Major Threats to Mankind

Colin Henshaw B.Sc., F.R.A.S., F.R.S.P.H.

North West Armed Forces King Salman Hospital,
Health Studies and Training Centre,
P.O. Box 100, Tabuk 71411,
Kingdom of Saudi Arabia.
CoHenSN1987A@hotmail.com
https://independent.academia.edu/ColinHenshaw

Introduction

At the present time there are several major threats to mankind, and some of these are linked to the current behaviour of the human population. It may sound hurtful, but the general population is basically ignorant, being more concerned with mundane activities such as sport, going to the pub, watching sitcoms on television and basic survival. The latter case is of course understandable, especially in developing countries where getting a job may be difficult, and where educational opportunities are limited.

Ignorance, however, is not just confined to people who have had little education. In their case it is understandable, as one cannot expect a peasant farmer to fully understand the implications of climate change, the threat of earthquakes, or tsunamis in coastal areas. Educated people can also be ignorant especially if their areas of expertise don't not expose them to the dangers that threaten us. We see this with politicians in both democracies and authoritarian regimes, and with senior business executives in major corporations. In many cases they simply don't want to know, and actually go into denial. The forty-fifth incumbent of the White House would be a case in point.

So how do we change the situation? Tony Blair said "Education, education, education," but though this might be desirable, getting the message through to the masses will not happen fast enough to be truly effective. Those that need

educating are those that govern us, so that the right decisions can be made, and made with immediate effect. Talking shops about climate change are having little effect, and the situation is now getting critical.

So let's look more closely at the threats that threaten the world's human population.

These can be listed as follows, and many of them are interconnected.

1) **Climate change.**
2) **The Population Explosion.**
3) **Asteroid impacts.**
4) **Supervolcanoes.**
5) **Epidemics.**
6) **Wars.**

Climate Change

Climate change is the most serious threat at the moment. So what is causing it? The main cause of anthropogenic climate change is energy abuse in all its manifestations. The world is consuming energy at a prodigious rate, and in so doing burning up fossil fuels that release carbon dioxide into the atmosphere. Carbon dioxide is a greenhouse gas that traps the Sun's heat causing the temperature to increase. Unfortunately it is not alone. There are other greenhouse gases being discharged into the atmosphere as well, such as nitrous oxide (N_2O) and methane (CH_4). Greenhouse gas emissions have been increasing since the start of the Industrial Revolution during the Eighteenth Century, but in the late Twentieth Century it has been accelerating to the point where climate is being affected. Increasing global temperatures will result in the melting of land ice, such as glaciers, and the ice-caps in Greenland and West Antarctica. If we just consider Greenland, if all the ice there melted then the sea-level would rise by around seven metres. That would be enough to inundate all our coastal cities, while Bangladesh and the Netherlands would lose much of their land area. Island nations such as the Maldive Islands may well disappear. Climate change caused by global warming would have other effects. Permafrost in Arctic areas would melt, releasing large quantities of methane. Methane, as we

will see later, is at least twenty times more efficient as a greenhouse gas than carbon dioxide. Climate change would initiate a positive feedback cycle, resulting in more global warming and further releases of methane. Warming of the seas would result in the disintegration of methane hydrates on the ocean floor that would release even more methane into the atmosphere. In addition to the melting permafrost and the disintegration of methane hydrates, methane is also released by the millions of cattle that are reared on farms around the world.

When things are heated they expand, and the oceans are no exception, and this alone will contribute to rising sea levels. The effect of rising sea levels will be disastrous to populations living in coastal areas. As sea defences become ineffective, flooding will force entire populations to seek refuge inland, leading to conflicts in these areas as the immigrants compete with resident populations for living space and resources. Rising sea levels will result in a greater mass of water in the oceans, thereby increasing the pressure on the sea floor. This will result in isostatic readjustment that will in turn lead to more earthquakes and volcanic eruptions. If the earthquakes occur under the sea then this will lead to an increase in the frequency of tsunamis that will devastate coastal areas resulting in extensive damage and loss of life. Megatsunamis may result from the collapse of volcanic islands and continental shelves. A notable example was the Storegga Slide 8,200 years ago, that caused the collapse of a 290km stretch of continental shelf off the coast of Norway. A volume of rock with an area equivalent to that of Iceland collapsed into the abyss and generated a megatsunami that penetrated as far as 80km inland in eastern Scotland. It would have devastated coastal communities along the eastern coast of Britain and also Doggerland, which connected Britain to mainland Europe at the time. Evidence for the megatsunami has also been found in England, Norway, Denmark and Greenland.

