to understand them.

Chinese medicine has believed since ancient times that the mind (as opposed to the brain) and the body are intrinsically linked. The first physician in China to use anaesthetic, Hao Tuo, recorded how his treatment of a man with scabies was only possible when he replaced the man’s fear of the treatment with anger. Fear, Hao Tuo proposed, would prevent the treatment from working, so he annoyed his patient to the point of rage, and then treated him. The treatment itself would have been the same regardless; it was the man’s mind, his personality that made the difference.

In Western antiquity, Socrates considered how the mind learned. Aristotle proposed that the mind was built, and that learning was based on education and experience over time rather than something innate from birth. Many theories persisted over time and the human mind and personality were long held to be matters for philosophical debate. Assorted explanations would wax and wane throughout history. Overall, however, the prevailing view continued to believe that human traits were unchangeable, some inherited, and some a matter of superstition.

These ideas of divinely gifted personalities and astrological influence held sway for centuries. For much of that time the brain was not even considered the source of someone’s personality, their
memories or learning. Science, however, questioned this idea just as it questioned everything else. Like so many other areas of human interest, what was once the concern of philosophy - life, the mind, consciousness - became that of science. In conjunction with physical medicine, ideas of the nervous system and the physical nature of the brain came to correct many long-held misconceptions. David Hume and other Enlightenment thinkers explored ideas of what made humans human. By the late 1800s, centred in particular in America and Germany, science, or an application of scientific method, had started to dominate the study of personality, behaviour and thought.

Benefitting from a middle-class upbringing and nation starting to invest heavily in education, the German medic and academic Wilhelm Wundt introduced empiricism to the study of the mind. Until his work in the 1870s, psychology had remained a concern of philosophy. At the University of Leipzig, Wundt established the first laboratory designed for psychological experiment. He would go on to produce groundbreaking work on the psychology of language and knowledge.

The first to formalise ideas around perception and understanding, Wundt examined the conscious mind and the relationship between the physical and the mental. He related anthropological notions of culture to Darwin’s biological theories. He also proposed that psychology could only attempt to explain the effects of an experience. It would not be able to predict that one follow from the other.

Wundt was the first person to describe himself as a psychologist. He started an intellectual race to discover more about what made humans act the way they did, and many important figures followed his work. These would include some of the most famous figures in the fields of psychology and social science. They would define psychology for generations and become feted around the world.

These figures included the Russian Ivan Pavlov, whose work covered impulse and conditioning. He examined how involuntary or subconscious actions could be triggered through repeated association with outside stimuli. He was so important that the Soviet government forgave him his repeated denunciations.

Sigmund Freud, arguably the most famous of all students of psychology, formally established psychoanalysis; the use of psychology as a therapeutic tool to help those struggling with anxieties. He popularised ideas around repression, sexuality, and subconscious feelings of desire, guilt or anger. He notably defined the id (the irrational, random, impulsive mind), ego (the rational, pragmatic mind), and super-ego (the partly unconscious driving, ambitious mind).

Freud’s intellectual collaborator-turned-rival/critic Carl Jung furthered the work of the older man with ideas such as the collective unconscious - the existence of unconscious ideals and concepts shared throughout humanity irrespective of culture or geography. He also defined the personality traits of extraversion and introversion, and even the very notion of the self.
Psychology uncovered the motivations and triggers, the interpretations and processes that humans share, consciously and subconsciously, learned and instinctive. It understood there were elements of psychology unique to an individual, but also that there were aspects common to large groups or even to all humans. It gave logical explanations to social, economic and cultural influences, reactions, emotions and behaviours.

An understanding of the mind, whilst slow to gain widespread acceptance, especially given the conflicting theories over certain aspects of interpretation, started to be applied in fields outside academia and health. Anything that dealt with people started to see some use in at least trying to understand that with which it dealt. Including business.
The Undermining of Economics

Economics is important. It provides insights and understanding, analyses and explanations. It is, however, the study of the past - of past events, activities, interactions, causes and effects. Its forecasts are based on analyses of history. As long as history repeats itself, as long as the world stays roughly the same, as long as people are consistent, the forecasts will be reliable.

In times long gone, astrologers applied mathematics to the movement of stars and planets in order to predict human affairs. The most brilliant mathematicians were sought after by the most powerful rulers in order to offer superior astrological advice. In modern times, economists apply maths to past economic, and even non-economic behaviours in order to predict future ones. Once again, the most brilliant mathematicians are being employed, not in research or engineering, but in the business of prediction.

The hegemony of economics is what is damaging; not the discipline itself. Economics’ role in growth, and national dependency on that growth, has given economics incredible influence over rulers, and by extension, over us. The influence and importance of economics has made it into a billion-dollar industry in itself, but its work affects trillions of dollars. Governments and businesses pay huge sums to those that can read the economic signs, decipher the maths and interpret the models. Their advice, directly or indirectly, affects almost every aspect of modern life.

In many ways the problem is not of economists’ making. They are under pressure from politics and markets to deliver certainty, despite generally knowing they cannot. So, whilst their forecasts are usually bounded by provisos and probability, they are reduced to simplistic, binary statements. Politicians, especially in fast-moving, media-saturated times, believe the public need decisiveness, clarity and action. Markets are weaker when they have to rely on ambiguous information. So economists are at best misrepresented as, or at worst pressurised into, making apparently certain predictions.

Wielding such influence, bearing the weight of so much responsibility means economics must look serious, credible, and solid. And there is nothing more serious and credible than complex science. So economics has pursued the certainty that comes with rigorous, clinical science. It has looked towards physics, and away from its origins in philosophy, as a template.

Physics studies the workings of the natural world. Economics studies the workings of the financial world. Physics sees the interplay of atoms, the flow, movement and effects of forces, energy and work. Economics observes the interplay of industries, the movement and effects of goods, money and labour. Physics seeks to explain the very big (astrophysics and cosmology, gravity) and the very
small (atomic and subatomic, quantum). It deals with fundamentals, like the four forces – gravity, electromagnetic, strong and weak nuclear, that explain, and can be harnessed to assist our daily lives.

Mathematical models underpin physics, describing the relationships between inputs and outputs, causes and effects. Mathematical models underpin economics, describing the relationships between financial and policy inputs and outputs, causes and effects. Economics, however, lacks much of the empirical evidence, the rigorous, repeated examination of physics. Physics is strong because it is constantly tested. Physics knows that there is a gulf between explaining the big and the small. It knows that it cannot explain everything. Economics is reluctant to accept such ignorance. It struggles to say it cannot explain everything, or that it might be wrong, or that a better, more reliable model might turn up someday soon. To do so would be to diminish its role, and to diminish the vital confidence it supplies.

Chaos theory is one of the more famous, but also profoundly complicated mathematical theories. Its most famous incarnation, due to its elegance as well as various misinterpretations, is the butterfly effect – when a very small event can have massive, unforeseeable repercussions via a complex chain reaction. The cause and ultimate effect in these events can only be seen in retrospect; never at the time. Weather, predictable on within certain parameters, remains unpredictable in many respects because of the chaos effect. The dependence of weather on the effects of feedback means that a small temperature change in one place can multiply in intensity and have devastating effects thousands of miles away. Or it can peter out to nothing more than a light breeze.

Weather, in the 21st century as much as in the 17th, can have huge effects on the economy. Not just directly on harvests, shipping or oil extraction, but on more complex, nuanced areas like migration patterns and urbanisation. Unlike the cost of oil increasing, which has generally fairly predictable effects, changes in migration are much harder to predict given the vast array of reactions it can have from wage inflation and welfare to social, media and political responses. This is where chaos enters the system. If devastating weather events cannot always be accurately predicted, and certainly they can almost never be predicted a long way ahead, then what chance the knock-on effects? When irrational humans are involved, with their varied, strange reactions to events; with the influence of democratic majorities or vocal minorities, it makes it all but impossible to find an applicable pattern. Looking at what led to what only makes sense, it only appears inevitable, when viewed retrospectively. Piecing together the events and reaction many years afterwards.

Chaotic systems, where random events mean that the finishing point cannot be predicted simply by the nature of the starting point, can be deterministic or non-deterministic. In deterministic systems, where no outside influences affect it, small variations in the initial stage can ultimately bring about very different results, and which way the system will go is unpredictable. Weather systems – as opposed to climate that can undergo outside influences – act like this. Conversely, other systems are chaotic because they are subject to outside influences. These influences can themselves be
random in their nature, and they can bring about unpredictable outcomes from an otherwise predictable system.

