CLIMATE CHANGE AND SCIENCE: A HOPE-FILLED PERSPECTIVE?

By Howard G. Andersen, PhD

Introduction

This paper, along with the others by Drs. Rapske and Perkins comprising this set has been spawned by *Generation Dread*, the provocative book by Canadian writer Britt Wray. Wray's book focuses much attention on the psychological reactions to climate change, particularly among the younger cohorts of the world population. She takes the science of climate change essentially as a given and the consequences of climate change as largely apocalyptic.

This paper argues that science is a necessary, but insufficient consideration in answering to climate change phenomena. In turn, it will consider the following topics.

1. The phenomenology of climate change,
2. What science, plus engineering and technology, can do about climate change,
3. The necessary place of the humanities in considerations of climate change
4. Harnessing the modern power dynamic of business and politics in response to climate change.

The final section will draw conclusions.

The Phenomenology of Climate Change

Climate change generally is a natural phenomenon with quite dramatic shifts over millennia of time. But human induced climate change on a global scale is a phenomenon defined by current science as taking place starting with the Industrial Revolution some two hundred years ago. The essential process of climate change is the currently increasing amount of carbon dioxide in the atmosphere.[1] Without

[1] Carbon dioxide levels in the earth's atmosphere in earlier periods of the planet's history are usually calculated from the composition of air bubbles trapped in core samples of glacial ice. According to the Royal Society, various ice ages in the earth's geologic history are caused by small and slow variations in the orbit of the earth around the sun. Atmospheric temperatures have varied significantly over those time periods. But the level of CO_2 in the earth's atmosphere remained in the range of 170 to 330 ppm (parts per million) through many "ice age cycles." The level of CO_2 was stable at about 280 ppm for centuries up until the Industrial Revolution. Currently the CO_2 level is over 400 ppm. See royalsociety.org/ News and resources / Projects / Climate change: evidence and causes, accessed 22 Aug 2024. See also https://science.nasa.gov/climate-change/.

some carbon dioxide in the atmosphere, the earth would be much colder than it is. But carbon dioxide emissions since the beginning of the Industrial Revolution have increased the total amount of carbon dioxide in the atmosphere beyond what it was previously and consequently has led to an increase in global temperatures. Global warming, in the current age, is therefore a result of human produced waste products, in this case, carbon dioxide. The long history of humans and their waste is a helpful context for understanding our present situation.

Solid waste

Ancient societies were unavoidably confronted with the issue of solid wastes[2], not only human and animal excrement but also waste from harvesting and from cooking, broken pottery, building materials, discarded clothing, etc. Some ancient cities in very dry climates like Egypt and the Middle East were simply built up, layer by layer, on top of accumulated waste material.[3] Frequently whole rooms or collapsed buildings are found buried in the rubble. In the case of ancient Jerusalem, forms of solid waste were easily dumped into the valley below the city and fires usually were kept burning there. Jerusalem featured a "dung" gate, one of its twelve gates, through which human and animal excrement could be disposed. In Indigenous cultures in the "New World", waste piles referred to by archaeologists as "middens" were created and left to settle and decay. Except for the burning, none of this was waste *treatment* but just waste removal and indefinite storage.[4]

Liquid waste

There seems not to have been much compulsion to do anything about liquid waste in ancient times, presumably because liquid waste would run away of its own accord under the force of gravity. In some ancient Roman cities, public latrines were flushed with continuously running water which ultimately drained into rivers or lakes. In London in the hot summer of 1858, the river Thames came to be known as "The Great Stink" because it essentially was the sewer for the burgeoning city; sewage seeped into the houses of parliament built on the river bank.

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[2] Curiously, however, no reference is made to any form of waste management system in such biblical accounts as the temporarily idyllic Garden of Eden (Genesis 3) or even in the description of the highly sophisticated and futuristic new Jerusalem of the Apocalypse (Revelation 21).

[3] Such mounds are called "tells" by archaeologists. The index of *Documents from Old Testament Times* (D. Winton Thomas (Ed.) Harper Torchbook, New York 1958) for example lists twelve such tells, and there are more. Many ancient place names in the Middle East include tell, for example: Tell Kuyunjik (mound of Nineveh) and Tell Nebi Yunus (mound of the prophet Jonah).

[4] Most modern societies now have solid waste management schemes which include impounding and some incineration sometimes generating electricity, and sometimes including methane collection which can be used to heat green houses, or power vehicles.