Climate change has occurred on numerous occasions in the geological past, such as the Palæocene-Eocene Thermal Maximum. During this epoch average temperatures were around 8°C warmer that they are today. The planet was largely ice free, with unique ecosystems found in the polar regions where the Sun would not rise for six months every year. During this period there was a

massive input of carbon dioxide into the atmosphere over a period of about five thousand years. It is the nearest analogue to the anthropogenic global warming we are experiencing today. The causes of the Palæocene-Eocene Thermal Maximum are open to debate. Several possible causes have been cited, including the release of carbon dioxide from coal in terrestrial sedimentary rocks through volcanism in Norway and Greenland (as the Greenland Sea began to open up), and the release of methane from gas hydrates in marine sediments. Around fifty million years ago, during the Eocene period, India collided with southern Asia creating the Himalayas and the Tibetan Plateau. This is an extremely high mountain range the likes of which have rarely been seen in geological history. Erosion of the mountains extracted carbon dioxide from the atmosphere leading an extended period of global cooling. Ice began to accumulate in Antarctica around 45 million years ago. Around six million years ago, towards the end of the Miocene, the Straights of Gibraltar closed up several times resulting in the Messinian Salinity Crisis. The Mediterranean dried up, and enormous deposits of evaporites were laid down in the Mediterranean basin. This extracted salt from the oceans leading to freezing point elevation, encouraging the formation of sea ice at the poles. The Milanković Cycles, (cyclical variations in the Earth's orbital eccentricity and axial tilt) which up till that time had little effect, began to kick in, leading to a succession of glaciations, punctuated by a series of short interglacials when global temperatures were milder. We are now in an interglacial period, at the start of which humans began to settle down and grow crops. The onset of agriculture around 12,000 years ago (though the first tentative steps may have occurred as far back as 23,000 years ago) required humans to clear forests releasing carbon dioxide into the atmosphere, while in the Far East humans began to grow rice in paddy fields that released methane into the atmosphere. Methane, as mentioned earlier, is a very efficient greenhouse gas, and the effect of these gases has extended the length of the current interglacial period.

Recent increases in atmospheric carbon dioxide has led to further global warming, so where is it all coming from? As mentioned above, humans are discharging enormous quantities of carbon dioxide into the atmosphere through the consumption of fossil fuels in order to provide energy. Much of this will be due to vehicle exhaust emissions and energy required for industrial and

domestic consumption. In addition, the clearing of forests continues to make a significant contribution.

However there is one other factor that is not generally considered, and that is light pollution. Our cities are grossly over-lit through street, security, vanity and domestic lighting, and much of this is totally unnecessary and can be eliminated without loss of amenity. Some estimates indicate that as much as 60% of all municipal energy consumption is wasted on street lighting. This does not include lighting from other causes such as commercial and domestic lighting. Municipalities are now trying to mitigate this with L.E.D. street lighting, mainly for economic reasons but unfortunately the introduction of this opens up a whole new can of worms. Much of this lighting is far too luminous for the purpose intended, and is distressing to local residents who have to endure it. As lighting becomes cheaper, Jevon's Paradox kicks in and people can afford more lighting for the original cost of running one. This results in more light pollution, with its concomitant environmental effects, and energy consumption will hardly be affected. Light pollution is increasing by at least 2% per annum, and some estimates have quoted as much as 6%. So, if local and national governments world-wide are concerned about mitigating global warming, then they should cut back on energy wastage. The obvious thing to cut back on is street lighting, which is not an essential civic amenity by any stretch of the imagination. Vanity lighting such as architectural lighting, illuminated monuments, and skybeams should be eliminated entirely as it doesn't serve any useful purpose. We can survive without most of this lighting as humankind has done for countless generations, ever since humans first appeared on this planet. We should appreciate the fact that *darkness at night is normal,* and we should respect it. However some lighting will be necessary, so what can we do to minimise its impact? In suburban and residential areas, it can be motion operated and subject to an 11 p.m. till dawn curfew. The luminaires should be fully recessed into their housings and not exceed a colour temperature of 2,200K (and preferably less, say 1,750K) which will minimise adverse environmental effects and intrusion onto properties. Street lighting is ostensibly deployed because people fear crime and believe it improves road safety. Studies have shown this is not necessarily the case. Where curfews have been introduced criminality had gone down by as much as fifty percent. Lighting lulls drivers into a false sense of

