

The Scientific Study of History:

Speculative Philosophy of History explained

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Some parts of this document have been previously published in my book *How Change Happens: A Theory of Philosophy of History, Social Change and Cultural Evolution*.

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Preface

This paper was written in order to examine the order of discovery of significant developments in history. It is part of my efforts to put the study of social and cultural history and social change on a scientific basis capable of rational analysis and understanding. This has resulted in a hard copy book *How Change Happens: A Theory of Philosophy of History, Social Change and Cultural Evolution* and a number of websites such as [How Change Happens](#) and [How Change Happens Rochelle Forrester's Social Change, Cultural Evolution and Philosophy of History website](#). There are also papers on [Academia.edu](#), [Figshare](#), [Mendeley](#), [Vixra](#) and [Social Science Research Network](#) websites and other papers on the [Discovery of Agriculture](#), [the Discovery of the Atomic World and the Constituents of Matter](#), and on [Guttman Scale Analysis and its use to explain Cultural Evolution and Social Change](#) and [The Course of History: Substantive Philosophy of History explained](#). Other papers by Rochelle Forrester include, [Rochelle's Philosophy Website](#), and works on Epistemology and the [Philosophy of Perception](#) such as [Sense Perception and Reality](#) and on [Slideshare](#), [Issuu](#) and [Scribd](#). Rochelle Forrester is a member of the [International Network for Theory of History](#).

This paper is an analysis of the summary of my book *How Change Happens: A Theory of Philosophy of History, Social Change and Cultural Evolution* in which I suggest ever increasing human knowledge of the world we live in, is the driving force for much social and cultural change. The social and cultural change follows a particular and necessary path which can be rationally analysed and understood and this enables the study of at least a part of human history to be put on a scientific basis.

In the second edition of *How Change Happens: A Theory of Philosophy of History, Social Change and Cultural Evolution* I suggested the following as a summary of the ideas in that book:

- 1) Human beings meet their needs by using the resources in their environment.
- 2) Human beings have a limited knowledge of their environment.
- 3) Human beings have the ability to learn and remember so their knowledge of their environment increases over time.
- 4) As human knowledge of the environment increases, new ways of meeting human needs become available.
- 5) If the new ways of meeting human needs are better than the old ways of meeting human needs they will be adopted and the old ways discarded.
- 6) The adoption of new ways of meeting human needs constitutes social and cultural change in itself, but also leads to further social and cultural change.
- 7) The order of discovery of new means of meeting human needs follows a particular path from that which is more easily discovered to that which is more difficult to discover. Many discoveries require prior discoveries before the discovery can take place. This means there is a necessary order in the discoveries that constitute and cause social and cultural change.
- 8) The particular order in the discoveries means social and cultural change occurs in a particular order so that the sequence of social and cultural change is inevitable and is rationally understandable.

I then suggested that:

“All of the above statements appear to be obviously correct. If they are then the study of social and cultural history can be considered to be a science in the same way as biological evolution is. Social and cultural change derived from increasing human knowledge is not random and so can be scientifically understood. We cannot predict the future of social and cultural change as we do not know what future discoveries we will make. This is analogous to biological evolution where changes in living species are unpredictable as we do not know what changes will occur in the environment of those species. However biological evolution does make changes in living species rationally understandable, just as an analysis of the order of discovery of the human environment makes social and cultural change rationally understandable.”

This suggestion that we cannot predict future social and cultural change as we do not know what future discoveries we will make, should be qualified as there are some circumstances in which we can predict future social and cultural change. Those circumstances are explained at the end of this paper under the heading Making Predictions and predictions are made which if shown to be correct will confirm the correctness of the theory outlined in [*How Change Happens: A Theory of Philosophy of History, Social Change and Cultural Evolution*](#) and [*The Course of History: Substantive Philosophy of History explained*](#) and this paper.

I will investigate each of the above eight statements in turn to show they are “obviously correct”. The first statement is “Human beings meet their needs by using the resources in their environment.” There are a number of theories of human needs such as Maslow’s hierarchy of needs which runs from basic human physical needs such as oxygen, water, food, warmth, and shelter, to needs for safety, and cognitive needs to know and understand, and emotional needs such as love, respect and self development. Maslow’s hierarchy of needs is a bit controversial and there are other statements of human needs such as the functional requisites of societies, which involve needs for systems of communication, production, distribution, defence, member replacement and social control. These needs are general human needs that apply in all, or almost all, human societies.

Concerning the basic physical needs we obtain oxygen from the air without any great effort, but the need for fresh water ensures that hunter gatherers never went far from fresh water supplies and when humans became sedentary they built their settlements near supplies of fresh flowing water or diverted fresh water to their settlements via aqueducts. The acquisition of food has been such a major activity for humans that the types of societies humans progressed through in history have been named after their food acquisition methods. Hunter gathering, agrarian and pastoralist societies all have different principal food acquisition methods and it is only with the creation of modern industrial societies that food acquisition has become a lesser activity within societies. Oxygen, water and food are all obtained from our environment.

There are also needs to travel, whether on foot, or horseback or horse drawn vehicle, or motor vehicle or aeroplane, or sailing ship or steamship and the resources that allow us to travel come from our own bodies, the bodies of other animals, wind or the energy derived from coal and oil which drives vehicles built from wood or metal. Our bodies and other animal bodies and the food for our and other animal bodies, and the wind, coal and oil and the materials used to build motor vehicles, ships and aeroplanes, all come from our environment.