One such outside influence can be the very act of prediction itself. This is what happens in financial markets. A prediction can become at once self-fulfilling and self-defeating and it is impossible to accurately know what the effect will be. For example, if someone is seen as a reliable, knowledgeable source, and they predict that the stock market will rise over the coming days, chances are it will rise quicker and by a greater amount as confidence is gained, because of the prediction. That means that the prediction of a rising market ended up being true, but no one can ever know whether it was going to rise anyway, or whether the confidence supply by the expert inspired it. At the same time, whilst the prediction was correct in its nature, the degree of increase and the timeframe for it could have been wrong, as confidence flooded into the system. That inaccuracy could, in modern markets, have cost millions, which in turn might damage the expert’s reputation, leading to a different reaction to their next prediction.

Science develops models that mimic the natural world as accurately as possible based on the current understanding and available information. These models are adequate for our practical purposes, right here, right now on Earth (although sometimes they are required to work beyond that). Fundamental to science is the fact that every effect has a cause, as described by Rene Descartes in the 17th century and expanded by Newton a little later. If an object moves or changes state something caused that observable change and physics aims to describe what the outcome will be. If a body of a certain mass and construction is placed under a force or is heated, what will become of it? The influences of friction, inertia, energy and thermodynamics all create models to explain what happens. These conclusions led to the field of determinism in which, given a finite number of elements, forces and so on, a physical reaction can be predicted. If a ball of a given size is thrown with a measurable force, at a known angle and under the influence of known air resistance, then its final landing point can be accurately predicted.

As has happened many times before and since, science influences philosophy, and determinism in physics was mirrored in theories of human behaviour. Philosophical determinism held that humans were subject to a finite range of influences and as such their behaviour was not of their own determining. Just as science implied a rational natural world where every cause could, in theory, be measured and so every effect could be predicted, so too with people. If you just knew all of the potential influences; if you could measure and model them and the long and short-term reactions, you would be able to predict human behaviour perfectly, in the same way as physics predicts the movement of a ball.

In this assertion, determinism was at odds with the concept of free will; that humans made their own decisions freely, unimpeded and unpredictable by anyone but God. Theology had long wrestled with the notion of free will - the idea that God had imbued humans with free will in order that they might be able to choose between good and bad, right and wrong. Unfortunately, that in turn contradicted God’s divine wisdom and goodness in creating a person that would choose to act in the wrong way. Regardless of the explanation, religion could not predict or fully explain the choices a
person made. Whatever guidance a religion offered a person, they could, and did go against that advice given the right circumstances. Religion, like economics, is a human attempt at explaining and ordering the world so it is only to be expected that both would fail to predict or fully govern human behaviour.

Science fuelled capitalism, so it is no surprise economics felt it was the new science that measured capitalism. Science had largely supplanted religion in explaining the world, so it is clear why it would be tempting to see economics and physics as effectively synonymous. Physics, after all, owned many of its origins to early astrology, which led to astronomy and the maths that described it. If something so robust, definitive and reliable can come from something so abstract, why should not economics leave its philosophical roots behind and become a science as well? A science of human work and finance. The problem is that science, true science has existed before humans and will continue after, unlike capitalism, language, social class and any other human construct.

That has not prevented some from being convinced that economics, trade, tax, labour, migration and so on are all natural parts of life and the world; as natural as atoms or gravity. As such, parallels are sought with complex economic models derived from quantum physics or thermodynamics. This thinking makes economics concrete; not a collection of competing theories but a real-world explanation of naturally occurring phenomena. So it was that economics pursued this route of being a science. It measured more factors, collated more data, and developed formulae of ever-greater complexity in order to create models from patterns in this data. Models that would predict future economic trends and events. Models that would enable planning, supply confidence, and run human affairs much more effectively.

Richard Freeman, Professor of Economics at Harvard University wrote an article, It’s Better Being an Economist (But Don’t Tell Anyone). In it he proposed that “physics and mathematics, which attract students who are, by conventional measures, smarter than economists and where the base of knowledge is better established” are at a disadvantage when it comes to the job market. He goes on to say that “economists earn more and have better career prospects than physicists or mathematicians”.

Part of the explanation for this is that economists tend to get ‘real’ jobs with ‘real’ companies (which have real influence), as opposed to those in ‘real’ sciences who tend to stay in either academia or other publicly funded areas. Even the academic economist can expect to be called upon by the well-funded sectors of accountancy and consultancy firms and financial services, boosting both their income and that of their institutions. Plus there is a lot to be said for being asked to attend meetings with important people in the corner offices of grand, imposing office blocks.

It is a commentary on the nature and importance of economics in the world that it remains so well rewarded despite the far more tangible, laudable and durable achievements of physics and mathematics. So it is reasonable to assume that some students who are inclined towards physics...
and maths at school may find themselves attracted to the career prospects of economics. In doing so they bring their inclination, their methodology and skills to a less scientific discipline. As such it should be no surprise that a great deal of economics and finance is, like physics, all but incomprehensible to non-technical people - including politicians and business leaders. By extension, it is has become all but impossible for non-technical people to rigorously question how economics works and be engaged in any productive debate on the subject.

Irving Fisher, Professor of Economics at Yale was a hugely respected economist, writer and pioneer on debt, capital and interest rates. Lauded by his contemporaries he was, by some measure, the best-known economist of his time. His reputation, however, was all but shattered with public pronouncements along the lines of "stocks have reached what looks like a permanently high plateau" and “values in most instances were not inflated”. These remarks, little more than ill-advised at any other time, were made in October 1929. The end of that month saw the Wall Street Crash, the greatest drop in share prices in US history, which precipitated the Great Depression. There followed over a decade of global recession, a contributory factor to German economic and social instability, the rise of Nazism, and the start of the most devastating conflict the modern world has seen.

Perhaps unfairly, this example of a respected economist not just failing to foresee the Crash, but actively suggesting it was all but impossible, has been used to criticise the discipline ever since. All the signs were there, observers have since pointed out. As it was, no serious economist foresaw the Crash. Few of them had raised the alarm over what could happen in America (and subsequently the world) as urban populations grew, agricultural industries failed, and market speculation ran wild, as it had throughout the 1920s.

Criticism from within has remained a part of economics ever since. More recent remarks like “[markets have] forecast nine of the last five recessions” (from Paul Samuelson – Nobel Prize winner and MIT economist) and “the record of failure to predict recessions is virtually unblemished” (from Prakash Loungani – former IMF and Federal Reserve analyst) are also used to undermine economics as a predictive profession. So are the failings of the key economists of their time evidence enough to write of the whole profession – as distinct from the discipline itself?

Large-scale financial events, global recessions and market crashes are only one type of very particular event that an economist might be expected to predict. Judging the profession’s overall record must call for a wider examination. Does their inability to foresee a huge economic disruption mean they also routinely fail foresee smaller ones? Does it undermine their qualification to make macroeconomic plans or business sector forecasts? Is it like a seismologist who fails to warn of an earthquake or meteorologist who misses a hurricane?

Economists typically work on the same reasoning as most of us – if something were true yesterday and the day before, it looks like it is true today and so it will probably be true tomorrow. As a rule,
they are right more often than they are wrong, and that is because the world changes only very slowly. A recession, by its nature, is a sudden, erratic shift in the normal order of things. Failing to predict such remarkable events is surely beyond what could reasonably be expected. Human affairs being unpredictable and recessions being chaotic in their nature, why should economists be in a position to warn us? Is it just a case of too much faith being invested in them; faith they did not seek. Are they victims of a wider human desire for certainty? There is, however, another factor: the pressure on economists not to predict economically damaging events.

There is little appetite for doom and gloom in the world of finance. Businesses and markets thrive on optimism, on confidence. There is plenty of proof for this and as Keynes said “Worldly wisdom teaches that it is better for reputation to fail conventionally than to succeed unconventionally”. In other words, predict something terrible, and no one wants to know (like the Cassandra of Greek myth); fail to predict it, and no one will thank you anyway. Markets fear the self-fulfilling prophecy – say a business will fail, and it quite possibly will. So it is probably best to keep quiet.

Even though Jeremiah of Biblical times was in the minority in his doom-forecasting, those in charge still resented the effects his prophecies were having. Perhaps that might also be the case with modern economics. Many (but by no means all) economists have failed to predict serious crashes and recessions, despite it appearing to be one of their most important roles. However, it could equally be the unwillingness of rulers to want to hear doom-laden economic data and advice.