security on illuminated roads, leading them to take less care resulting in more accidents. When all is said and done, cars have headlights, so driving down unilluminated roads should not be a problem. So if street lights are to be cut back how do we maintain standards of safety and security that is a major concern to many people? All-night lighting is only justified in city centres where there is a twenty-four-hour society, and a high volume of vehicular and pedestrian traffic. However, even here street lights can be made dark-sky compliant. As mentioned earlier, in suburban and residential areas, street lights can be motion operated. A motion operated light only comes on when needed. This can also be extended to security lighting. A motion operated light may well be a deterrent to a criminal whereas a light switched on all the time just makes the criminal's job easier. One is safer under a blanket of darkness; criminals will then have to bring their own lighting which will make them easier to detect. On roads generally, there are alternative methods of improving safety without naïve recourse to street lighting. Street lights can be replaced with cat's eyes and other reflective devices, reflective signage, while on motorways, raised crash barriers and baffles on the central reservation can eliminate the glare of the oncoming traffic. These measures are very effective and have the added advantage that they don't consume energy and need little of no maintenance. It's not rocket science. Unfortunately the general population is convinced that more and brighter lighting is beneficial and this myth is promulgated by the lighting industry and municipal lighting departments in order to maximise profits and safeguard their own jobs. The one notable effect of the measures mentioned above is that the environment will become noticeably darker. The detrimental effects of lighting on living organisms are now well established, so this will have obvious benefits to wildlife. Light-at-night exposure is also detrimental to human health by suppressing melatonin production, leading to an increase in breast and prostate cancers in affected areas. If neighbourhoods become totally dark after curfew, then residents will actually sleep better, and their health will generally improve. If people do have to go out, then there is no reason why they can't provide their own lighting by using a torch.

Light pollution, then, is just one aspect of a much larger problem, but it is the simplest to solve. Just cut back on all unnecessary lighting and only retain that which is absolutely necessary.

In addition global warming, climate change has other insidious effects. It is also melting the North Polar Ice Cap which, because of its high albedo, reflects solar radiation thereby helping the cool the Earth. As the ice cap melts, more of the Arctic Ocean is exposed. This is not very reflective, and instead absorbs solar radiation, thereby exacerbating global warming. There will be more evaporation and consequently more precipitation globally. As the ice cap melts, fresh water is discharged into the North Atlantic, which may deflect the Gulf Stream in the North Atlantic. The Gulf Stream maintains the mild temperatures of North West Europe, and if deflected towards Spain and Morocco will result in the onset of extremely severe winters. One scenario posits that if as a result of increased snowfall in winter, there will be so much snow that some of it will persist into the summer and on into the next winter. Subsequent snowfalls pile on top of it and before we know it we have entered the next glaciation. This is all very speculative, but what if….? This will result in mass migrations of population as people from northern countries migrate south to warmer climes. As with rising sea levels this will result in conflicts as the migrants compete with indigenous populations over land and resources.

Consequently, it is essential to reduce the impact of humans on the environment. Unfortunately apart from a few enlightened people, few people seem to care. Most people, governments and municipalities are totally myopic and are only concerned with their own self-interest. They couldn't care less about the future and the welfare of future generations. This has to change. We mess with the environment at our peril, and if nothing is done the environment will pay us back with our own coin and with compound interest, and it won't be pretty.