There is also a need for shelter which would have begun with caves and crudely put together wooden and dirt shelters. When humans became sedentary, more sophisticated shelters could be built. Initially they were still constructed of wooden and other plant material and dirt, but this eventually led to stone buildings and brick buildings and wooden buildings put together with metal nails, screws and bolts. The caves, wood, mud, stone, brick and metal are all materials taken from our natural environment.

The human need for warmth is met by the sun and from the energy provided by food which is taken from the environment we live in. A further source of warmth is from clothes made from plant and animal materials and from fire which comes from sufficient heat being produced in combustible materials. The heat can be produced by rubbing sticks together or by striking one piece of flint against another. Eventually we learnt to produce heat by electricity which comes from a variety of sources, such as burning coal or oil or from converting mechanical energy into electrical energy via falling water or wind turbines or from the sun via solar panels. Electrical energy ultimately comes from the resources in our environment, as does clothes from plant and animal materials, and fire caused by friction between two materials in the presence of combustible materials like wood and other plants.

A further human need is for safety and security. This has been met by humans by means such as running away using our legs or by repelling threats like other people and animals, by striking them with fists or legs. Weapons were developed to help in protecting people from wild animals and other people. Weapons were first made from materials such as wood, stone, bone and horn, which are of course materials taken from the human environment. They were later made from metals which are also materials taken from the human environment.

All human physical needs are derived from materials in the human environment. They have to come from the materials in the human environment because there is no other source available to meet those needs. The human environment can be considered as expanding over time for example the seabed, far from the coast, for most of human history, was not part of the human environment, but with modern underwater research and oil drilling and mining it can now be considered a part of the human environment.

Cognitive needs to know and understand the world we live in have traditionally been supplied by religious beliefs which have been used to explain natural phenomena such as storms, earthquakes and volcanic eruptions. Religious beliefs have usually satisfied the human need to have a means of influencing the world around us by appealing to supernatural beings which are considered to be controlling natural phenomena. Religious beliefs have also supplied people with explanations of why we are here, what is the purpose of our lives and what happens when we die. These cognitive needs are usually met by science and other modern intellectual disciplines, in industrial societies. Both religion and science come from the human brain and its observations of the world around us, and both the human brain and the world around us, are part of the human environment.

The other human needs such as for love and the respect of others are also derived from the environment we live in, but they are usually derived from other people in the environment. Human beings, in common with our primate relatives, have always been a social species so this need has been met in a similar way throughout history but with variations for different cultures. All human needs are derived from the human environment as there is no other place, known to us, from where we can meet our needs.

The second statement is “Human beings have a limited knowledge of their environment.” Human knowledge of the environment was initially limited to that which could be perceived with the naked human senses. Human knowledge gradually increased over time as observations became more sophisticated and with the invention of writing and later printing and the internet, they could be recorded and communicated to others.

Many human societies have changed from hunting and gathering to farming and/or pastoralism and then to being industrial societies. What was necessary for this to happen? Obviously a knowledge of agricultural and pastoral practices and of the technology required for industrial society. Without this, the change from hunter gathering to farming and pastoralism and then to industrial society could not have taken place. The knowledge came from the capacity of humans to learn and from the human desire to meet certain needs in a better and more efficient manner.

However the human capacity to learn has existed ever since humans have been on this planet and the needs have always been there, even though previous societies have been less able to meet the needs, than industrial societies. The difference is that the knowledge of how to meet the needs in a better and more efficient manner has not always existed. It has gradually accumulated over time. It is the increasing knowledge that is present in the change from hunter gathering to farming and pastoralism and then to industrial societies, that is absent from the preceding society. The knowledge required for industrial societies was not available in agrarian and pastoralist societies and the knowledge of how to domesticate plants and animals was not known to prehistoric hunter-gatherers as shown by my paper on the [Discovery of Agriculture](#).

This paper shows there was no knowledge of agriculture, before agriculture began to be practised, other than the brief (few thousand years) period of proto agriculture, which occurred in the period immediately preceding the discovery of agriculture. Proto agriculture involved the tending of wild plants by weeding, watering and other practises designed to promote the growth of the wild plants which gradually provided humans with the knowledge required to practice agriculture. Some anthropologists claim that prehistoric hunter gatherers knew about agriculture before it began to be practised, and deliberately decided not to practise agriculture as they preferred hunting and gathering, but they provide no evidence at all for such claims. The reasons why it is clear hunter gatherers did not have the knowledge required for agriculture are outlined in my paper the Discovery of Agriculture.

Yet many of the needs of hunter gatherers are the same as for modern humans. Only the knowledge of how to meet those needs is different between the various types of societies. This can be used to explain many of the differences between those different types of societies.

However the knowledge differences between those societies are not limited to knowledge of how to grow crops and herd animals and of various industrial processes. Agrarian societies, other than the Neolithic, usually have a knowledge of writing, metallurgy, transport (for example, sailed and wheeled), and mathematics and in many other areas that does not exist amongst hunter-gatherers. Equally industrial societies have a knowledge of scientific matters that does not normally exist in agrarian societies, except by diffusion from industrial societies.