In 1962, Rachel Carson's seminal and highly influential book, *Silent Spring*, drew attention not only to liquid wastes but more especially to non-organic waste produced by modern chemical processes.[5] In particular, Carson highlighted "run-off" from farming operations with quantities of not only organic animal waste but more importantly of synthetic chemical fertilizers and pesticides. This nonorganic, chemical run-off was not equivalent to a naïve and harmless "running away" and wound up in rivers, lakes and oceans as solid deposits that did not decompose, serve as nutrients for other living organisms, or evaporate like the water that carried them there. It amounted to an irredeemable poisoning of waterways and the killing or maiming of aquatic life. The distinctive feature of liquid waste, or liquids carrying undissolved solid waste, is that it is eventually pulled by gravity to the lowest available place on the planet, usually the oceans, where it stays.

Gaseous waste

Ever since there have been lightning strikes or erupting volcanoes on planet earth, there has been CO_2 and other gas wastes going into the atmosphere. And since humans have used fire, the same is true. But not until recently was attention given to gaseous wastes as being problematic, especially those that are human produced. For example, in the mid 1970s in North America and Europe, much attention was focused on automobile exhaust gases as serious atmospheric pollutants. Testing regimes were created in some jurisdictions, requiring cars to pass a pollution test annually before they could be licensed. This program, which proved successful, has now been abandoned due to the standardized use of catalytic converters in newly produced automobiles. While these converters are not a perfect solution to exhaust gases, by most estimates they convert 90 percent of the hydrocarbons in exhaust to less harmful carbons, and to nitrogen and to pure water vapor.

Similarly, in the early twentieth century it was determined that the earth had an identifiable 'ozone layer' at 15 to 30 km above the earth's surface.[6] The ozone layer reflects ultraviolet[7] radiation from the sun back out to space. It therefore serves to protect life on earth from too much ultraviolet radiation. In the 1980s scientists discovered that this layer had "holes" in it, particularly over Antarctica. It was determined that human release of a range of fluorocarbon gases into the atmosphere was the cause of this hole. Fluorocarbon gases were used in human created

[5] Carson's book is referenced appreciatively by Wray (pp.71ff) in connection with the enormous anxiety it produced among high school students in Washington State.
[6] To the non-specialist, ozone molecules consist of three oxygen atoms. While humans thrive on oxygen, ozone is a unique gas with its own properties distinct from oxygen itself.
[7] Ultraviolet light is not the wavelength that contributes directly to global warming, but it is a major factor in the sunburning of human skin, for example.

refrigeration systems and were sometimes casually being released into the atmosphere. A process for their eliminating their use and dispersal into the atmosphere was developed and required by law in most jurisdictions in developed countries and the same successful transition to less harmful gases has been achieved.[8] The ozone layer is gradually repairing itself and is expected to be near its historical status by the 2040s.[9]

A categorically important point about these kinds of human created waste is that the solid ones usually remain in place, sometimes over thousands of years, while the liquid ones move under the force of gravity to lower levels, eventually reaching the world's oceans. The pathways for this movement are largely traceable, and therefore offer some means of remediation. Gaseous wastes, in contrast to both solid and liquid wastes, move freely across the globe. Those that are heavier than air, like carbon monoxide and radon, can collect in hidden and unsuspected areas like basements or caves and mine shafts. Those that are lighter than air, like carbon dioxide, can disperse through the earth's entire atmosphere in days or weeks.

The current state of world climate

The current situation has been designated "climate change" since the early 2000s. Climate change generally refers to a state of overall global warming which creates a series of associated complex problems. Climate is mostly a reference to the state of the earth's atmosphere, though, of course, the solid land masses of the earth as well as its oceans are part of the mix of concern. Several features distinguish climate change from earlier issues of pollution noted above.

First, climate change is a long-term process. Weather change may be measured in hours or days. But climate change has been used to describe changes over centuries, millennia and even longer. Such very long-term changes are usually estimated from ice cores taken from glaciers which have built up over very long periods of time. Current climate change discussions are generally expected to address changes over periods of 30 years or more.

Second, current climate change discussions are primarily about the atmosphere of the earth, somewhat about the oceans of the earth, and not so much about the land masses of the earth though all three make distinctive contributions.

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[8] Additional tweaks to refrigeration systems are ongoing. This is important in view of increasing demand for air conditioning systems worldwide. See: https://www.economist.com/science-and-technology/2024/09/04/new-tech-can-make-air-conditioning-less-harmful-to-the-planet?utm_campaign=r.science-newsletter&utm_medium=email.internal-newsletter.np&utm_source=salesforce-marketing-cloud&utm_term=9/4/2024&utm_id=1917894.