So how can we mitigate against climate change? A universal culture change will be required in our attitudes to energy usage, especially such forms as night-time lighting. We will need to cut back and eliminate our dependence of fossil fuels, but this will go against vested corporate interests such as those of the oil industry, the automobile industry and the cement industry. We will have to develop more forms of renewable energy. This will mean more wind farms, tidal energy, solar energy, etc. Electric cars have already been developed, but these need to be manufactured in ways that are not detrimental to the environment.

New forests need to be planted to replace those that have already been cut back, and remaining forested areas need to be protected from logging operations. All these changes will require drastic changes in our lifestyles, but we have no alternative.

The Population Explosion

Over thousands of years human populations have been slowly increasing as they colonised new areas. They may well have contributed to the extinction of megafauna towards the end of the last ice-age, though this is still a matter of debate. In recent centuries, with the development of more advanced medicine, many of the limiting factors (diseases, etc.) that kept human populations in check have eventually been overcome. Infant mortality declined, and children now can all expect to live into adulthood. Agricultural practices improved, providing more food, and living conditions improved thereby reducing the risk of disease. With more people surviving, and living long enough to have families of their own, the population began to rise rapidly. This is reflected in the rise of major conurbations, like London, the Mersey Valley, New York, Chicago, Los Angeles, Mexico City, Cairo, Calcutta, Dhaka, Sao Paolo, etc. The total human population has now exceeded seven thousand million, and all these people will need food, water, accommodation, education, and health services.

The needs of the population are taking its toll on the environment, as more land is taken over for agriculture, forests are cut back, and the environment polluted with our own waste products. Most people are oblivious to the needs of the environment, while others couldn't care less, and the effects of this are manifested in climate change. By 2050, the human population will have increased to nine thousand million. This begs the question as to how all these extra people are going to be fed, housed and provided with welfare. Furthermore, there will be so many people on the planet that any well intentioned attempt to mitigate climate change will probably be futile. Some have suggested that regarding climate change we have already passed the point of no return, and anything that we do now will have little or no effect. These prophets of doom, such as Stephen Hawking and Mayer Hillman, have

suggested that we are heading for a major ecological collapse that will decimate human populations globally, if not cause our extinction altogether.

Bacteria growing on a Petri Dish obey what is known as a Malthusian Growth Curve. Populations grow slowly at first as they establish themselves, then they will expand exponentially. The expanding population of bacteria will consume all their food and begin pollute their environment with their waste products. Ultimately the population expansion will stop as the numbers level off. As many new bacteria are now being produced as are dying off. Eventually the Petri Dish will become so polluted with waste products and dead bacteria that a point is reached that the numbers of bacteria being produced does not exceed those that are dying off. The population now declines as the bacterial population enters the death phase. All living things obey the same law, and humans are no different. In the case of humans the Earth is our Petri Dish. Consequently we need to find ways of controlling our numbers. One humane way would be to encourage more same sex relationships. These couples will have opted out of the reproductive process. If enough people enter into such relationships then the remaining population can reproduce at the same rate they are doing now, without increasing the population. They could even reverse it.

Asteroid impacts

Through geological history the Earth has suffered from asteroid impacts. The frequency of these events depends on the size of the impacting body. Impacts by smaller bodies are more frequent than those by larger ones. In recorded history there have been several. Around 3,700 years ago, a possible asteroidal air-burst may have wiped out communities at Middle Ghor in Jordan, possibly contributing to the biblical myth of Sodom and Gomorrah. In 1490, the Ch'ing Yang event occurred in China. It was a presumed asteroidal air-burst, and contemporary accounts report that as many as 10,000 people died, though recent research has not confirmed this. Russia, with its enormous surface area is a large target that has been hit three times since the turn of the Twentieth Century. The Tunguska airburst on June 30th 1908 destroyed enormous areas of Siberian forest, and was the largest impact event in historical times. The

impactor was between 60 and 190 metres across and it may have wiped out a heard of deer and killed two people, though this is not confirmed. Thirty-nine years later a metallic asteroid exploded over the Sikhote-Alin Mountains near Vladivostok on February 12th 1947. Russia was struck yet again on February 15th 2013, when a stony asteroid about twenty metres in diameter exploded over Chelyabinsk, scattering meteorites over a wide area. The explosion of the asteroid caused considerable damage to local communities and 1,491 people suffered minor injuries from flying glass, etc. Another event occurred at Rio Curuca, Brazil on August 13th 1930. These events are probably more numerous than we realise as many of them will occur over the oceans and will not be detected, though orbiting satellites may change this. A high energy air-burst was detected over the Mediterranean on June 6th 2002, between Libya and Crete, and this was attributed to a small asteroid entering the atmosphere undetected. The danger of these is that they may be mistaken for nuclear explosions that could initiate a conflict between nuclear powers.