Perhaps because to act on such advice too soon would have serious implications - although not as serious as the implications of the recession - they just do not want to take the risk. Any economic prediction will come with a measure of probability, and rulers tend to gamble on the side that will maintain the status quo; they, like all humans, think that, on balance, it will be all right. If a government or central bank acted such as a way as to try to mitigate the effects of an on-coming recession it would suggest to the markets that those important, influential parties were worried about a recession. Markets tend to act much quicker and more nervously than governments and their reaction would inevitably lead to more panic and ultimately the recession that was predicted. A self-fulfilling prophecy. However, if the government had held its nerve, if they had taken the chance, perhaps the recession would not have happened, or it would have been less severe.

In the 1960s, psychologist Peter Watson coined the term Confirmation Bias. It referred to a person’s inability to rationally assess a piece of information that supports their belief. The phenomenon, though, was not new: the Greek historian Thucydides noticed it in times of war around 400BCE, as did Dante in the Divine Comedy. The father of rational, empirical method Francis Bacon noted that: “The human understanding when it has once adopted an opinion ... draws all things else to support and agree with it.”

Watson experimentally demonstrated the human tendency to seek out, and exaggerate the importance of, those facts that confirm what we believe, or want to be true. The economist that finds the evidence, patterns and trends that support business or government goals or existing
courses of action will be embraced by power. So important is the economy, particularly the stock markets, that many economists are paid by companies and governments, making their objectivity questionable, or at least worthy of serious scrutiny.

There are conflicting ideas about whether recessions are inevitable. Whether national and international economic policy is just a case of governments and banks staving them off for as long as possible. Of generating as much income as they can in the good times before the storm hits, then hunkering down until the worst of it passes. Like living in the path of a hurricane, but the causes of a hurricane, although not always predictable in the longer-term, are at least agreed upon. Certain conditions have to be present for one to form, and once formed, it will travel along a likely path. But economics as a whole cannot agree on the causes of crashes and depressions because they are not purely scientific and mathematical in nature. Their nature changes as human society changes. Although there are many parallels, the Wall Street Crash was not the same as the dot.com crash or the 2007-08 crisis.

Arguments about the fundamental nature of economics aside, has the economic profession actually had its prediction-making credentials scrapped? Did the collective failure to foresee recessions – events that caused misery to millions of ordinary, low and middle-income people – mean the profession is ultimately of little use? That they had failed in their duty to those that paid them and that gave them power and responsibility?

Blame seems to be shared around depending on who is asked, and it is the circle of finger pointing that has gone towards damaging public confidence in those in charge. Economists have, for well over a century, had the collective ears of big decision-makers. Economists say their assessments always contain a measure of probability and it is for the rulers to decide on an appropriate, cautious course of action in accordance with the chances of events going one way or the other. Government and business say the economists failed to warn them in time or with adequate insistence. Were these instances failures of prediction, of action, or of persuasion?

Both parties, economists and rulers, were responsible for not being alert to the shortcomings of their particular situations. Leaders were over-reliant on a narrow group of advisors and were driven by short-term goals. Economists had come to slavishly believe in their own data and mathematical processes and were seduced by power. Both groups were certainly too insular, unwilling to hear uncomfortable ideas from outside their immediate experience, too protective of their own privileges.

The root of the prediction problem is twofold: the timeframe and the presentation. Any prediction needs to be presented in language the audience can understand, without diminishing key details. The most important detail being how robust that prediction is. What conditions need to be present
for it to be true? What are the real chances of it happening? If the prediction does not work out, rather than apportioning blame or seeking excuses, explain why and what can be learned.

Economic forecasts are principally the concern of government and business. Economies, like the weather, are complex, chaotic and only broadly predictable in the very short term. However, the nature of business and government, the time it takes to implement strategy or make decisions, means they need to plan long term. Something put into place now could take years to generate actual actions. The further out the economist is required to forecast, the weaker their prediction, or the broader the boundaries of probability. The further from certainty the advice is, the less useful it is to decision-makers.

Political scientist Philip Tetlock ran a 20-year test on forecasting as part of his Good Judgement Project. He took over 28,000 predictions covering economics, politics, culture and more from a wide range of academics, government officials, writers and others. Tetlock developed a system of contests to find out which predications worked out. He found that, generally, the forecasts made by experts over the course of years were little better than an average of random, chance selections. This performance declined as the range of the forecast moved towards three-to-five years. Almost all government and large business decisions and strategies need at least three years to enact.

Some of this delay is structural, as in companies that place too much hierarchy or bureaucracy into the decision-making process. Some, especially in government and the public sector, is unavoidable, involving huge numbers of people and catering as equally as possible to vastly differing groups. Yet shareholder, employees and voters all demand visible action in the short-term.

This contradiction in timeframes, along with ever more scrutiny of leaders, in turn puts pressure on those that advise them. Leaders need to sound certain in their decisions and about the future so advisors are pushed towards certainty in their predictions. This is true generally, but nowhere more so than in economics. The wellbeing of markets, the country and each individual has become dependent on economic forecasts. The confidence those groups have to spend, to invest, to employ, to grow depends on confidence supplied from government, central banks and others nominally in control.

Assessments and predictions of future economic trends and events used to be largely a matter of judgement; the collective wisdom of a few, select experts and policy-makers. The rise of computing saw more and more complex models arise. The appearance of something akin to science, which deals much more in certainties and facts, started to overpower the human judgement element. Those in charge, aware that their jobs and reputations were on the line, looked for certainty, or at least a plausible excuse.

Private and public sectors generate scores of economic forecasts over the course of a year. Many of them differing in some detail or another. But government tends to have to reduce all of this to just one or two key treasury forecasts. They need to deliver a confident, sure plan. This reduction and
the inherent unequivocal statements it leads to naturally produces errors. Statements are misleading, decisions are poor, and the public are further disenfranchised.

Arguably the most damaging result, particularly of failures around the 2007-08 crisis, was a public now too skeptical of economists and other experts they lumped in with them. Those that pour over statistics and probabilities and use their specialist knowledge to aid big decision-making. Those that deliver advice in complex language bounded by probabilities and never entirely certain or unequivocal.

Whether economists are certain about their predictions or not, those who interpret their advice, who stake a nation’s prosperity on it, need to accept the unpredictability of the world. Indeed, they need to embrace and value it. Expert forecasters, especially economic ones, are incredibly valuable but no one wins if their work is over-simplified or de-humanised. You can never be sure what will happen on a long journey, but you should at least have a map, and economists are often the best cartographers we have available.

Scientists took what the ancient astrologers got right; the patterns and the movement of planets and stars, the maths that predicted their paths, and discarded the idea that they might influence human affairs. Astrologers lay the foundations of what would become a scientific, human understanding of the universe. Perhaps economists’ work – analytical, honest, rigorous, insightful, philosophical work – will form the basis of something else. Something more accurate, more radical, more accessible. Freed from the weight of having to predict incidents beyond its capabilities, economics could pave the way for future experts, even scientists to take up their good work and cast aside the unreliable assumptions.

Such a new discipline would almost certainly require even more input from technology, the sector increasingly underpinning every aspect of government and business. Too much faith can be placed in technology, especially where irrational humans are concerned, but it is inevitable that those in charge will see it as the potential solution to prediction.
After the Second World War, America grew increasingly concerned about Communism; not just spreading from the Soviet Union, but already within the US. Senator Joseph McCarthy was charged with rooting out ‘subversives’ within American society. Chief amongst his concerns, outside politics, were the influential worlds of the entertainment industry and academia. The former was centred in California and the history of the McCarthy witch-hunts in Hollywood is a long, well-documented and tawdry one.

In academia, the danger of young minds being corrupted was closely monitored. American paranoia was in part a response to the British ‘Cambridge Five’ spy scandal that saw well-connected Cambridge University students recruited to the Soviet cause and then going on to important government and establishment jobs. The American reaction was: root out the Reds in the universities and kill off the fifth column at its origin.

In the search for subversive influences many conservative observers conflated atheism and Communism and focused their attention on university philosophy departments. The academic pursuit of philosophy was also home to other dangerous ideas. Ideas ready to challenge the belief that capitalism was the natural order of the modern world, even if it was a purely academic consideration.