The changes from hunter gathering to agrarian/pastoralist to industrial societies were caused by changes in the methods used by humans to produce the goods and services that meet human needs. These were changes in the technology used by humans but behind the changes in technology were changes in knowledge. It was the changes in knowledge that caused changes in technology, which caused the historical development from hunter-gathering to agrarian/pastoralist and then to industrial

societies. The idea that increasing human knowledge is a major cause of social, cultural and historical change can be traced back to Comte and J. S. Mill.

There are also many more specific examples from the history of science and technology that show human knowledge of the environment is limited at any given point in history. There was an almost universal belief before the sixteenth century that the Earth was not moving and the Sun and everything else orbited the Earth; there was no knowledge of electricity and of how to make it and use it other than the occasional shock with wet hair and electric eels before the nineteenth century; and there was no knowledge of galaxies outside our own until the twentieth century.

Now, in the early twenty first century we know the Earth and planets orbit the Sun, we can make and control electricity and use it for a vast range of purposes and we know there are many more galaxies composed of billions of stars. It seems very obvious that throughout human history, human knowledge of the world around us has been limited, and even now hardly anyone would believe that we know everything about the world around us. There is most likely a lot more to be learnt, but we have no idea how much.

The third statement is “Human beings have the ability to learn and remember so their knowledge of their environment increases over time.” Human beings have the ability to learn and they have this ability above and beyond that of any other living species. This is why our societies look so different from those of other species. But this has not always been so. When humans first became a separate species, we were not much different from the other species. We were hunter gatherers like all other species and it was only about 10,000 years ago with the discovery of agriculture that humans began to live significantly differently from other species.

Human intelligence is usually believed to be considerably superior to that of other species, and although this may involve a certain amount of human centrism, human achievements over the last 10,000 years are quite unlike those of any other species. It is human intelligence and our ability to learn and remember that has enabled humans to develop some understanding of the world around us which has resulted in new technologies that have greatly changed the way we live. The human brain has evolved over time and is the largest brain in relation to body weight of any animal on Earth, other than a few tiny animals such as ants. This is a vital part of why humans are able to learn and remember and over time increase their knowledge of their environment.

New communication technologies such as writing, printing and the internet has enabled humans to preserve their knowledge, so that it is not lost and to communicate it to other humans to ensure it spreads around the world. Religious, economic and political interest groups may sometimes oppose the spread of knowledge, but their opposition is usually only temporarily successful. Societies that reject new knowledge, and the technology that often accompanies new knowledge, will often fall behind and be taken over by societies with better technology.

It seems quite obvious that human knowledge of our environment has increased over time. Originally our knowledge of our environment was limited to that which could be perceived with our naked senses. Then we learnt how to make fire and tools and how to grow plants and domesticate animals, to build permanent buildings, to record information which led to the development of writing and an understanding of mathematics and astronomy. Eventually with the development of modern science we obtained a more sophisticated understanding of mathematics and astronomy and of the structure of matter and of the laws of the natural sciences. This led to new technology such as steam engines, the internal combustion engine, jet engines, rockets and aeroplanes, cars and electricity, electric lighting and heating, television and computers all of which work, which suggest that our knowledge of our environment really has increased over time.

The fourth statement is “As human knowledge of the environment increases, new ways of meeting human needs become available.” This statement deals with the link between increasing knowledge and new technologies. Examples include the knowledge that plants grow from seeds and can be assisted to grow by weeding other plants and by providing water and fertiliser, which led to the development of agriculture which was a new way of providing humans with food which is one of the most basic human needs.

Knowledge of how to use kilns and obtain higher temperatures within kilns led to the ability to smelt ores and produce new metals and tools so that stone tools were replaced by bronze and then iron and steel tools. Knowledge that metals could be mixed with other materials to produce harder and less brittle metals led to the creation of bronze and steel tools.

Knowledge of the properties of gases led to the invention of the steam engine, which led to improved means of removing water from mines, driving industrial machinery and of better land and sea transport in the form of railways and steam ships. The new technologies derived from the steam engine could not have been developed without prior scientific discoveries of the properties of gases.

Knowledge of how to generate, use and control electricity led to the development of electric lighting, heating, air conditioning, numerous household appliances, telephones, television and computers. These devices were dependent upon the prior scientific work of Michael Faraday who invented the electricity generator and the electric motor.

Knowledge of nuclear physics and in particular of nuclear fission led to the development of nuclear power and nuclear bombs. The discoveries leading to the development of nuclear power and bombs include the discovery of the neutron by James Chadwick in the early 1930's and when neutrons were fired at heavy elements such as uranium they would split the uranium atoms which released more neutrons and created a chain reaction which released the energy for nuclear power and bombs.

Human needs are not limited to basic survival and comfort needs. They also include cognitive needs to understand the world around us. Increasing knowledge has led to a better understanding of the universe and our place in it. We no longer believe we are the centre of the universe inhabiting a stationary planet around which all other objects in the universe moved. We now know we occupy a planet spinning on its axis and orbiting the sun which is just one of billions of stars in the universe. We now understand that geological and meteorological events are not caused by gods, but by natural forces which are capable of being scientifically understood.