A major asteroid impact in the ocean has the potential to generate megatsunamis that may cause extensive devastation to coastal areas with enormous losses in terms of casualties, property and infrastructure. Chevron-like dune deposits in southern Madagascar and Australia lead researchers to detect a possible new impact crater, the Burckle Crater, in the Indian Ocean south east of Mauritius. The crater (if that is what it is) is about thirty kilometres in diameter, and is believed by some to have occurred some 5,000 years ago. This explanation has been contested as others who have suggested that the chevron deposits were caused by prevailing winds. However, this does not alter the fact that a major asteroid strike in an ocean would cause extensive devastation, so the threat needs to be taken seriously.

These events, however are minor compared to events that have occurred over geological history. The most notable was the asteroid impact that occurred sixty-six million years ago that marked the end of the Cretaceous period and the start of the Palæocene. This ended the Mesozoic era and initiated the Cainozoic, which is still continuing. An asteroid of somewhere between ten and fifteen kilometers in diameter struck the ocean just off the coast of what is now the Yucatán Peninsula in Mexico. It excavated the Chicxulub Impact Crater that is

about 180km in diameter, triggering a mass extinction event that wiped out the dinosaurs (apart from birds: we can imagine a similar event happening now in which all the mammals became extinct except for bats) and about 75% of all other species. It affected aquatic species as well as those that lived on land, including the ammonites, marine cephalopods resembling the nautilus. No tetrapods weighing more than 25kgs survived, and those that did probably sought refuge in burrows. The Chicxulub event coincided with the eruption of the Deccan Traps flood Basalts in India and it has been suggested that the impact was responsible, though it may have been coincidental. Impact scars across the planet testify to the fact that over geological time these have happened quite often, though they may not all have been quite so devastating.

There have been five major mass extinction events since the Ordivician period:

1) **The Ordivician-Silurian Mass extinction 439 million years ago. Cause: falling sea levels, glaciation, and vegetation extracting carbon dioxide from the atmosphere causing global cooling. Maybe a nearby supernova.**
2) **The Late Devonian Mass Extinction around 364 million years ago. Probably occurred over an extended period. Cause: root systems of giant land plants released nutrients into the oceans resulting in algal blooms that extracted oxygen from the water, killing off animal life. Volcanic eruptions discharging ash possible caused cooling that killed of terrestrial animals.**
3) **The Permo-Triassic Mass Extinction 251 million years ago. The worst of all mass extinctions, killing of 96% of all species, including the last of the trilobites. Cause: the Siberian Traps Flood Basalts, possibly due to an asteroid impact, though this is debated. Carbon dioxide was liberated causing global warming and acidification of oceans. The carbon dioxide encouraged bacterial growth that released large quantities of methane.**
4) **The Triassic-Jurassic Mass Extinction between 199 and 214 million years ago. Cause: asteroid impact and flood basalts leading to climate change.**
5) **The Cretaceous-Palæocene (K-T) Mass Extinction 66 million years ago. Cause: asteroid impact possibly coinciding with the Deccan Traps flood basalts.**

There have been numerous other minor events. One possibility is the Younger Dryas event in which an asteroid is believed to have impacted the Laurentide Ice sheet in North America about 12,900 years ago. This event probably contributed to the extinction of megafauna in North America and also to the decline of the Clovis culture. Another possibility is the Pliocene-Pleistocene marine extinction event that occurred around 2.6 million years ago. However it was not caused by an impact, but by a supernova located 46 parsecs away in the Scorpius-Centaurus OB stellar association. This showered the Earth with high energy muons, and deposited radioactive ^{60}Fe in marine sediments. The radiation from muons would have led to cancers and mutations in larger animals ultimately leading to their extinction. Consequently about thirty-six percent of all marine megafauna became extinct, including the giant Megalodon sharks. To become a major threat, however, a type II supernova would have to occur within 8 parsecs of the Sun in order to destroy half of the Earth's ozone layer, but fortunately there are no near candidates.