The first Chancellor of the University of California, Los Angeles (UCLA) was Raymond Allen. He would go on to play a leading role in US psychological warfare strategy but prior to his time at UCLA he had come under pressure to dismiss professors that had joined the American Communist Party. To do so legally, he reasoned that any Marxist academic was obliged to follow Soviet ideas and propaganda and as such could not deliver the unbiased search for truth that education required. That meant the teachers involved could be discharged for not doing their job properly rather than for having a political opinion.

Allen, a philosophy professor, ‘proved’ that the political and philosophical bias of Marxist-Communism was unscientific - it failed to establish a hypothesis which could then be tested, and as such it was irrational, and therefore unbefitting a credible academic. There was no room for debate, interpretation or nuance in this; for Allen it was logical, irrefutable. This delivered a formula by which colleges could dismiss those declared to be, or suspected of being, Marxists or Communists. Furthermore, Allen spread this work across all the academic institutions of California, forcing job applicants to have their applications scrutinised by the state’s un-American activities committee. It handed a veto over academic appointments to a non-academic body that no institution could fight, and it influenced education for generations.
Into this atmosphere was fed the work that the University of Chicago and the RAND Corporation did on Rational Choice Theory. People always making the right, self-interested choices meant free markets and democratic elections, neither of which operated in the Soviet world, was the correct, natural order. These two senses of the rational – Allen’s scientific method and the rational nature of humanity – were drawn together to provide a guiding philosophy for America for the next 40 years.

The end of the Cold War meant that in the first half of the 1990s, the internet age met a new world order with the end Soviet Communism. A new technological era, a global era, was evolving at the same time as liberal, Western models of democracy and economics appeared to have indisputably won the day and taken over the world.

Political scientist Francis Fukuyama won over many observers with his somewhat unfairly reduced statement that ‘history was over’. The ultimate triumph of the US-inspired free market, liberal democratic model meant there were no more major global social shifts to come. He, like many thinkers before him going back to the 1700s, felt that progress was leading the world ultimately towards one, stable state; a social and political equilibrium. At last, with the end of the Cold War, the world had gotten there.

This sense of one-world politics combined with the internet; a free, open platform for the exchange of ideas and information. To many, civilisation was on course to enter a new golden age. Conflicts on a truly global scale were petering out. Humanity could get on with making new things, finding new markets for the benefit of all. It would see the final success of globalisation. Just as innovations in shipping had effectively broken down physical geographical barriers to global trade, the internet would end cultural and linguistic borders. This utopia had been made possible by the incredible achievements of science; the summation of feats from Faraday to Alexander Graham Bell to Edison to Tim Berners-Lee. Science and rationality had ended history, and with it ideological and religious conflicts.

Fukuyama revised his thesis in the wake of 9/11, but for a decade the idea that a sort of cultural and historical equilibrium had been reached found favour. We now look back on the idea that history could possibly have ‘ended’ with a single geo-political, ideological shift as naively hopeful and somewhat obtuse. What it did mark was the end of a sort of post-war certainty. The Cold War cast its shadow over so much that social and technological predictions largely played second fiddle to the ideological battle. Now, aided by the internet, everyone would find a voice and the world would know just how fragmented and disparate it really was.

In those optimistic days of the mid-1990s, computer science students at America’s leading universities were submerged in a world of internet possibilities. One such computer scientist was quick on to the field – Jeff Bezos set a template for internet retail by allowing users to find almost any book, cheaper and quicker than in a physical store. Having already worked on Wall Street for ten years, he helped build international trading networks and saw an opportunity to cut out the
middlemen (retailers) from the author/publisher/reader chain. This disintermediation became a model for many businesses to come and it allowed Bezos to get in early and start to dominate the early internet shopping sector.

A couple of years later, Stanford students Larry Page and Sergey Brin were looking at how people searched the internet for the pages they needed. They developed an algorithm designed to rank the suitability of a webpage rather than just its popularity (as other early search engines did). They refined this algorithm, called it Google, and launched it to the world in 1998 (and like Hewlett-Packard and Apple before them, briefly ran the company from a garage in Silicon Valley).

In the Valley and in Wall Street, a wave of companies were striking out, predicting a potential gold mine in the internet. The chance to offer services and products to millions around the world was too great an opportunity to miss. From the mid to late 1990s scores of companies were founded, usually by energetic students and graduates, many with extensive technical knowledge but often little business grounding. Investors, conversely, failed to fully understand the businesses, the people behind them and the potential markets. A market bubble immersed as money poured in from investors believing that the profit from those companies that worked would off-set the losses from those that failed. Share prices in these companies kept rising as long as people believed in this new breed of company.

A combination of poor stewardship, short-termism and outside influences from 9/11 to a global stock market downturn saw dozens of early internet companies go bust. Some, such as Amazon and eBay, kept their heads above water and weathered the storm. Those that survived emerged into a new internet age. The capacity and speed of computers and telephony continued to increase, as did consumer penetration to the point where around 50% of homes in the West had internet access. Dubbed Web 2.0, this environment saw the creation of an internet which was populated predominantly not by content produced and controlled by businesses, but by content produced by users. Ordinary people were uploading not just text but photos, audio, and video.

In 2003, Mark Zuckerberg, a psychology and computer science student, headed a (not entirely collegiate) group that developed an online social directory of students at his university, Harvard. Within 18 months Facebook had moved to Silicon Valley, had millions of dollars invested in it, and was on its way to connecting people, and their content, around the world. For a few years Facebook looked similar to many of those late-90s companies that offered something attractive to users, but had no way of making money from them. A business that would grow rapidly, burn through cash, and hope it could be sold or a way to make a profit would become apparent before the money ran out. The difference between Facebook and those earlier, less fortunate companies was that now it was users, not those behind the business, that kept the it going. It was users providing content, activity and data. It was users that would become Facebook’s most valuable asset, and the asset that would repay investors.
The user-generated content phenomenon radically changed many Silicon Valley business models. Hardware had to provide more and better means for users to generate that content, from devices including cameras and microphones and a range of new input devices to new forums and platforms to write and share ideas. For those providing internet services, it meant huge opportunities to learn ever more about their customers.

The user-generated internet also suggested something else; that America had been right over the last 50 years. That this new era was about the power of the individual; the worth of the individual and their capacity to create their own wealth and satisfaction. Human Capital as described by those influential University of Chicago professors and that merged into the Cold War ethos of the US really did win out. Individuals would now be allowed, even encouraged to create their own worth on the level playing field of the internet. All you needed was a computer and a connection and an idea you believed in and you could change the world.

The American Dream. The socio-political and economic primacy of the individual and their freedom. The ultimate victory of rationalism and choice. Progress that is synonymous with technology and science. These were the beliefs that the twenty-and-thirtysomethings of Silicon Valley were raised on and believed unquestioningly. However, like many of their forebears, particularly those of the 1960s and 70s, they entered the tech sector seeking to improve the world and prove their theories. They were driven idealists, convinced of their personal right to succeed but also to pioneer; to discover new ideas and new ways to do things. To find new applications for technology.

The internet was a vast, hopeful new world. A tool to bring the world together and allow anyone access to any knowledge or experience. It would make life simpler for everyone. Google would mean you could find out anything you needed to know or access any service you wanted. Facebook would break down barriers of geography and allow new voices and ideas to be heard on a scale never previously dreamt of. Such lofty ambitions, however, required funding. No matter how noble the aims of the founders; no matter how novel these businesses were, they were businesses subject to the same pressures of capitalism as had existed for over 300 years.

As these companies and their peers soared in influence around the world, they recruited more experts, developed and implemented new ideas, and built ever more elaborate infrastructures. Money was invested, shares were sold, and so, inevitably, profits had to be made. In the case of many of these companies, entirely new in their nature as they did not actually produce any physical product or provide a conventional service, their business models were simplistic. Most had no direct source of revenue, relying entirely on a constant source of outside investment. A few went with a subscription model of some sort. Many saw advertising as the best route to stability.

What investors saw, and in time tech companies came to embrace, was the opportunity to gather untold levels and types of personal data from users, and the potential value of that data. In their use of social media, search and online retail, and later media consumption, an unparalleled picture of
who an individual was could be built up. And people would pay for that level of knowledge; that level of insight into groups and individuals.
Visions of the future

Humanity’s need to plan and prepare, whether to protect themselves or to gain advantage, has led to a desperate search for reliable predictions. Weather, natural disasters, economic fluctuations, the outcomes of conflicts or gambles - all have been analysed by means that are superstitious, religious, scientific, and quasi-scientific. These predictions have been considered, at the time, vital; of national or even international importance. Money and resources were poured into making them as reliable as possible. Luck and skill, manipulation and intelligence played a role in elevating those that predicted into well-rewarded, fated individuals.