[9] See this report from the United Nations Environmental Program: https://www.unep.org/news-and-stories/press-release/ozone-layer-recovery-track-helping-avoid-global-warming-05degc#:~:text=NAIROBI%2C%209%20January%202023%20–%20.

The landmasses of the earth are generally stable,[10] the oceans less so, and the atmosphere very much less so.

The importance of the atmosphere of the earth to the well-being of human beings and to all other living things can hardly be overstated. It is the air we breathe, the unavoidable and completely necessary context for the functioning of all of life.

Responses to the climate change narrative

The current overall climate change narrative has many elements and is full of contradictions, ironies and self-service. First there is the anxiety produced by the threat of climate change as highlighted by author Britt Wray. As with the nuclear annihilation threats of the mid-twentieth century, large numbers of people feel they have nowhere to turn. New neuroses have been defined and therapists are in increasing demand to deal with this phenomenon, as Wray makes clear.

Second, there is the political and media fixation on climate change. It is an insatiable topic. Many books and many journals are devoted to the topic as are countless articles, blogs, and social media threads. Climate change publishing sells, and this is not missed by publishers.

Also not being missed is the opportunity for public personae like politicians, the uber-rich, and high-profile entertainers to grandstand, lecture others, and pose as saviours while all the while adding their own exaggerated carbon footprint jetting around the world to attend high-profile ideological conferences.[11]

A tremendous amount of business activity has been created by climate change narratives including such things as heat pumps for the home, efficient appliances, smokestack scrubbers for industry, waterway remediation, electric cars, new kinds of batteries, wind farms, solar farms, and much more. The profit motive is a risk to the science.[12] In addition, some technological and business solutions to climate change have their own *additional* climate impacts with unanticipated costs like wind farms killing birds, the noise of construction of wind towers possibly killing whales, charging stations for electric vehicles needing added electrical generating capacity as well as the added distribution systems required. An ultimate irony may be extensive carbon generating flights for tourists to see "the last remaining polar bears," and

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[10] Landmasses are generally stable despite tectonic shifts, earthquakes, landslides and erosion.

[11] In fairness, though, such people as Bill Gates buy "offsets" to "pay for" their outsized personal carbon footprint. Bill Gates has also "turned the sod" for a small, next generation nuclear power plant in Wyoming. See https://www.npr.org/2024/06/14/nx-s1-5002007/bill-gates-nuclear-power-artificial-intelligence#:~:text=Gates%20has%20invested%20%241%20billion,to%20cool%
Also see the final footnote in this article.

[12] Big business funds some scientific research, and big pharma, for example, an amalgam of big business and science, can hardly stay unconnected to government funding as illustrated by a crisis like COVID-19.

carbon producing ocean cruises to Antarctica to observe the breaking of the ice sheets.

One might say that the ultimate irony about the human induced climate change narrative is that the Industrial Revolution, the very thing contributing most to climate change, was an enormous boon to humans, increasing their material well-being manyfold, and their life expectancy dramatically. As if this were not enough, all this happened and continues to happen while the world population grows more than eight-fold since the early 1800s![13] But the cost of this to planet earth and therefore to human well-being is being increasingly highlighted. It seems it is time to pay.

The Place of Science

At least some of the problem of climate change is scientific in nature, because climate change is about the physical world. People need science to tell them, as only science can, if there really is a problem, and if there is, what is it? How bad is it? What can humans do about it? What timeframe have they got to fix it?[14] How will they know if they have succeeded?

Other not mainly scientific questions are: Is the ideal earth a planet whose climate does not change? Can people really define what the planet's "natural" state is or should be? And then there are the very practical questions of engineering, technology, funding, and politics going beyond the remit of science to change or manage climate change.[15] Climate change has not only been an employment and business boon to entrepreneurs and elites but also to employment of scientists and other academics.

A strong voice of science is sorely needed and also to be properly understood in the overall climate change conversation. The testing and verifying of its ideas are underway but, in the nature of the case, takes time. In the meantime, it is important to act on the information available.

What is science?

Science deals explicitly with the physical universe, its solids, liquids and gases, including how these elements operate in living systems. In relation to global climate change, this means it deals with the land, oceans and atmosphere of planet earth.

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[13] See the conclusion for a new twist in this story.

[14] Good science on complex subjects takes years to collect data, analyze, test and verify results, and propose solutions.