Increasing human knowledge of the environment around us has led to new ways of meeting human needs throughout history, so human needs are now met better than at any other time in human history. Humans are on this planet in greater numbers than at any previous time in history and life expectancies are longer than in any time in human history because of increasing human knowledge and improved technologies.

The fifth statement is "If the new ways of meeting human needs are better than the old ways of meeting human needs they will be adopted and the old ways discarded." Human history is littered with discarded technologies and beliefs. We no longer use stone, bronze or iron tools. Modern tools are made from steel which is the best material for tools as it is strong and it is not brittle which was a weakness for iron. We no longer travel on horseback or in horse drawn vehicles, we use railways or motor vehicles. We no longer, except for recreation, travel in sailing ships, we use modern cruise liners, or we fly around the world. We now send messages by email rather than by postal services. This process is often forced by economics as firms adopting improved technology are usually able to provide a better quality product or a cheaper product to consumers and they will expand while firms ignoring new technology will eventually go out of business.

There is some controversy as to whether the adoption of agriculture was a better way of meeting the human demand for food than hunting and gathering. This matter is discussed in my paper the [Discovery of Agriculture](#) where I suggest agriculture was the better way of meeting the demand for food. There is no question that agriculture is able to produce much more food per unit of land than hunting and gathering and this means it is able to support a much greater population than hunting and gathering. In addition there are many benefits in sedentism, which is a direct result of agriculture, such as the ability to build permanent dwellings, increased personal possessions and far less chance of coming in contact with dangerous predators such as big cats, wolves and bears and poisonous snakes, spiders and insects.

Human beliefs about the world around us are also regularly discarded and replaced by better beliefs. We no longer believe disease is caused by the gods, witchcraft, or an imbalance in the four

humors. We believe that disease is caused by viruses, bacteria or environmental or genetic factors and this is supported by double blind studies of diseases and treatments and statistical analysis of those diseases and treatments.

We used to believe the Earth was the center of the universe and everything orbited an unmoving Earth. Now we believe that the Earth spins on its axis and orbits the sun in circular orbits in curved four dimensional spacetime and flies through space as part of an expanding universe. The new beliefs in astronomy are backed up by observations made with modern telescopes and by modern mathematics such as non Euclidean geometry.

We no longer believe that all matter is made up of some combination of air, water, fire and earth. We now believe that matter is made up from the elements of the Periodic Table each of which has a particular type of atom. The atoms themselves are made up of protons, neutrons and electrons and protons and neutrons are made up of quarks which may or may not be made up of strings. The belief in the modern view of matter is supported by many scientific experiments which mean that the modern beliefs are much more plausible than the classical views as to the nature of matter.

The adoption of new and improved means of meeting human needs occurs throughout human history. The process is sometimes delayed or interrupted by religious institutions or special interests using the power of the state to stop the new methods of meeting human needs. Human societies which fail to use the new methods of meeting human needs are likely to fall behind the more innovative societies in both wealth and military power.

The sixth statement is "The adoption of new ways of meeting human needs constitutes social and cultural change in itself, but also leads to further social and cultural change." Ever increasing human knowledge is the ultimate cause of the development of human societies from hunter gathering to agrarian to industrial societies and ultimately to post industrial societies. However as human societies change from one form to another, there are substantial changes in the social and cultural systems of those societies. The different types of societies tend to develop with different population structures, class systems, belief systems, government and legal systems, and different types of economies. The changes to these social and cultural systems are dependent on the prior changes to technological systems and so occur in a particular order as the technological changes occur in a particular order.

Hunter gathering societies tend to be nomadic, to consist of bands of a few dozen people related by kinship and all of the same ethnicity and language. Their form of government is usually egalitarian, without bureaucracy and with no monopoly of force and with informal conflict resolution. They have no food production or surplus, the division of labor is limited to age and gender and land control is limited by the bands nomadism. Hunter gatherer societies tend to be egalitarian, do not have slavery and there are no luxury goods available for the elite. There is no public architecture or literacy.

Agrarian societies are sedentary with most of the population, which can number in the millions, living in rural areas. The societies are class based and may consist of more than one ethnic group and language. The governments are usually hereditary, centralized and bureaucratic, and have a monopoly of force, and dispute resolution is usually by law and judges. Food production is the most important area of the economy, although there can be occasional shortages. The division of labor is much greater than in hunter gatherer societies. The land is controlled by the ruler and aristocracy and the society is highly stratified, with forced labor such as slavery or serfdom common, and the elite has considerable access to luxury goods. Public architecture and literacy normally exist in agrarian societies, although literacy is not widespread.

Industrial societies populations are sedentary, urban and normally number in the millions. The relationship between members of the population is based on class and residence. Industrial societies can have more than one ethnic group and language and governments are usually centralized and democratic. There are many levels of bureaucracy and governments claim a monopoly of force and conflict resolution is usually through law and judges. Industrial societies are usually secular and scientific with religion having a significantly lesser influence than in agrarian societies. Food production is a minor area of the economy and usually there are no food shortages. There is an

extremely high level of division of labor. The control of land is spread amongst the population, but unequally, and society is stratified by class, although there is no slavery or serfdom. Luxury goods are available and there is substantial public architecture and literacy is widespread.