This history of prediction is littered with misconceptions and mistakes. Sometimes very costly mistakes. There is a group, however, whose predictions are considered generally less realistic but are no less influential for that. This group have, indirectly, shaped technology and society often far more than any economist or political or religious figure. Their predictions have had little of significance resting on them, so accuracy was of little importance, but those predictions have been retrospectively interpreted as being remarkably accurate, especially considering the timeframes they worked to – often projecting decades, even centuries ahead.

Visions of the future have played a role in creative arts for centuries. Artists have taken technology, the possibility of other worlds, and humanity’s ongoing search for god-like abilities as inspiration. Such notions have influenced music (particularly those working in experimental and avant-garde forms of classical composition, as well as those using new technologies to create more popular forms) and visual arts (most notably in the Futurist movement). It is, however, in literature, and later performance media (film, television, and to a lesser extent theatre) where visions of the future have found a natural home.

The origins of science fiction as a literary genre are debated, with cases being made for it dating back to 2000BCE with the Epic of Gilgamesh (the king that would be immortal). From around 400BCE there are examples in Greek, Indian, Arabic and Japanese literature of manned flight, travel through space and time, other worlds and robots (although that term would not be used to refer to human-like machines until 1920).

The robot, along with space, and travel to other worlds and eras, have been mainstays of science fiction since the genre emerged. Both were really only believable with advances in science and technology. As a result, such literature moved away from fantasy and the metaphysical and towards a grounding in reality; to extrapolating from the latest scientific developments and asking what will happen when those developments become commonplace and even obsolete.

The genre’s reliance on technological advances, both real and fantastic, meant it was only in the 19th century that science fiction began to find its voice. Taking direct influence from real scientific
endeavour it merged human stories with engaging, novel ideas and the use of often-cautionary metaphor. Mary Shelly’s Frankenstein is generally accepted as the original pioneer of science fiction despite the expression not being used for another hundred years. The years following its publication saw a number of writers speculate on the future or where the new scientific age might lead society. The two giants of 19th and early 20th century science fiction, and arguably those that came closest to formalising the genre, were HG Wells and Jules Verne.

Wells’ works includes The Time Machine and The Island of Doctor Moreau. These titles enabled Wells to ask questions about contemporary social order, conflict, and humanity’s dominance over other species and where these questions might lead. In his non-fiction Anticipations of the Reaction of Mechanical and Scientific Progress Upon Human Life and Thought: An Experiment in Prophecy, the author, to some degree or another, predicted a world at the end of the 20th century built around cities filled with trains and cars and commuters. He hinted towards the sexual revolution of the 1960s, the EU and an America-dominated world. But he also saw the end of capitalism and democracy (replaced by a form of technocratic, expert rule), the reduction of world languages to just three or four, and, common with many writers and thinkers on all sides of the political spectrum at the time, suggested some form of eugenics would alter the human race for the better.

Verne’s work, almost 50 years before Wells’, was more representative of a stylistic shift from fantasy to science fiction as befitted his age. He laid many foundations for the genre allowing others after him to develop new ideas. Twenty Thousand Leagues Under the Sea focuses on the scientific brilliance of Captain Nemo and his quest for both knowledge and revenge on the society that excluded him. Journey to the Centre of the Earth also focuses on the questionable, erratic brilliance of one man whose personality turns science into something both inspiring and dangerous. Verne is more concerned with the human than the technological (except, perhaps, for his electrically-power submarine), but away from his fiction he did predict a form of global news that was broadcast for mass-consumption.

Both Wells and Verne imagined a time when travel to the moon was viable, even if they could not quite accurately forecast the means, context and implications. Verne even included solar-powered space transport and space travellers landing in the sea (foreshadowing the splashdown method used by the US and USSR throughout the 1960s and 70s).

What Wells and Verne hinted at - the social and political implications of technology (be it an over reliance on it, or an ignorance of it) - others would take as the core purpose of their writing. Science fiction would increasingly use fantastic ideas of a future world to reflect on the nature of contemporary society and politics. For George Orwell and Aldous Huxley a possible future offered profound warnings about the present. They created two of the early 20th century’s best-known literary visions of the future in Nineteen Eighty-Four and Brave New World.

Nineteen Eighty-Four has become as famous as a cultural phenomenon as much as a novel, partly because of its dazzling originality, but also because of Orwell’s use of language to describe concepts
that at the time were complex and far-fetched but that have since entered common use. Nineteen Eighty-Four, written in a world where fascism had given way to a form of Communism that to many looked very similar, is noted for two significant observations. One being the use of disinformation; the power that controlling the public’s access to news and information can bestow. The other being the idea of subservience through surveillance; equality through fear. Both of these were evident in Nazi Germany but were particularly pernicious in the Stalin-era USSR.

Although contemporary to the late 1940s, Orwell’s vision has repeatedly been cited as prescient in the West in every decade since. It seems that every generation thinks their society is more like the world of Nineteen Eighty-Four than the last. It has never been a flattering comparison. Governments are accused of changing history, of misleading, of controlling, and worst of all, of monitoring. A screen in the home both feeds ‘news’ and observes the viewer. There is distrust between neighbours. There is a remote, shadowy ruling elite. Facts are no longer facts unless certain people say they are (but those people are never known). Simplistic, base entertainment is used to distract the public. Unthinking nationalism, simplistic and often violent solutions to social problems, euphemistic political language (indeed, the general abuse of language to confuse, undermine and obfuscate – something Orwell was particularly alert to) are all part of Winston Smith’s Oceania. For Orwell these were desperate warnings. For contemporary readers of all political persuasions they are a vision of what is just around the corner.

Orwell was from an upper-middle-class family of landowners and mid-level colonial diplomats; a background he largely rejected both personally and politically. His fellow Old Etonian (and one-time teacher) Aldous Huxley was from a family of intellectuals and scientists, and he embraced this, along with a contemporary taste for satire and iconoclasm. Huxley’s Brave New World is perhaps less popular than its more overtly political younger cousin, but it is no less important. Indeed, many argue it is more relevant and prescient than Orwell’s tonally bleaker vision.

Huxley’s world is sleek and industrialised, consumer-centric and deliberately American – for example, the calendar counts from not the supposed birth of Christ but from the year in which Henry Ford produced the first Model T. Humans are created to order and according to society’s needs - the right proportion of dull workers to superior leaders to middling middle-managers. Here too, language is used to mendacious political ends, and there is a shadowy ruling elite (the ten World Commanders). However, whilst Nineteen Eighty-Four gives a sense of oppression and gloom, Brave New World actually implies a content existence. Happiness through conformity – doped and indifferent to the inequalities. A society subdued through luxury, entertainment and the consumption of an ecstasy-like drug, soma. A society comfortable knowing that the best people for the job rule the world because they were created as such.

At a more mundane level Huxley predicts genetic engineering, forms of entertainment that operate beyond sight and sound, personal flying transport, and a (largely unremarked upon) method of preserving one’s youth. Fundamentally he sees a world where the pursuit of progress and reliance on technology leads inevitably to being controlled by, and subservient to that technology.
There are a number of parallels between the two books. Both have been regularly cited as maps showing the roads contemporary society has already started down. From CCTV and the internet to increasing automation and concepts of morality, they are deemed to be warnings that if we do not stop this now, if we do not regulate or rise up in opposition, a horrible future awaits us.

It is, however, society’s relationship with itself and its leaders that hold the direst warnings. Both Nineteen Eighty-Four and Brave New World predict a stratified society where your role in the social order defines you and cannot be changed. To question this is to challenge society as whole. Society itself becomes a tool of the oppressive regime. Around two decades before Stanley Milgram explored the human unwillingness to stand out from the crowd, Orwell and Huxley were warning of the dangers posed by any society that views free thought as suspicious, even treasonous. In both novels the individual was worthless yet feared by the rulers. They were powerless yet had the power to disrupt the well-ordered world the rulers valued.

Where Orwell saw a state that would break the freethinking individual so that they conformed, Huxley took a different view. Those seeking to question the prescribed behaviours were sent to live outside of the attractive, comfortable, modern cities so that they could not disrupt the modern world. Their punishment was discomfort and solitude. Individualism could only exist in exile. The price of comfort and community was conformity.