[15] A recent book written by a venture capitalist who has devoted more than a decade to climate change issues, is optimistic about the prospect of the human family making the right overall decisions and succeeding, or at least succeeding as well as the human family can (Tom Steyer, *Cheaper, Faster, Better: How We'll Win the Climate War,* Spiegel and Grau, New York, 2024).

There is nothing bigger than land, oceans and atmosphere on planet earth. And all three of these elements are constantly changing and interacting. Climate change must somehow come to an understanding of how all of this interaction has changed over substantial periods of time. The interactivity of these elements is sometimes illustrated by the so called "butterfly effect" which says that the movement of something as insignificant as a butterfly's wings on one side of the planet may have exaggerated consequences on the other side. Any comprehensive model of climate change raises serious issues about starting conditions, unknown exponentials, tipping points, and possible discontinuities to be considered.

The "scientific method" consists of observing a problem or a phenomenon in the natural world, then creating a hypothesis about what might cause the phenomenon. The hypothesis must be tested against real world data so that a theory can be formed. Then the predictive capacity of the theory must be tested against additional real data.

Most of this methodology is practiced also in other fields like the humanities and social sciences. The scientific method distinguishes itself particularly in two ways: 1) by its experimental method and 2) by its subject matter. As to its experimental method, something akin to experimentation is also done in the humanities, for example, by looking at different data sets on the same phenomenon. But there is generally no *manipulation* of factors and variables like there is in scientific experimentation. exploring the world of the explicitly physical, especially with quantifiable, measurable facts. Such things as thought, feelings and ideas,[16] as well as music and art[17] as such, are not generally part of science's remit.

Scientific notions of climate change

People who have lived long lives can usually recount a shiveringly cold winter or series of winters which eventually gave way to something more moderate and "normal" or, even, perhaps, warmer than usual.[18] Similarly, people may remark that they've never heard of a season with so many reported hurricanes. Beside the fact that such remarks are more about weather than climate, they may just represent observation bias or reporting bias. And, in any case, they are not reporting on any

[16] In the last few decades, scientists have explored the neurology of human thought, feelings, and ideas seeking a link between these phenomena and the physical world. Brain activity connected to thought and emotion is quite detectable as electro-magnetic fields. What about the *will to act*? Steven Pinker, a Canadian author working at Harvard has written about this topic. See, eg. *The Language Instinct*, Harper, 2007; *How the Mind Works*, Norton, 1997, 2009; *Rationality*, Penguin, 2021.

[17] Music has a distinct physical element in its physically measurable sound waves, and art has distinct physical characteristics in its materials and colours for example. But by general consensus, describing the physical elements is not the same as describing the music or the art.

[18] This is the "reversion to the norm" talked about by statisticians.

well defined entity nor on anything that has been objectively measured. These observations are of a qualitative nature.

A scientific approach to climate change would need rigorous and quantified definitions of measurable variables. One would expect that there might be any number of independent variables contributing to anything called climate change. And one might hope that climate change itself could be limited to as few as one dependent variable.

While this seems to be too much of a simplification, it is in fact what climate change has been reduced to, at least till a better construct can be reached. The rise of average global temperatures since the beginning of the Industrial Revolution is a dependent variable. The increase of so-called greenhouse gases in the atmosphere is an independent variable. The rise of temperature and gases have substantial support from empirical evidence and known physics. Temperature is a main driver of the movement of air over land and over the oceans. The temperature of air itself depends, partially, on the composition of that air.[19] Some gases comprising the air, like carbon dioxide, trap the sun's heat and will not release it back into space. This is called the greenhouse effect.[20]

The greenhouse effect, then, is a straightforward theory of climate change over time, at least from the beginning of the Industrial Revolution.[21]

Misunderstanding and limitations of science

Modern science stands at significant risk through no fault of its own. This risk is largely because of its enormous success in creating a better world in terms of material well-being and longevity for the human race. Science is constantly