If the Cretaceous-Palæocene event had not occurred, the dinosaurs would not have become extinct, mammals would not have diversified, and we would not be here. In fact we could say the same about the other extinction events as well, as they pressed the re-set button on evolution, wiping out existing forms and allowing adaptive radiation amongst the survivors to take over in its wake.

So, impact events are a fact of life throughout geological history. They can and will happen again. It is not a question of if, but when. If we miss the next major impact event through rampant, galloping light pollution enveloping the Earth, then we will only have ourselves to blame. Light pollution prevents the army of amateur and professional astronomers around the globe from monitoring the skies effectively. Professional astronomers have to migrate to remote areas where pristine skies still prevail, but this may not be enough to detect the next major impactor. The dinosaurs and the residents of Chelyabinsk can testify to that.

In the event that a major impactor is discovered, what can we do about it? If the impact is impending, then probably very little. To paraphrase John Pyper-Ferguson in "Drive" (1997), just sit back, stick your head between your legs and kiss your arse goodbye. If targeted by a nuclear weapon, then this may just blow

it up into smaller pieces that will still follow the original trajectory. Instead of one object we now have several, and these may still cause extensive damage. However, if the orbital parameters reveal that the impact will not happen for several decades or centuries, then it may be possible to aim spacecraft to collide with the object, or to explode a nuclear weapon, or a series of nuclear weapons, next to the object, that will give it a little push, thereby changing its orbit. Over time this minuscule change will build up so that it will make up the difference between a hit or a miss. For smaller objects, one can deploy a small gravity tractor. This consists of a spacecraft placed adjacent to the asteroid whose gravitational influence pulls the asteroid, slightly changing its orbit. Instead of striking the Earth, the object will make a close pass and harmlessly go on its way. A third option would be laser ablation, in which a powerful laser is fired at the asteroid, vaporising its surface. The escaping gases will then push the asteroid, again changing its orbit. Consequently it is very important to scour the skies to locate all these potential impactors before they become a major threat. If we have plenty of time to act then the threat can be averted. To achieve this will require an international effort, so nations will have to pull together in order to mitigate the threat.

Supervolcanoes

Volcanic eruptions have caused extensive damage and loss of life over historical time. One of the earliest recorded was the Thera eruption in the Aegean that caused a tsunami that was probably responsible for the collapse of the Minoan civilisation on the island of Crete. In 79AD Mount Vesuvius in Italy erupted and destroyed the cities of Pompeii and Herculaneum, killing around 16,000 people. Around 186AD the caldera at Lake Taupo in New Zealand erupted that reputedly caused spectacular sunsets recorded in Rome by Herodian, and by Fan Ye in China. As New Zealand was not inhabited at the time there weren't any human casualties, but much of the north island was devastated, and deposits of ash-fall can still be seen. The caldera has erupted numerous times in the past and the 186AD eruptions was just the most recent. In 1753 the Laki volcano in Iceland liberating 120 million tons of gas over an eight month period. It killed about 20% of Iceland's population due to famine, caused crop failures in Europe, droughts

in India and famines in Egypt and Japan. In more recent times, Mount Tambora erupted on the Indonesian island of Sumbawa in 1815, killing around 100,000 people. The ash fall-out spread around the Earth causing global cooling, leading to the "Year without a summer" in 1816. This in turn led to crop failures and famines in many countries. In 1883 the volcano on the island of Krakatoa erupted, killing over 36,000 people and generating a tsunami. The explosion was so violent that the island was almost completely destroyed and produced the loudest sound on record, being heard on the island of Rodrigues in the Indian Ocean, and in Alice Springs in Australia. As with Lake Taupo, this was just the latest of a series of volcanic events in this area. In 1902 Mount Pelée on the island of Martinique in the Caribbean erupted, killing 29,000 people in a pyroclastic flow. The capital, St. Pierre, was completely destroyed. In 1985, the Nevado del Ruiz volcano erupted in Colombia, wiping out the town of Armero and killing 23,000 people. There have been several other notable examples.