It is quite clear that certain social and cultural systems are much more clearly associated with certain technological states than others. There is a disproportionate co-relation between certain technological states and the type of social and cultural systems that accompany those technological states. This disproportionality needs explaining and the explanation is provided in my papers [How Change Happens](#) and [The Course of History](#).

There are cases where modern technology exists in some societies but the social and cultural changes have not taken place. However these societies are in the process of changing and over time will change. Not all modern industrial societies are democratic, but those that are not, are in the process of becoming democracies. Fifty years ago there were very few democracies, now most governments are either democracies or pretend democracies, where they hold elections but where the government is almost certain to win. There has been a tremendous diffusion of technology over the last one to two hundred years and the social and cultural change takes a while to catch up with the technological change, but it will eventually do so. This paper and my other papers [How Change Happens](#) and [The Course of History](#) are concerned with long term changes to societies, not the short term situation where modern technology is introduced to agrarian societies and the social and cultural systems of those societies takes time to catch up.

The important point is that changes in human knowledge cause changes in technology and through the effect that technology has on the social and cultural systems of a society, the change in human knowledge will affect all elements in that society. Changes in human knowledge may also directly affect the social and cultural systems in human society. Ideas such as biological evolution and cultural relativity have affected human society, without producing any technological innovations. Human history in all its elements will be affected by the increase in knowledge that gradually accumulates in human culture.

It is necessary to describe not only why societies and cultures have certain similarities, but also why they differ one from the other. Many of the differences are a direct result of differences in the physical environments occupied by the various societies or cultures. Societies or cultures located in the arctic or in temperate zones or in the tropics will all be different from each other, as will inland groups and coastal groups and groups in areas of good rainfall will differ from those in deserts. Such differences will be much greater among agrarian and hunter-gatherer societies located in different environments, than between industrial societies located in different environments. This is because hunter-gatherer and agrarian societies are much more dependent on the immediate physical environment than industrial societies. The behavior of powerful individuals can also cause societies to differ from each other, but these changes will usually not be long term. The rise and fall of Nazism and Communism are examples of such temporary societies.

It is however quite clear that the adoption of agrarian technology led to different social and cultural systems from that which normally exist in hunter gatherer societies. Equally the change from agrarian technology to the technology of industrial societies has led to those societies developing different social and cultural systems than exist in agrarian societies. This social and cultural change is continuing as the world adopts modern computer, internet and robotics technology.

The seventh statement is “The order of discovery of new means of meeting human needs follows a particular path from that which is more easily discovered to that which is more difficult to discover. Many discoveries require prior discoveries before the discovery can take place. This means there is a necessary order in the discoveries that constitute and cause social and cultural change.” Human knowledge of the properties and structure of nature is acquired in a particular order. Certain things will necessarily be discovered before other things. Fire had to be discovered before metallurgy, as it is a necessary part of the metallurgical process. Copper was inevitably the first metal to be extensively used by human beings as it has a relatively low melting point. This meant it could be more easily released from its ores and shaped and reshaped than other metals. However the working of

copper requires a furnace and moulds so that inevitably it could only be done by a sedentary people. It is obviously not practicable for hunter-gatherers to carry round furnaces and moulds. This meant that metallurgy could only develop after the domestication of plants and animals. The occasional example of sedentary hunter gatherers such as those on the north west coast of America seem not to have developed metallurgy. Copper is a soft metal which limits its uses; a much stronger metal, bronze, can be made by mixing copper with another metal such as tin. Inevitably bronze was discovered after copper, as the use of copper is a necessary part of the manufacture of bronze. Bronze could not be made without the earlier discovery of how to produce copper and tin. The next metal to come into common use was iron. Iron has a melting point of 1535°C , about 500°C higher than copper. This means a bellows is required to produce the necessary heat for the smelting and working of iron. Inevitably, metals that cannot be worked without a bellows only came into common use after the invention of the bellows. They would also only come into common use at a later time than the use of such metals as copper and bronze, which did not require the use of bellows. Iron came into use after bronze, as the process of creating an alloy is a relatively simpler process than the creation of heat of 1535°C required to work iron. Iron was followed by steel, an alloy of iron and carbon. Obviously steel could not be made until after it had been discovered how to work iron, as iron is a necessary part of the production of steel.

The process of one thing necessarily being followed by another, either because the earlier thing is a necessary ingredient in the later thing, or because the earlier thing requires a simpler technology, such as fire with a lesser heat, can be seen throughout the history of science and technology. Inevitably, the steam engine had to be invented before it could be given rotary motion, and it had to be given rotary motion before it could drive the new machinery being developed in the industrial revolution and steam locomotives and ships. The sedentary lifestyles produced by the agricultural revolution were a necessary part of a great host of scientific and technological discoveries. Cities, metallurgy and writing are just three of the more important developments that would not have happened without the prior development of sedentism. The domestication of animals was a necessary precondition to developments such as wheeled transport and plough agriculture. The discovery that the Earth and other planets orbit the Sun could not be made, or at least confirmed, without the prior invention of the telescope. Without the telescope there would have been insufficient information about the movement of extra-terrestrial bodies to support the heliocentric theory. The development of more complex mathematics such as calculus and differential equations was necessarily dependent upon the earlier development of number systems and simple operations such as addition, multiplication, subtraction and division. The discovery of electricity had to take place before electrical heating and lighting and computers. The splitting of the atom by Ernest Rutherford had to take place before the development of nuclear power and nuclear bombs. These are just a few of the more obvious examples of the way in which certain discoveries or inventions could not have been made without prior discoveries or inventions being made.