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[19] The composition of the air that humans breath, and how it changes, is not well understood by the general public. Earth's atmosphere consists of about 78 percent nitrogen, 21 percent oxygen, 0.9 percent argon and 0.1 percent other gases. A number of other gases account for this remaining 0.1 percent, with carbon dioxide accounting for only 0.04 percent. Both the land masses and the oceans of the earth absorb heat from sunlight. In turn, some of this heat escapes back to space. If there were no carbon dioxide in the atmosphere, more of this heat would escape, and the world would be a substantially colder place. Carbon dioxide, as small as its percentage of the atmosphere is, is part of a "blanket" keeping the earth warm. But if the amount of carbon dioxide in the atmosphere increases, the blanketing effect also increases compared to historical norms, and the world experiences global warming.
The burning of fossil fuels produces surprising quantities of carbon dioxide. One litre of gasoline, or about .74 kg, produces 2.3 kg of carbon dioxide! This is 1230 litres of carbon dioxide! For those who have some memory of the conservation laws of physics, this seems impossible. What needs to be remembered is that a large volume of oxygen, a component of carbon dioxide, is also consumed in the combustion process. A two-litre automobile engine running at 2000 revolutions per minute, for example, will consume no less than 2000 litres of air *every minute*. (The air supply tubing of such an engine has about 100 times the volumetric capacity of the fuel supply line.)

[20] In light of the law of conservation of energy, if added energy in the form of heat is stored in the earth's lower atmosphere, some equivalent cooling must be present somewhere else. The earth's stratosphere is indeed cooling and this cooling has its own implications.

[21] According to https://climate.copernicus.eu , a European climate change service, the year 2023 marked the first time on record that every day within a year has exceeded one degree Celsius above the 1850-1900 pre-industrial level. Close to 50 percent of days were more than 1.5 degrees Celsius warmer than the 1850-1900 level.

misunderstood, misinterpreted, and misused. Scientific findings are usually technical and need explicitly scientific language to explain. Since the 1750s, science has developed credibility perhaps especially among lay people who may not have much scientific understanding. In the COVID health crisis of 2019 and following years, for example, people looked to science and scientific spokespersons for how to protect against the disease. Science spokespersons were under enormous pressure to deliver consistent and actionable advice. They often seem to have been trapped into giving advice which could not be supported by previous or following science. Science has the capacity to deliver decisive answers and remedies for many things. But the scientific process usually does not move quickly. Experimentation and fulsome testing inevitably take time. By the time a health crisis, for example, has passed through a population, there may be many more studies still to be done to understand fully the elements of the crisis. Because of its meticulous methodology, often science cannot deliver more than partial or tentative solutions when the need for such solutions is most strongly felt.[22]

Considerable skepticism is warranted about every climate change finding. Science itself, in principle, advises serious skepticism especially early on in its search for truth.

Misuse and misrepresentation of science

Science has been active in developing possible solutions to climate change. Solar panels have benefited from developments in the understanding of thin films and understanding the nature of rare earth elements in the periodic table has improved the capacity and efficiency of storage batteries substantially. Aerodynamics has been important in the development of wind turbines, as has hydrodynamics in the development of wave energy. Hydrogen power has involved branches of chemistry.

But since science as science necessarily seeks to be objective and therefore amoral and value free, it is subject to great misuse by naive actors or actors without scruples.

The cigarette industry, for example, used a variety of scientific mean to enhance the smoker's experience of the product. When alternatives to cigarettes were promoted, the vaping industry relied heavily on science to develop new products. One such product called JUUL wound up delivering even more nicotine

[22] In relation to protections against COVID-19, ancient Jewish traditions and health practice collected around AD 200 in *The Mishnah* sound surprisingly modern. Advisories were vigorously promoted in the face of some diseases like leprosy and other maladies: 1) seek and receive an expert diagnosis of a health issue (the priests were not only religious functionaries but managed the health care systems in ancient Jewish society (See NEGAIM 1-10), 2) very frequent and meticulous washing of hands (See YADAIM especially 1:1-4), 3) social distancing (See, for example, YADAIM 3:1).

than a "good" cigarette and achieved enormous business success in a very short time. Several years of intensive scientific work went into this venture. The principals of JUUL, while intent on "getting people off cigarettes" wound up getting large numbers of people onto JUUL which delivered more nicotine than ever. The profit motive wound up driving the scientific development effort completely.[23]

Further, the fossil fuel industry, seen as by far the biggest culprit in the current climate dilemma, relied completely on science to make it what it is. Geology and geophysics are essential to initial and ongoing discoveries of oil and gas reserves underground or under the ocean. Chemistry is essential to many elements of extraction and to all elements of distillation, refraction and refining. Chemistry is completely essential to the development of the myriad of different plastics essential to modern ways of life.