Huxley later stated the world was heading more quickly towards his Brave New World than he expected. Twenty-five years after he wrote the book he felt psychological conditioning, drugs and overpopulation were paving the way to his vision of a luxurious, ordered dystopia before the end of the 20th century.

Brave New World was a reaction to the outcome of the First World War, and Nineteen Eighty-Four, a reaction to the Second as it moved into the Cold War. In the years after the dropping of the atomic bombs on Hiroshima and Nagasaki, science fiction became both respectable (it had fallen prey to being written off as trashy or sensationalist) and urgent. It remained a political metaphor, as writers would grasp the Cold War analogies of alien races or robots enslaving humanity to underline the importance of anti-Communist tactics. Other writers recounted the dangers of placing scientific and technological advances solely in the hands of the military and the politicians, especially in a world where the destruction of humanity was not just possible but apparently quite likely.

As well as warnings, writers were also looked to for inspiration of what might be to come. Creative thinking, rather than logic and strategy, provided a vision – something to strive towards or prepare the world for in the longer-term.

As science and technology both advanced and became less the concern of academics and more an everyday reality, science fiction writing evolved. It continued to ask humanity difficult questions whilst also looking ever more to the science behind the future. The 1950s is seen as the golden age
of science fiction, and of that era three writers – Isaac Asimov, Arthur C Clarke, and Robert Heinlein - known as the ‘big three’ - dominated. It is Clarke and Asimov who are now widely seen as the most important, enduring, astute and influential, well beyond the worlds of literature and film in which they worked.

Clarke and Asimov studied science and technology; they immersed themselves in these subjects as well as areas of social science, in order to create visions that were both compelling, and convincing. Visions that were less about fantasy and more about what might really be possible if humanity took a particular route.
[from Chapter 21]

A New Intelligence

As, over time, the guidance of spiritual and religious advisors gave way to that of economists, so technologists in turn have come to overtake them. Each group in their own era and in their own way tried to predict the world and advised those in charge. The people looked to their leaders for certainty, unable to accept that certainty was the one thing no one could truly offer. Leaders had to reassure the people the best they could by relying on arcane, complex guidance few could reasonably question.

Religion’s principal concern was morality to a point where it claimed a virtual monopoly on the issue. In time, morality sprung from the evolution of society – killing, theft and intolerance did not lead to productive societies whilst generosity and kindness did. Despite this, religion’s ability to shape society, for good and ill, has nonetheless been spectacular. Economics has established a track record of successfully analysing capital and work. However, its over-reliance on rationality, mathematics and a desire to emulate science has been key to discrediting it or at least reigning in its influence.

Humans continually tried to find patterns, first in religious texts and scriptures, then in behaviours, ideas and numbers. The limitations of human intellect to find such patterns means it was succeeded by machine intellect some time ago. The technologists’ greatest weapon in making a more rational world is artificial intelligence. In particular, AI’s capacity to find bewilderingly complex patterns within almost incomprehensible quantities of data.

Economics, psychology and neuroscience have found, and continue to find patterns in human behaviour. More of those patterns will become evident as computing power improves - bearing in mind we are approaching the limits of Moore’s Law and now need a new breakthrough such as quantum or organic computing. Unfortunately, some of those patterns will merely look like patterns, and some will be based on unreliable data.

AI, in common with new developments throughout human history, brings with it suspicion and fear. The fear of the unknown. The mass-collection of personal data from multiple sources is new and troublesome. But AI needs it in order to build up a vision of the world, to understand it and to make predictions. What AI reveals in that data can be disturbing for the fragile human psyche.

In China, a state more comfortable than most with surveillance of the individual, the government is piloting an AI-based system that rates the credit-worthiness of citizens based on their data. Data gathered predominantly online – from shopping, social media interaction, time spent watching videos and so on. With this data it will decide, without human intervention, whether a person should be given credit. This is one of a number of stories that are seen by many as the thin end of an
extremely worrying wedge. How long before access to credit become access to services or to overseas travel visas?

In Chicago, the police department have trialled a system that analyses crime data. It takes information on high-risk areas of the city, as well environmental data and data on individuals with past convictions for violence and brings them together. They try to intervene early with those who have social links to convicted offenders. They use GPS data from phones to assess if a high-risk person is entering a high-risk area and allocate resources accordingly. However, the system is prejudiced. The data on past crimes, offenders and sentencing input to the system is based on a history of targeting ethnic minorities, or those who live in certain parts of town, and of the very human prejudices of the public, police and judicial system. Any such system is only as good as the data its given, and in the US, potentially more than anywhere else in the world, a disproportionate number of black and Hispanic people have been through the justice system.

The parallel with Philip K Dick’s Minority Report is obvious. But how much concern about this is due to humans fearing change and how much of it is genuinely, rationally justified? This type of policing could be more reliable than human intervention alone. It is dispassionate and logical. It works only on the evidence given to it (even if part of that is flawed historical data). Police have tried to pre-empt criminal activity for years by focusing on areas or individuals who fit certain profiles. The AI system will not always be right, but given there is evidence to suggest that human police officers can be affected by anything from the time until the end of their shift to their family circumstances at least AI will be consistent. Human biases are seen to be more extreme and more unpredictable than machine ones. They are also harder to account for and to correct over time.

Yet we are more comfortable with human biases because we too have them. We think the mistakes will even out and probably in our favour. We feel that a human can be made to see our perspective; to empathise with us.

There are years of debate due on whether society wants a system that dispassionately profiles potential criminals or credit risks and the role of human politicians in deciding how to programme such AIs (for example, should it consider ethnicity or socio-economic background). But these are early days and no one will rely solely on these AIs as they operate today. Machines will only be trusted when they too are part of a conversation on how to manage society.

The potential of AI to make independent, unbiased decisions is a source of hope as well as fear. AI views all data equally and can learn when to trust data and when to question it, as well as when to refer to an outside agency, typically humans. Much is made of who controls and designs AI and what their motives might be. As AI becomes increasingly commercial it should be considered how past tech pioneers started out well intentioned and believing they could predict and even control their creations. When released into the human world, however, the imperfect, unpredictable stakeholders, whether users, advertisers or investors, changed their creations.
If the gulf in resources and knowledge between government and Silicon Valley is so great as to make regulation all but impossible, perhaps the two groups will simply come together. Technology has the potential to understand humans, but not necessarily to make human-like decisions. It can measure but not always predict. In creating comprehensive profiles of people, rather than using them for commercial purposes, they could aid governmental and community discussion and decision-making.

The ability of AI and the technology around it to gather, compile and process vast amounts of data can help bridge the divide we see opening up in society; between leaders and the led, as well as amongst groups of individuals. AI can bring together opinions and voices, but in an intelligent, unbiased way; a way that helps leaders to make informed decisions. A way that will not be offended or provoked. Democracy, often criticised as the worse form of government apart from all the others (by Winston Churchill, but possibly by others before him and certainly by many after) and as the tyranny of the majority, has an obvious problem. Not every vote is equal. It is assumed that things average out, but how safe an assumption is that?

We are faced with a time, not too far away, where every interaction and experience, both online and real-world, generates data. In doing so, a person’s data profile will say who they are, what they know, their background, job, income, opinions, habits, education, talents and skills. This knowledge can help create social cohesion. It can help schools create diverse classes and curriculums; help employers recruit diverse groups of employees. It can help authorities to plan communities and help businesses spring up around bringing people, and more importantly their experiences, together. It can ensure that a range of voices are incorporated, but it can also moderate the extremes by highlighting them as such. One person-one vote, the tyranny of the majority, would become one person-one voice; a voice weighted in importance according to who and what it represents. A public record of the knowledge that voice has; the contribution it has made elsewhere.

AI will certainly be able to achieve this - to assign an appropriate weight to a particular voice or voices. It could ensure a representative voice according to the question. By understanding how likely it is that a person has understood and considered a decision, it could measure the most amount of good for the most amount of people, whilst not ignoring everyone else.

Unlike opinion polls that take a sample representation and multiply it by the population it hopes to analyse, AI can handle entire nations of individuals like this. It can produce advice that truly takes everyone into account and produce a result that is not just the best for everyone, but nuanced according to their circumstances. In this, AI is a tool for decision-makers as well as wider society. It can reduce division; open up conversations, rebuild trust. It can expose people to the views and ideas of others whilst reassuring them theirs has been accounted for as well. Furthermore, it could encourage (or nudge) people to research the topic they are contributing to as to do so would increase the weight given to their voice.