The eighth statement is “The particular order in the discoveries means social and cultural change occurs in a particular order so that the sequence of social and cultural change is inevitable and is rationally understandable.” A given technology will tend to produce a particular social and cultural system, so that it is possible to produce a table such as that below which shows various technological systems and the social and cultural systems that tend to accompany the particular technological system. The four technological systems described are hunter-gathering, pastoralism, agriculture and industrial technology. The table below is a modified version of a table shown in *Guns, Germs and Steel: A short history of everybody for the last 13,000 years* (Diamond, 1998, 268-269).

The information provided by the table is very similar to that discussed in the sixth statement which deals with how technological changes result in additional social and cultural changes while the eighth statement deals with the order of social and cultural change resulting from increasing human knowledge. The table shows both that technological changes cause social and cultural change, and that social and cultural change occurs in a necessary and inevitable order.

social and cultural consequences of new technologies

| | Hunter gathering | Pastoralism | Agriculture | Industrial Technology |
|------------------------|----------------------------------|---|------------------------------------|---------------------------------------|
| Settlement pattern | nomadic | nomadic | sedentary mainly rural | sedentary mainly urban |
| Number of people | dozens | thousands to hundreds of thousands | millions | millions |
| Basis of relationship | kin | kin based clans | class and residence | class and residence |
| Ethnicity and language | one | one | one or more | one or more |
| Government | egalitarian | chiefs | centralised and hereditary | centralised and democratic |
| Bureaucracy | none | none | many levels | many levels |
| Monopoly of force | no | yes | yes | yes |
| Conflict resolution | informal | centralised | law judges | law judges |
| Religion | yes | yes | yes | secular and scientific |
| Food production | no | yes principle area of economy | yes principle area of economy | yes minor area of economy |
| Food surplus | no | yes but occasional shortages | yes but occasional shortages | yes generally no shortages |
| Division of labor | limited to gender and age | wider than for hunter gatherers but still limited | extensive large farming population | highest level of division of labor |
| Control of land | band but limited due to nomadism | horde but limited due to nomadism | ruler and aristocracy | spread among population but unequally |
| Social stratification | no | to some extent by kin | to a great extent by kin | yes by class |
| Slavery | no | no | yes | no |

| | | | | |
|------------------------|----|--------------------------|----------------------------------|------------|
| Luxury goods for elite | no | only to a limited extent | yes | yes |
| Literacy | no | no | yes but generally not widespread | widespread |

The table shows the social and cultural consequences of the technological states referred to in the top line. It is designed to give a general overview of the sorts of social and cultural situations that will exist for any given technological state. There are occasional exceptions to what is mentioned in the table, for example the agrarian Incas did not have writing, but a record keeping system known as quipu, based on knotted ropes that served some of the purposes of writing. It is also true that there are many different types of hunter-gathering, pastoralist, agrarian and industrial societies and not all can be included in a relatively simple table. The societies practising shifting agriculture are obviously not included in the agriculture column of the table. The agricultural column is concerned with the civilisations that existed in China, South East Asia, India, the Middle East, North Africa, Europe, Central America and South America. There are also a variety of industrial societies, for example not all industrial societies are democratic. It is however considered that democracy will be the typical form of government of industrial societies, much like monarchy was the typical form of government for agrarian societies. However with agrarian societies we have many thousands of years of experience with these societies, so we know a lot about them. We have only a brief experience of industrial societies so the type of social and ideological states that may exist in such societies may be arguable.

Societies technological systems have changed from hunter gathering to agrarian or pastoralist to industrial societies and as these changes have occurred they have been accompanied by other social and cultural changes such as those listed in the above table. The social and cultural changes did not and could not occur without the prior changes to the technological systems so it is clear the changes must follow in a particular order with the technological changes involved in the transition from hunter gathering to agrarian to industrial societies occurring before the social and cultural changes.

But this does not just apply at the macro level of the transition from hunter gathering to industrial societies, but also at a more micro level analysis of historical change. The modern view of the universe could not be developed without prior discoveries producing telescopes and developments in mathematics such as calculus and non Euclidean geometry. The motor car required the prior development of the internal combustion engine. The steam engine required prior discoveries concerning the properties of gases and a certain standard of metallurgy. The development of metallurgy and pottery required prior discoveries in how to make and use fire. The discovery of how to make and control electricity was a prior discovery necessary for later discoveries such as the electric telegraph, telephones, television and computers. There is a necessary and inevitable order of discovery and of the social and cultural consequences of the discoveries that operates on both macro and micro levels of historical change.

Making Predictions

In the statement at the beginning of this paper I suggested that the theory proposed in *How Change Happens: A Theory of Philosophy of History, Social Change and Cultural Evolution* and *The Course of History: Substantive Philosophy of History Explained* was a scientific theory even though it could not make predictions about the future. I considered it to be a scientific theory because it could explain what has happened in the past. I compared it with biological evolution where changes in living species are unpredictable as we do not know what changes will occur in the environments of those

species. However there are some circumstances where biological evolution can make predictions about the future.