Science, engineering and technology

In the focused construal of the mandate of science above, highlighting the fundamentals, it is clear that it takes something more to make things happen in the real world beyond the facts and the understanding of them brought about by science. It takes technology and engineering to create *working* solutions, it takes business to make *economic* solutions, and it takes social science, regulatory regimes, educational, religious and other institutions, and politics to bring about large-scale *changes in human behaviour*. Engineering has played a large role in western civilization since the Industrial Revolution. In the last several decades, technology, especially digital technology, has asserted its own place and has created the most wealthy and powerful businesses imaginable.[24] Social media companies affect human behaviour in relation to virtually everything and by virtue of this, a whole new power dynamic is operative, in some cases challenging the power of elected governments.[25] Political and moral dimensions are now inevitably in every societal mix.

Attention to all these factors and human dynamics, and probably more, is necessary to change the actual climate of planet earth, an almost unthinkable task.

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[23] JUUL's own Canadian website (https://www.juul.ca/en-CA/signin) puts it this way: "The mission of Juul Labs is to transition the millions of Canadian adult smokers away from combustible cigarettes, eliminate their use, and combat underage usage of our products. JUUL is a vaping product designed for adult smokers."
Note the scientific reference in the company's name and note too that *part* of the company's stated *mission* is *to combat the use of its own products,* in, at least, a segment of the population.

[24] America's ten biggest stocks by capitalization are sufficient, at a 10 percent return, to generate Canada's entire annual GDP.

[25] Consider the influence of Meta on the politics of America.

A Necessary Place for Theology and the Humanities[26]

The humanities

Any action taken by human beings reflects something of a worldview and a value system. In a world as enthralled with technique[27]as late modernity is, questions about values and ethics need explicitly to be asked and answered. Such questions need to be asked earlier rather than later in any technological or political process because they are far-reaching, complex, and deeply critical to human well-being. The state of the humanities in Western higher education is in some peril, and funding for it is disheartening. So far, in climate narratives, questions about justice have been appropriately raised, but this does not cover all the values and ethical questions. As in the case of science, the humanities are necessary, even though insufficient in themselves to answer climate change questions.

The general goal of climate science, to limit global temperatures to not more than 1.5 C degrees above pre-industrial levels, is a value call. Were pre-industrial temperatures ideal? For everyone? For how long? What makes this ideal? The notion that the Western world, with its long history of progressivism, would choose a state 150 years in the past as being ideal is remarkable and perhaps unprecedented in the history of Western civilization. This notion may well be seen as a serious lack of vision or imagination about the future in a post Judaeo-Christian world.

This notion raises the question of humanity's vision for an "ideal planet." Volcanoes are highly disruptive of human societies, but would a planet without volcanoes be more ideal? Lightning causes forest fires and other disasters but would we eliminate lightning if we could? Rockslides, caving of beach heads, flooding of low-lying areas and silting of harbors is deeply troubling to mankind. But they all are the result of gravity. Would we eliminate them if we could? And, even if we could imagine and create a more suitable environment for human beings, do animals and forests not have a right to their own interests as well? The value question is what makes us human. Trivial or superficial answers to such questions are not helpful.

A worldview that does not adequately account for the *natural* catastrophes of planet earth is not worthy.

Christian theology

We must also add that a worldview that does not take full account of human

[26] Since the early twentieth century, theology has been eliminated entirely from the curriculum of most universities in the "new world." The humanities are currently under threat, too, not so much by elimination but by Marxism and woke ideologies.

[27] Consider, for example, the work of the late French sociologist, Jacques Ellul, *The Technological Society,* Knopf, 1964.

nature and the utterly human drive to individual autonomous personal power is not realistic either. In the end, human beings are responsible for climate change. The Industrial Revolution which gave rise to increasing levels of carbon dioxide in modern times has been a boon to human beings, especially in the West, and its gains and its ways of life will be impossible to give up. It will be truly remarkable if a solution to climate change will be made effective without disadvantaging the less powerful. The very long-standing Judaeo-Christian heritage of the West had a deep understanding about why the earth and nature have not been continuously pristine, and why human beings cannot arrive at completely satisfactory and long-lasting answers to the human condition.

The West, having largely abandoned any consciousness of its Judaeo-Christian roots is largely lost in the face of serious challenges to the very continuance of the human race, as Britt Wray's book exemplifies.[28] People are searching for other perspectives. Indigenous cultures are one such offering, especially in the "New World" of North America and Australia. This perspective is found to be attractive by many; this attraction is designated "wisdom."