So volcanic eruptions are a major threat, but they are small fry compared to what can actually happen. Supervolcanoes are much more massive eruptions that have the capability of devastating half a continent, but none of these have erupted in recorded history. The most famous example is Yellowstone National Park, in the United States, which is a well-known tourist attraction with its geysers. However it holds a dark secret that puts much of the western United States under threat. It is the site of a supervolcano that last erupted about 600,000 years ago, spreading ash over as wide area. It was the last of a series of eruptions over the past two million years that erupted with a periodicity of about 600,000 years, suggesting that the next eruption is imminent. However Yellowstone is not the only example. Around the world there are several other notable examples. The Phlegræan Fields outside Naples in Italy is a supervolcano that has erupted several times over the past forty thousand years. In Saudi Arabia the Al Wabbar eruption produced a crater about two kilometers across and 600 metres deep. It was formed in geologically recent times when molten magma from the interior came into contact with saturated rock. The crater is located in an area with established volcanic activity – there are several cinder cones in the vicinity along with localised flood basalts. About 74,000 years ago the Toba caldera on Sumatra exploded sending ash flows right across the Indian Ocean. Some have suggested that the global cooling that ensued

reduced the human population down to a few thousand individuals, resulting in a genetic bottleneck from which we are all descended. However, others have refuted this, as core samples extracted from the bottom of Lake Malaŵi have not shown any evidence of mass faunal change in East Africa at that time. Nevertheless, a supervolcano erupting at the present time would have a devastating effect on the world's population.

Epidemics

Epidemics have been known throughout history and may even have changed it. With modern medicine and standards of hygiene they are no longer considered a major threat, but the possibility that they may recur is ever present. Perhaps the most famous of these are those caused by bubonic plague. This is caused by the bacterium *Pasteurella pestis* that is transmitted by rat fleas. Epidemics of plague have occurred 541-542C.E. (the Plague of Justinian), in 1341 (the Black Death), 1665 – 1666 (The Great Plague of London), and 1855 (the Modern Plague). Mortality rates due to plague are very high. It was estimated that the Plague of Justinian killed about twenty-five million people, or about thirteen percent of the world's population at the time. Amazingly, Emperor Justinian I caught the disease himself, and actually survived. The Plague of Justinian may have reached Britain and expedited the advance of the Anglo-Saxons in the 550s. The Black Death in 1341 is estimated to have killed off about sixty percent of the European population, while the Great Plague of London is estimated to have carried off about 100,000 people. The Modern Plague started in 1855, in China, and caused almost ten million deaths.

The Antonine Plague of 165 – 180 C.E. was recorded by Galen, and it is claimed it caused two thousand deaths a day in Rome and possibly killed ten million people all told. Some believe it was caused either by smallpox or measles.

The Third Cholera Epidemic occurred between 1852 and 1860. It started in India and spread across the world, and even got into the U.K. where it killed off as many as 23,000 people. Cholera is caused by the bacterium *Vibrio choleræ* that is largely spread by the fæcal contamination of water supplies. This was realised by Dr. John Snow in 1854 when he surmised that contaminated water was the

cause of the epidemic around Broad Street in London. He took the bold step of removing the pump handle in the street forcing local residents to obtain their water from elsewhere. As a result the epidemic subsided.

New diseases can pop up all the time, and many of them are zoönoses, originating in animals. A case in point is the Spanish Flu pandemic of 1918 that spread globally and killed more than 40 million people, more than were killed as a result of the First World War. In 1957 the Asian Flu epidemic killed an estimated two million people. Vaccines are now available against flu, but they have to be updated every year. New strains emerge as viruses jump the species barrier from birds (especially chickens and ducks), and pigs. Swine flu originated in Mexico in 2009 and spread globally, and a vaccine was subsequently developed. Corona viruses, most of which are not dangerous, also cause flu-like symptoms, and these have been responsible for a number of epidemics as the viruses jumped species from animals to humans. This happened in the case of S.A.R.S. (Severe Acute Respiratory Syndrome) in 2003, which is believed to have originated in bats. Another example is M.E.R.S. (Middle East Respiratory Syndrome) that broke out in 2016, mainly in Saudi Arabia. The disease is thought to have originated in camels, but it has also been found in bats. How camels acquired the infection is not understood. The infection initially occurred in those who had close contact with camels then they passed the infection on to others.