The [Biologos site](#) states:

“A scientific theory also allows scientists to make predictions, and good theories provide accurate predictions. Can the theory of evolution allow accurate predictions? The answer, once again, is yes. Darwin himself predicted that the earth must be very old for evolution to occur. He did not know the age of the earth, but further research has shown that the earth is 4.55 billion years old, which is plenty of time for evolution to occur. Darwin also predicted that since plants on islands were most closely related to certain mainland plant species, the seeds of these plants should be able to withstand immersion in seawater for long periods of time, and again, Darwin was shown to be right.^[30] Many decades after Darwin, we now know that variation in organisms is due to mutations in DNA and that these mutations are inherited, just as Darwin predicted.^[31] Also, Darwin’s principle of natural selection predicts that particular sequences of DNA should behave in a manner that benefits only themselves and not their carriers, which modern research has thoroughly confirmed with the discovery of transposons and other types of “selfish DNA.”^[32]”

These predictions are not about the future evolution of species but about future discoveries which, when made, would provide additional evidence for the theory of biological evolution so that now it is almost universally accepted by biologists. Similar types of predictions can be made concerning the theory advanced in this paper and others such as my book and website *How Change Happens: A Theory of Philosophy of History, Social Change and Cultural Evolution* and *The Course of History: Substantive Philosophy of History Explained*.

Such predictions could involve societies that are not completely industrialised and have a mixture of agrarian technology and industrial technology, such as many African and Asian countries. These countries, often called developing countries, are transitioning between agrarian economies and industrial economies. If you look down the right hand column of the above table you will see the characteristics of industrial societies, yet many societies in the modern world have only some of those characteristics. It could be predicted the societies without some of those traits will develop the full set of traits for industrial societies in the future. Many of the characteristics of industrial societies are similar to those of agrarian societies, but certain characteristics such as urban rather than rural settlement patterns, democratic rather than hereditary political systems, secular and scientific beliefs systems, rather than religious belief systems, agriculture becoming a lesser part of economic activity, the ending of slavery and increasing literacy rates are areas of difference between agrarian and industrial societies. Predictions could be made that the developing countries will eventually acquire the full set of traits possessed by fully developed industrial societies.

It could be predicted that developing countries will continue to urbanise and rural populations will decline as a percentage of total population. This process began in Europe with the industrial revolution and has spread to the developing countries as they have been developing industrial economies. Eventually it is expected the countries, currently called developing countries, will become as developed and urbanised as the developed countries.

Developing countries that are not democratic like China, North Korea and Saudi Arabia and those that hold elections which could not be described as free and fair will eventually become democracies with free and fair elections. The [Freedom in the World](#) website notes that democracy has been in decline since 2005 around the world but this is just a short term trend, the longer term trend will be for more democracy.

Agriculture will become of less importance in the economies of developing countries compared to industry and services. This is both the result and consequence of the process of urbanisation and of the development of new industries since the industrial revolution and subsequent technological revolutions.

Religion will decline and societies will become more and more secular. This includes Islam which is currently the world's fastest growing religion but which will decline when the Islamic countries get richer and more democratic and birth control becomes more available and it becomes possible to safely leave the religion. More and more people will become nominally religious, claiming to belong to a religion but showing little genuine faith. Attendance at religious observances will decline and that will be a much better indication of religious belief than self described religious affiliation.

Slavery and other forms of forced labor such as serfdom, which used to be widespread in agrarian societies, have been abolished throughout the world. The only forms of slavery still existing in the world are illegal and rare.

Literacy and educational levels will increase as developing countries become more industrialised. This is both the result of increasing living standards providing more money for education and education increasing living standards as more educated people make a society richer.

Standards of living in developing countries will catch up with those of developed countries. This will result from the diffusion of technology from industrialised countries to the developing countries as has already happened in countries such as Japan, South Korea and Taiwan.

These predictions will not necessarily occur in a smooth or even pathway. There may be many setbacks on the way. Look at the evolution of France towards democracy. First introduced in 1792 (except for female suffrage) it was quickly followed by the dictatorship of the Committee of Public Safety and then of Napoleon and then by a Bourbon restoration. The Orleans monarchy of 1830 to 1848 could be seen as a small step towards democracy, as there was a wider franchise and reduced powers for the monarchy, after the 1830 Revolution. The Second Republic of 1848 to 1852 which resulted from the overthrow of the Orleans monarchy was democratic, but for the omission of female suffrage, and was overthrown by Napoleon III who re-established an autocracy. The Third Republic established in 1871 could be considered to be something like a democracy, other than the lack of female suffrage which was eventually added in 1944. Today France is a clear democracy with no one questioning whether elections are free and fair. There will be many apparent regressions but the long term trend will prevail. Historical aberrations like Nazism and Communism will come and go but the long term trend is for democracy to become the usual form of government for industrial societies.

There may be something in the Hegelian and Marxist dialectics with a thesis being opposed by an antithesis resulting in a synthesis, which amounts to a new thesis, which will be opposed by a new antithesis. This sort of analysis may fit with the progress of a country like France moving towards democracy, but it is important not to confuse short term trends which can occur with an antithesis, with the long term trends to new systems like democracy.