Christian theology needs a thorough re-think and re-framing of the categories in which it does its thinking. In the early days of Christianity, beginning especially with the creeds of the fourth century, theology became abstract and rationalist. Its categories were inspired by Greek philosophy. The purpose of Christian theology became to develop a cohesive and comprehensive *system of thought* in Platonic style. While it was possible to find in biblical documents, data that would support the various elements of what became the Christian system of thought, the biblical writers themselves would not find much resonance with this approach. The biblical documents are, in fact, a telling depository of just the kind of pragmatic, experimental, reactive, engaged, and narratival wisdom, and ways of life that the world now needs more than ever. This is not to say that a perfect world could be created by human beings. But it is to say that a world that takes fully into account both the "fallenness" of human beings and the "curse," the fact that weeds and thorns also grow in finely planted fields, would be a better and a more reconciled world. The world and the humans living in it need to be redeemed, bought back and brought forward to more perfect natures. But given what human beings are, they are incapable of effecting such a grand purchase for themselves. Humanity will have to look well outside of itself for a better world.

[28] Wray quotes Gus Speth, an environmental lawyer and scientist (p. 15): "I used to think the top environmental problems were biodiversity loss, ecosystem collapse and climate change…I thought that with 30 years of good science we could address those problems. I was wrong. The top environmental problems are selfishness, greed and apathy…and to deal with those we need a spiritual and cultural transformation. And we scientists don't know how to do that."

Organizing Global Power Structures to Change Climate

The process for effecting any large-scale change involves a number of well-known managerial steps.

1. Defining the problem and the most advantageous solution with a measurable target.

Science has already set a number for temperature change.[29] Science believes that climate change can be usefully, though perhaps not entirely adequately, reduced to a single number, namely degrees of global temperature change since the beginning of the Industrial Revolution. Keeping this number below 1.5 C degrees has been set as the target.[30] The solution is to reduce the global emission of carbon dioxide into the atmosphere.

2. Choosing the most effective and efficient means of achieving the goal.

There is an industrial element to achieving the goal and a more individual and personal element. As with many things, conceptualizing the means for something is much easier than activating the means. The means to do this is to convince nations and, ultimately, inhabitants of the globe to reduce carbon emissions. This is perhaps the bigger undertaking that humanity has ever attempted. A comparable undertaking might be staving off nuclear war for nearly 80 years following the nuclear annihilation of Hiroshima and Nagasaki in August 1945. But nuclear war has far fewer players than climate change does, and the stakes are much more dramatic, immediate and obvious.

3. Rallying political support and committing the financial resources needed.

Institutions like the United Nations (UN) and other international bodies are deeply engaged in climate change discussions along with legislatures of many, many countries. This is a truly enormous task because institutional leaders and political leaders are not uniformly convinced about climate change and, more importantly, there is no agreement on how responsibility for climate change should be shared. One argument is that the industrialized countries should shoulder a much greater share of the burden of climate change amelioration since these countries benefitted

[29] How adequate this temperature is remains to be seen. This is a very long term "experiment" and the answers won't be known for decades. In the meantime, it is the best we have.
[30] This may have been exceeded already. There is some talk now of two degrees.

most from the Industrial Revolution and thereby contributed most to climate change.[31]

4. Establishing a regulatory environment for public and private players in the climate change space.

Dealing with global climate change is a new project for humanity. While the goal is at least clearly defined, the rules for achieving it are not. New rules for industry and for the general public in each country are necessary for the project to succeed even partially.

5. Implementing agreed processes, measuring results, and adjusting accordingly.

Politicians who spend huge sums of public money, often money in the form of public debt, are not typically held to close account for results. If climate modification is to be achieved, it must be sustained over a long period of time. Accountability of power structures is essential and course corrections need to be clarified and implemented.

Science, as science, does not have the power nor does it have the authority to effect climate remediation or mitigation on its own. Science can tell us what the problem is and propose solutions. Similarly, the humanities do not have a mandate beyond changing the thinking of human beings, which is undoubtedly a significant part of what needs to be done. It therefore remains for the political structures[32] of the world to authorize and power the technology and the changes of behaviour which are deemed necessary to deal with climate change. While the nuclear bomb threat resulted in the formation of the UN and other international leagues following the Second World War, there were only a small number of players to be managed, most notably the Soviet Union and the USA. Much persuasion is needed to create fairness in global responsibility for climate change. The UN was not built for this challenge.

[31] Every country, without exception, is a contributor to greenhouse gas emissions. China contributes about 30 percent to carbon dioxide emissions, the USA about 15 percent, India 7 percent and Russia 5percent. A quick calculation of pollution per citizen readily changes the look of this picture. Smaller countries who contribute only small percentages may well ask how relevant it would be for them to reduce their footprint even to zero. Canada's contribution is 1.5 percent

[32] These structures are, in turn, made up of human beings who are influenced by all kinds of educational, cultural, and religious factors.