This is a complex solution for complex times, but it might help steer the inevitable change in direction in such a way that everyone feels they have a part in it. And what of AI’s ability to steer
decisions on an individual level? Its capacity to deal rapidly with trillions of bits of data on billions of people means it can personalise. It can individually design online experiences, tailor exposure to information, but also help inform the design of the real world in which we live.

By applying the ideas of nudging, the behavioural science of making you fit a pattern, of making you more predictable, of subverting the human inclination to think short-term, AI is a potentially powerful tool. AI, with input from economics, psychology and neuroscience could make people predictable. By turning human experience and history into data and feeding it to AI, patterns in behaviour could be uncovered. New methods of nudging could be exposed. After astrology and economics a new predictive science could soon emerge. AI could prove to be the key to a real psychohistory by both the strength of its analysis, but also its ability to make people act more rationally. It could push into line those that do not fit the models. It could make them healthier, more economically prudent, but it could also turn them into more voracious consumers, more ideologically driven, depending on who controls the AI.

Silicon Valley’s understanding of both addiction and ‘me-ism’ has created a possibly dangerous environment. A business model has emerged that has made a commodity of personal data (derived from an ever-increasing number of connected devices and services) and the psychological profiles that it generates. Ironically, the culture that persuades people they are unique is also the culture that is trying, and often proving, they are quite predictable and far from unique.
Technology and the Future of Prediction

Governments who are managers. Businesses who seek to get involved without fully understanding the nature of the problem. Politics and ideology no longer seen as the best systems for running the world. A society feeling overwhelmed by vast amounts of information and rapid change. Individuals who are convinced they are important, unique and deserve to be heard in each and every debate regardless of whether they are qualified. Tech companies building ever more detailed (but potentially flawed) profiles of their users, the world they inhabit and how they interact with it. Technologies that offer an open, unbiased and accountable way of recording and analysing decisions. The means to contribute to decisions, to guide government as individuals and groups both equally, yet with favour to those with the most to contribute. A technology married to science and social sciences that can both predict and make more predictable. A human desire for certainty – a desire to know what the future holds.

Asimov’s psychohistory looks to many like a terrible curse. Humans reduced to predictable bystanders in their own lives. Governed by something that is not human but was created by humans that took on a life of its own. Asimov himself was ambivalent about the nature of his fictional Foundation society. Rather than making a moral judgement he considered human nature and the new societies we build in the image of previous ones. It is this inclination that makes human progress predictable through the new science of psychohistory.

Would having our futures mapped out and guided for us by a high-functioning intelligence applying a new science be all that bad? Could the everyday continue to be under human control, whilst the big picture, long-term plans we humans are so poor at comprehending is taken out of our hands?

It is to the advantage of government as well as tech companies, and business more generally, to make humans more predictable. Whether that is what they will buy, the health services they will require, or the policies they will agree with. For the first time in human history, it may be possible to make people behave in a determined manner. A new science with a connected, data saturated environment and AI at its core; a new way to understand and to manipulate humans.

As Aldous Huxley observed, we may be moving towards a world where individuals can only exist in exile from comfort and community – a technological exile, removed from the influence of the digital which predicts our needs. Those who opt out of the digital domain, thereby retaining ownership of their data and refusing to be part of the predictive model, would be punished. Not by anything so archaic as banishment from society as such, but by excluding themselves from the comforts of the modern, connected world, and perhaps, from the services managed by government via digital platforms.
At the heart of *Brave New World* lies a question: whether it is better to live in a good hell or a bad heaven. A choice between living in blissful (or at least comfortable) ignorance or knowing discomfort. The digital world where you can get lost, only hear positive things, be the person you want to be, and in exchange, hand over all your data. Or the real world; messy, awkward, sometimes painful and unpleasant, and always unpredictable.

As government and tech companies become closer, as the former comes to rely more on the latter, citizens become consumers. In the name of progress we are expected to digitally monitor and pay for utilities (gas, water, electric), to access information, to pay taxes, to maintain friendships. Remove ourselves from the digital domain and we stop ourselves living a ‘normal’ life, like those free-thinkers of *Brave New World*. The nudge – keep living within the digital domain so that you can be monitored; so that you can be usefully added into the predictive model.

Nietzsche saw the power of a society in its ability to stop a person being who they could be; achieving what they could achieve. Restricting access to goods and services to only those engaged in the digital leaves almost no choice. Nietzsche’s superman was a thought experiment that could not live in the real world – he would need to trade, communicate and rely on the expertise of others. The digital world demands that we take part, play our role and at the same time places limitations on us.

There is an often-quoted exchange between a US official, part of Nixon’s entourage on his visit to Beijing in 1972, and the Chinese premier Zhou Enlai. Asked for his thoughts on the French Revolution 200 years earlier, he is said to have remarked: “it is too early to say”. Whilst the veracity of this quote has been disputed, it is cited so often because it neatly encapsulates the drawback of trying to assess events that are, in the truest sense, chaotic – riven with unpredictable, long-term, indirect consequences.

Revolutions, be they political or socio-technological, take generations to reveal themselves. To resolve the interplay between different aspects, their geographical and cultural spread, the utterly unpredictable, chaotic consequences they produce. One thing has been proved repeatedly to be true about revolutions, from the Agricultural to the Russian to the Data – humans adapt. It may take time and it may be painful, but we ultimately live with and shape these disruptive events, individually and collectively, and very occasionally, under the leadership of key figures.

Humans fear change, yet we have consistently proven ourselves to be incredible at adapting to it. We fear uncertainty, we have expended huge amounts of energy and resources trying to prepare for any eventuality, yet it frequently makes little difference. Human consciousness, the desire to question and to feel, has cursed us with frustration at our own limitations. So much so that we sometimes deny those limitations even exist. We are condemned not to understand some things, and certainly never to understand everything. Our intelligence is limited and flawed, but also incredible because of those limits and the way we work around them.
Ludwig Wittgenstein commented extensively on what humans can know, what we need to assume in order to progress, and the limitations in knowledge placed on us by language. Our use of language to communicate with others and ourselves (our internal monologue), means we can only achieve so much. The human mind is incredible, but not always in the way we might expect. Its ability to see patterns is incredibly limited. We can only focus on one element or trace out one pattern at a time. Partly by using past experience to fill in the blanks our brains fool us into thinking that we are taking in everything around us, but we are not. Where the mind is incredible is in its ability to very quickly switch focus from one thing to another, to sample rapidly and to read in detail.

On the other hand, even basic AI is incredibly pattern-driven, far superior to any human in its ability as well as capacity to analyse, but it is also inflexible. The conclusions it draws are based on vast amounts of data, and a small degree of assumption. Humans, by contrast, can draw conclusions based on relatively little data and huge assumptions. Just like recognising many breeds of dog despite having only seen one or two.

Work on AI has essentially been little different to all previous forms of software programming, by codifying knowledge and inputting it, transferring it from the human world to the machine world. The problem being that humans cannot fully explain everything that they know. Not just complex, uniquely human emotions, but everyday activities, especially those relating to physical motion and perception. It is why we demonstrate rather than explain processes that are actually quite complex. The thinker Michael Polanyi gave his name to Polanyi’s Paradox to describe how much of human learning is not conscious but passed on through often non-verbal cues. Summarised as ‘we can know more than we can tell’ it is why ‘teaching’ a machine is so difficult. Also, as far as AI is concerned, we can only teach in a human way, which is, if not useless, extremely limiting when teaching a non-human.

We have no better way to deal with this new technology. Supervised learning is the name given to the process most people associate with AI today. It involves thousands, sometimes millions of examples of something being fed into a computer, and the computer being ‘taught’ what they are so that they might recognise them again in the future. For example, voice recognition software, which is given thousands of examples of words and syllables being spoken in various accents and intonations. Having been so programmed, it then ‘knows’ what word it ‘hears’ probably getting it right even if it is said in an accent not previously encountered by the machine. This seems incredibly complex to us and requires millions of hours of programming and inputting to work, and yet still we find such systems incredibly limited in the real world.