A further way in which the theory can predict the future, concerns an examination of human needs. Human needs are known and are consistent overtime and it can be predicted that humans will continue to find new and better ways of meeting human needs. This is because modern science provides a means of making new discoveries about the world around us that does not look as though it is coming to an end. The only thing that could stop this process is if our knowledge of the world around us stopped growing either because we have a complete knowledge of the world around us and there is nothing new to know, or we met an insurmountable obstacle that prevents our knowledge growing. This does not look likely to happen and there does not seem to be any reason to believe this will happen.

Humans are not fond of dying and it can be predicted our life expectancy will continue to improve. This will be both due to life expectancies in developing countries increasing as those countries get richer and due to scientific discoveries leading to improved medical treatments which will increase life expectancy in all countries. During the thousands of years of agrarian technology there was little improvement in human life expectancy, but in the few hundred years of industrial technology there have been massive increases in life expectancy due to modern scientific discoveries and these discoveries do not seem as though they will end soon or end at all.

Means of transport and communications will get better leading to a single new culture based on science and rationalism and national distinctions will disappear and eventually, maybe in a hundred or a hundred and fifty years time, a single worldwide government will be formed. Steps towards a worldwide government can be seen in the development of organisations like the League of Nations and the United Nations and the European Union. Recent developments such as Brexit and the behaviour of the Presidents of USA and Russia should not be seen as the end of movements towards globalisation, they are just aberrations which will disappear as Communism and Nazism have.

A further prediction is that new technology such as artificial intelligence and robotics will lead to the end of work. Human beings will cease to have to work and any work done in the future will be of a hobby nature done for the personal enjoyment of the person doing the work. People will of course still need money and this will be provided by a guaranteed minimum income. This would involve a significant restructuring of society, but that will not be a problem. Such restructuring has been done before, for example when the modern welfare states were created and democracy replaced absolute monarchy as a political system.

Yet another prediction is that population growth will level off and possibly start a slow decline. This is already happening in modern industrial states as the population fails to replace itself and the population is only prevented from falling due to immigration from the developing world. The best example of this is Japan, which gets very little immigration and whose population has been [declining since 2004](#) . When the developing world becomes developed, and when religions which provides the main obstacle to the free availability of birth control decline, then the world's population will level off and may well begin a slow decline.

Climate change will happen, but will be rather less severe than some imagine as the danger is much exaggerated by sensationalism in the mass media. The mass media invariably ignores any good effects of climate change and reports on the worst predictions of any negative consequences of climate change, rather than the most likely consequences of climate change. The problem will be solved by the levelling off of the world's population and new technology such as electric vehicles and new ways of generating electricity.

If these predictions are shown to be correct then there must be some truth in the explanation for historical social and cultural change provided in this paper. This means that human history or at least a part of human history and arguably the most important part of human history is to some extent teleological. It is teleological in that human history is proceeding in a definite and necessary direction and possibly even to a definite end. This also means that the part of historical change derived from ever increasing human knowledge of the world we live in, can be understood in a scientific manner.

It is quite obvious that the theory behind this paper is correct, as to question the theory behind this paper, is to say we could have had nuclear power before we discovered fire, we could have had the internet before we created writing, we could have learnt to fly aeroplanes before we could sail ships, we could have had cities before we discovered agriculture, we could have had cars before riding horses. Obviously it would be silly to dispute that some discoveries and inventions must happen in a particular order and if they happen in a particular order then plainly the social and cultural consequences of those discoveries and inventions must happen in a particular order. The consequences of the discoveries and inventions occurring in a particular order and not being random means that to some extent at least, a part of human history can be treated on a scientific basis, just as biological evolution is regarded as scientific.

Plainly there is a necessary course in human social and cultural history as certain developments could only take place after certain other developments. Whether I have described the process with perfect accuracy maybe debated, but the overall theory I am putting forward is certainly correct. It may require some minor revision, but the theory is clearly broadly correct.

In conclusion I would state what can happen in history is set for us by the structure of the universe, such as the laws of physics, chemistry and biology, the properties of the particles, elements, compounds and mixtures making up the material of the universe and the genetics of the living matter, including humans, in the universe. The course of history, for example, the sequence of events is set for

us by the order of discovery of the structure of the universe which is an order from the easiest to the more difficult or from that which is closest to us to that which is furthest from us. These two questions, what can happen in history and the order in which it happens are two quite distinct matters that should be kept separate when studying social and cultural history, social change and cultural evolution.

The other significant feature of *How Change Happens: A Theory of Philosophy of History, Social Change and Cultural Evolution* and *The Course of History: Substantive Philosophy of History explained* is that they suggest a new way of writing social and cultural history and about social change and cultural evolution. They suggest it is possible to state not just what happened but also why it happened and why it happened at a particular point in time. An analysis can be done to show what the laws of the natural sciences and the properties of the material constituting the universe allow to happen in history and the order in which the discovery of those laws and properties provides a sequence in social and cultural history and in social change and cultural evolution. This allows the study of history to be put on a much more scientific basis than has been possible in the past. This is because both what can happen in social and cultural history and the order of events are necessary and certain and become capable of rational explanation. They are not random or dependent upon human whim or decision making. This method of writing history could provide a new way of writing thesis, articles and books in history, sociology and anthropology.