Conclusion

To answer the opening question, science is a hope filled perspective on climate change. But, not by itself. Contributions from engineering and technology are necessary as are perspectives from the humanities, along with the implementing capacities of business and politics.

Most people on the planet are better off, in at least material well-being and longevity than people at the beginning of the Industrial Revolution. And there are eight times as many people on the planet now as there were in 1800. The planet has not been destroyed. It is impressively resilient. But human beings do need to be aware of what is happening to it and seek to ameliorate the negative effects of advanced civilization and increasing population.[33]

Modern science is best placed to give information about the facts of climate change, the amount, the speed of change, and what can be done. Engineering and technology are best placed to produce technical solutions where these apply.

Before implementation of solutions, value choices must be made about choosing alternatives among solutions. The humanities and theology are needed for this choosing.

Implementing solutions for a global problem affecting humans in all countries will require an enormous amount of skilled negotiation and persuasion and the financial and other resources to accomplish it, if it can be accomplished at all. It might be argued that a similar requirement was what the world's nations faced at the end of World War II. But the nations of 1945 and following were severely chastened by the war, and perhaps were more unified in their anxiety to achieve a better life for all than is currently the case.

While pursuing every means possible to limit or reverse deleterious climate change, humans must still find ways to live with ongoing or residual climate change as a worldwide stressor. Wray's book offers some ways of thinking and being. A thorough-going Christian worldview should also be well articulated and seriously considered. The Christian worldview offers not only a narrative of the beginning of the planet, but also something of its teleology and its renewal, along with a clear articulation of human responsibility in an entropic world. Christianity's grand trinity of theological virtues, faith, hope, and charity, answer well to Britt Wray's articulation of climate dread.

Some ongoing questions remain. What will be the result of the scientific experiment in reducing climate change? Has the problem been defined correctly? Is average world temperature the best measure for climate change? Has it been measured accurately and consistently? Is 1.5 C degrees or even 2.0 the right or best

[33] See further below.

number? If the temperature is contained to either of these thresholds, what will humanity see and experience? If the temperature could somehow be brought back to pre-industrial levels would people see less hurricanes, less forest fires, less flooding and less hot summers?

Of special note regarding climate change is the fact that the human population of the planet is on a trajectory to slow its increase and then begin to decline over the following number of decades near the end of the twenty-first century.[34] If this is a good prediction, it is an indication that human beings are already adjusting their deeply held values about children and families in substantial ways. This prediction mirrors the agonies of Britt Wray's very personal journey and illustrates the depth of worldwide concern. Civilizations have come and gone over the millennia. It may be that the current human family on planet earth will wind up rescuing itself, yet again,[35] but perhaps again, just for a time.

Howard Andersen, PhD, Professor Emeritus of Biblical Languages, holds a BSc in Math and Physics from the University of British Columbia and PhD in New Testament Studies from Manchester University. He recently retired as Academic Dean of Northwest Baptist Seminary.

Andersen, Howard "Climate Change and Science: A Hope-filled Perspective?" Northwest Institute for Ministry Education Research. www.nimer.ca (retrieved Date Accessed).

[34] The April 2023 issue of *National Geographic* (pp. 34ff.) dramatized this by showing a curve growing *exponentially* from 1802 with world population of a mere one billion to three billion in 1959, then growing *linearly* from three billion to seven billion by 1974 adding one billion in each of four twelve-year periods. World population then continues to grow but more slowly and then begins actually to decline somewhere between mid-century and the year 2100.

[35] A recent book by Tom Steyer, a venture capitalist and one time contender for the US presidency has its own *triumphal* take on climate change. The title is *Cheaper Faster Better.* The subtitle is *How We'll Win the Climate War.* He, among a number of others, are creating relevant and lucrative businesses and advocacy groups out of climate change solutions. Steyer is aware of what science there is but bases his activism as much on the easily observable material destruction and human suffering caused by hurricanes, floods and other weather phenomena. Not surprisingly, his approach is diametrically opposite to that of Wray. His provocative chapter headings include: "Do the obvious thing," "Know what to know," "Stop rooting for the end of the world," "Redefine smart," "Against footprint shaming," "Kindness doesn't scale," "Measurements make miracles happen," and "Being right isn't everything."