H.I.V.-1 probably originated in southern Cameroon. Genetic studies reveal that the most recent common ancestor of H.I.V.-1 emerged around 1910, having jumped species from chimpanzees to humans. The disease is largely sexually transmitted, but it can be spread through contaminated blood. Chimpanzees are known to be hunted for bush meat, and someone probably killed a chimpanzee, took it home and cut it up, and the virus entered his body through an open cut. This person then became the first case of H.I.V and would have had sex with the local women infecting them in the process. The disease remained in the local population for many years. It only broke out when overseas travel exposed foreigners to the disease, who then brought it back to their own countries around 1981. However cases of H.I.V. prior to 1981 have been reported. H.I.V. has now spread globally and has killed around twenty-five million people, with

a further sixty-five million people already infected. The epidemic is on-going, but with modern anti-retroviral drugs the condition can be managed and it is no longer the death sentence that it was. Attempts at producing an effective vaccine have so far not proved successful, though work is ongoing.

The Ebola virus causes a hæmorrhagic fever with a mortality rate of up to 90%. Signs and symptoms appear between two days and three weeks after infection. The disease starts with a fever, headaches, muscular pain and a sore throat, that progresses to vomiting, diarrhœa and a rash. The patient may then experience both internal and external bleeding. The disease is highly contagious being transmitted from one person to the next through contaminated body fluids. The virus has been found in bats, which in some African countries are hunted for bush meat. The West African Ebola Virus Epidemic between 2013 and 2016 caused over 11,000 deaths, though the World Health Organisation considers this to be an under-estimate.

The potential for new diseases arising through viruses jumping species to humans is always there. Having not been exposed to these pathogens, humans may have little resistance to them so they may spread rapidly. It also takes time to develop a vaccine, so many people may die before an effective treatment becomes available.

Wars

Wars between different population groups have gone on since time immemorial and can be fought for any one of the following reasons:

1) **territorial gain.**
2) **ideology – religion or nationalism.**
3) **revenge.**
4) **revolutions.**
5) **civil conflicts.**
6) **defence.**

These are all traditional causes of warfare, but what has so far not happened is warfare caused by global ecological collapse. With the potential threat of environmental catastrophes, wars may break out as various populations try to save themselves from ecological collapse. Rising sea levels may force coastal populations to migrate further inland. A sea level rise of only a few metres may have devastating consequences for people living in coastal areas. If they are forced to migrate they will have to compete with resident populations living inland over food, land or resources. These populations may want to conserve these resources for themselves and will see the newcomers as a potential threat, leading to civil conflict, and considerable loss of life.

In the unlikely event of northern countries becoming uninhabitable through glaciation, the populations living there will be forced to migrate into areas further south. This will then put those countries under considerable strain, as they will have no choice but to accommodate entire nations. One can imagine a scenario where millions of Britons, Canadians, Icelanders, Russians, and Scandinavians have to migrate to warmer climates. The infrastructures of the host nations may not be sufficient to support them and conflicts over food, accommodation and resources may again follow. The migrations may actually degenerate into invasions as the migrants will almost certainly be armed, so the indigenous populations will be forced take to arms themselves in order to keep them out. Whatever happens, the situation is bleak and will become very ugly, and it will all be due, on hindsight, to the lack of concern for the future by the entire present day population of the planet.

Conclusion

The threats described above are serious and we ignore them at our peril. Consequently politicians and those in government need to be made fully aware of the problems and the consequences of procrastination. We know what the problems are but talking shops are not effective. What is needed is urgent action. We know what to do and we cannot delay. Whether we have passed the point of no return is debatable; some are pessimistic and think that a major

collapse is inevitable. Others are more optimistic and think we can solve the problems before they get critical. So let's hope they are right.