This type of data-heavy instruction has seen AI employed by Amazon to predict stock control, by hospitals in cancer diagnosis, and by JPMorgan to review commercial loans. Information that would have taken hundreds of dedicated workers thousands of hours to sift through can now be done in a few seconds by very powerful computers. This looks like intelligence, but it is still some way off emulating organic intelligence.
The next leap forward will occur if and when a new form of machine learning develops; one that does not need petabytes of data fed into it. One that can ‘see’ one breed of dog and recognise all others also as dogs. Just as humans can. This is AGI (Artificial General Intelligence) and predictions vary as to whether it is possible at all, and if it is, by when.

AI is a hotly debated topic with many ethical complications. Regulation and ownership are key issues, with concerns over the replacement of human workers in similar ways to those expressed during the Industrial Revolution. Amongst the other debates is whether an intelligent machine would have rights similar to those bestowed upon other forms or life, or even humans.

“God created man in his own image.” Ever since that idea was first proposed, probably somewhere around 500BCE, humans have seen themselves as the highest form of life (at least on this planet). The one best suited to the world. Writers and visionaries have imagined humans becoming gods by creating their own beings in their own likeness, both physically and mentally. We have a narrow view of the world and can only envisage intelligence in our own image.

We know that the way the human brain works is very different to how a computer, even the most powerful and complex computer, works. Yet we come back to an idea of a process of thinking and learning akin to our own. Despite the fact that computers do not (and need not) share our experiences, our language, or our physical connection to the world. We are flawed and limited but uniquely human. For example, our eyes can only sense certain frequencies of light, and suffer from myopia and colour blindness, or in some cases do not work at all. This means we understand the world in a particular way, and often in a way we cannot explain. It shapes our minds, allows us to imagine and create and guess and explore what we cannot see. True AGI, should it be possible, will have its own way of learning, of ‘sensing’ and gathering information, and of processing information, perhaps even of expressing itself, that we humans cannot. It may be better in some respects, worse in others, but it will not be the same. It might understand us, but it will not replace like with like.

Wittgenstein also famously said that if a lion could speak, we could not understand it. It would no longer be a lion, by its nature, it would be something else; something shaped by other experiences that would set it apart from other lions. Equally if a lion could speak, it would not speak any language, express any idea or worldview that a human could comprehend. So for AGI, which would cease to be the technology humans had created and become something else.

Currently AI is still in its adolescence. Much of what we take to be artificial intelligence is actually a cleverly designed algorithm applied to very large amounts of data via impressive amounts of processing power. AGI will learn without human interference; without being told what a set of data represents. Algorithms, even very complex ones, simply process data and provide a particular, albeit sometimes revealing, result.
Even in its nascent form AI has already established a good, if not always outstanding, predictive track record. In healthcare it has found patterns in cancer diagnoses. There are banks who use AI to study historical market data and make investment decisions and insurance companies who use it to assess risk—sometimes wholly reliant on AI, sometimes combining AI with human decision-making. AI has demonstrated an ability to predict the movement of crowds at sporting events, whether students will drop out of college, even a person’s sexuality with somewhere around a 90% accuracy. Whilst that sounds impressive, 10% could represent a huge number of people. Plus, if human leaders are reluctant to argue with the data-driven, more-often-right-than-wrong AI, the implications could be very serious.

The perfectly reasonable assumption is more information, more complex systems, and more application in the real world will only improve AI’s predictive ability, with or without the leap to AGI. Although there may well be limits to what is and is not predictable, and those limits need to be identified, the application of AI needs to involve everyone, otherwise the data is biased and the results unfair. Currently much of this work is based on the data available either through government and academic systems or from those groups that engage extensively in social media and internet search. That leaves a large number of people unaccounted for should someone be creating a predictive model.

There is, of course, a paradox in tech companies persuading people they are unique in order to get them to engage with their platforms in order to harvest data from them and use that to build predictive models of their behaviour. It perhaps reveals the comfort we find in the irrational and the contradictory. But it is surprising just how much of society and of human behaviour is predictable, or has become predictable.

Technology is also changing our brains and how we think. Attention spans, the ability to remember facts, concepts and feelings of pleasure and loss are, some believe, being irrevocably altered on a physiological level. But does it matter? Are these changes just part of the process? Neither good nor bad - what we lose in one place we gain in another. Our affinity for remembering facts replaced by a skill in understanding how the internet orders and searches information. Are we losing what makes humans special? Or were we never really that special in the first place?

Whenever there is great change, some fight and some acquiesce. Some see an opportunity to profit, others to improve the world, but overall, we adapt. The Luddites of the Industrial Revolution are often mistakenly assumed to have been against the machine age simply by virtue of being anti-progress; of being somehow pathologically nostalgic. In fact, they felt passionately that industrialisation was a way to circumvent labour practices and that it would destroy hard-learned crafts and skills. Attacks on machines and factories saw military action and the suppression and arrest of Luddites. The British Parliament, populated as it was by many with financial or political stakes in factories, passed laws making the damaging of machines a criminal offence. Although
defeated, the Luddite's ultimately played a role in the formation of trade unions and the development of workers' rights. It took decades for humans and machines to live alongside each other, and along the way they shaped each other and changed society for both good and ill.

AI is the latest advance in automation, intended to reduce the workers' share of dull, dangerous or dirty work. At the same time it is designed to remove humans and the costs they entail, enabling instead investment in machines which drives up profits for the owners. In the long term, the social trajectory industrialisation has produced is positive with millions of people enjoying a longer, healthier, more prosperous life. As has been demonstrated, we struggle with the long-term, whilst in the short-term we see only threat, disruption and discomfort. The Industrial Revolution created a new form of urbanised working class as semi-skilled and unskilled workers moved from farm to city. The unintended consequences were illness, social disorder, political turmoil, even war that took decades to recover from, but recover, and indeed thrive, is what societies did.

Globalisation then superseded industrialisation. Factories closed, the jobs they provided were moved thousands of miles away to less developed economies where costs (including labour and regulatory costs) were lower. In turn the economies of those towns and cities, that had largely grown up around one or two employers or industries, collapsed. Towns across the US and Western Europe became hollowed-out shells of addiction, mental illness, crime, joblessness and despair. Those individuals that could leave to work somewhere more prosperous often did so, leaving those that could not escape to cope with what was left.

An automated, AI-led, technological revolution could offer a route to recovery. People will no longer need to live in prosperous towns and cities where space is limited, and public finances are over-burdened. They will be freed from work, or at least partially freed, as many jobs still require some degree of human oversight or input. They will have more time to learn more skills. AI will free people. As the likes of Oscar Wilde and Matthew Arnold suggested, humanity's salvation lies in the freedom of the individual to pursue their innate vocation. To improve themselves without concern for economics. They should enjoy and indeed produce art for art's sake, not to prove their intellect, to further their place in society, or to earn money. That, to those idealists, is what freedom looks like.

For over a century people have hoped that a functional society could come from enabling everyone to pursue that which they are best suited to, rather than chaining them to desks or counters or machines. This utopian vision requires a more equal sharing of capital, and plays to a somewhat privileged, unrealistic view of the world. Marx insisted that this sort of freedom could only come about when the workers owned the capital; the means of production. But with no workers, who will profit and who will suffer?

One widely discussed option is the so-called robot tax; a tax on any business employing AI or automation to do a job humans could do or have done previously. But for how long will you be able to say that a job is a human job? Eventually robots will be the primary source not just of manual
labour but a great deal of intellectual work as well. AI is already much better at many of the process-driven tasks humans currently fill their time with. AI will only continue to be quicker, more robust and less costly than humans. So who will differentiate between what is robot work for robots or where robots are supplanting humans? An alternative may be, rather than a financial tax, a legal duty of care to former and never-will-be employees; to support their continued learning and skills development. This would at least deliver the advantage of businesses helping people to earn, and in doing so help them to buy the goods and services the businesses provide. Business can only gain from helping to main a healthy (in all respects) society.

Concerns about AI and technology, whoever they are from, should not be written off as the anti-progressive, lunatic diatribe of those who are too slow, old or ignorant to adapt. We should worry about those feeling marginalised or excluded (directly and indirectly) from the technological wonders that so excite some parts of the world. We should listen to those who resist the steamroller of Silicon Valley’s PR, marketing and lobbying industries. The fears of many sceptics need to be examined and applied, not brushed aside. That way a robust and inclusive future lies. Those with a stake in the Data Revolution should not be allowed to crush all opposition, no matter how persuasively they do it. Like the Luddites, opposition voices need to be involved in the decisions that shape a world that could well be on the brink of something remarkable or terrifying.