



The Enlightenment



A Secular Mini-Journal for Inquiring Minds

Volume 1

Number 1

January 2020

The Pale Blue Dot

By Carl Sagan

Look again at that dot. That's here. That's home. That's us. On it everyone you love, everyone you know, everyone you ever heard of, every human being who ever was, lived out their lives. The aggregate of our joy and suffering, thousands of confident religions, ideologies, and economic doctrines, every hunter and forager, every hero and coward, every creator and destroyer of civilization, every king and peasant, every young couple in love, every mother and father, hopeful child, inventor and explorer, every teacher of morals, every corrupt politician, every "superstar," every "supreme leader," every saint and sinner in the history of our species lived there-on a mote of dust suspended in a sunbeam.



The Earth is a very small stage in a vast cosmic arena. Think of the endless cruelties visited by the inhabitants of one corner of this pixel on the scarcely distinguishable inhabitants of some other corner, how frequent their misunderstandings, how eager they are to kill one another, how fervent their hatreds. Think of the rivers of blood spilled by all those generals and emperors so that, in glory and triumph, they could become the momentary masters of a fraction of a dot.

Our posturings, our imagined self-importance, the delusion that we have some privileged position in the Universe, are challenged by this point of pale light. Our planet is a lonely speck in the great enveloping cosmic dark. In our obscurity, in all this vastness, there is no hint that help will come from elsewhere to save us from ourselves.

The Earth is the only world known so far to harbor life. There is nowhere else, at least in the near future, to which our species could migrate. Visit, yes. Settle, not yet. Like it or not, for the moment the Earth is where we make our stand.

It has been said that astronomy is a humbling and character-building experience. There is perhaps no better demonstration of the folly of human conceits than this distant image of our tiny world. To me, it underscores

our responsibility to deal kindlier with one another, and to preserve and cherish the pale blue dot, the only home we've ever known.

What an Amazing Wonder - This Pale Blue Dot How Did Our Planet and We Humans Come To Be?

By Donald Hatch

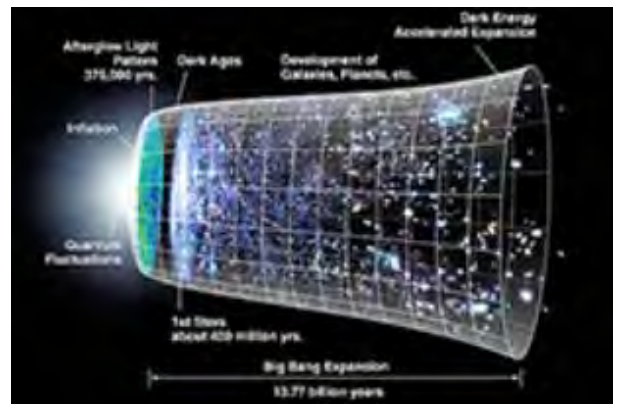
Sitting in my comfortable La-Z-Boy chair in my ninetieth year, I sometimes cogitate about just how lucky I am. I am in reasonable health, have family around me, have all the conveniences one could ask for, can still drive my car and have enough income to keep the wolf from the door. Also, I have complete peace of mind, believing that my short time on this earth is the only life I will ever live, and at some time in the future, my body will return to the earth from whence it came.

So, I wonder, what were the series of events occurring over billions of years that led up to me being born in 1930, enabling me to be able to get an education, establish a career, raise a family and now enjoy a lengthy retirement? As a student of science, I have read that it all began 13.77 billion years ago with a big bang. This prompted me to investigate the major events that happened between then and now, in order to try and get some idea of how it was that I came to be a resident on our pale blue dot during the 20th and 21st centuries. I trust readers will be willing to join me on this explorative journey.

The Universe

Pre-human Times

Immediately after the big bang, the universe was very hot and very dense. As the universe cooled and expanded, complicated developments occurred, little of which I understand. Suffice to say that after about 400,000 years, large quantities of hydrogen and helium and a bit of lithium and beryllium were present, and after about 200 million years these elements began to lump together and form stars. After about 400 million years galaxies began to form and by one billion years many galaxies existed as the universe continued to expand. A spiral galaxy similar to our Milky Way is shown below right.



The 13.77 Billion Year Old Universe

But stars within galaxies do not last forever. After a few billion years they burn out. Smaller stars like our sun turn into red dwarfs, then white dwarfs and finally brown dwarfs. Large stars become supernovas and some may eventually become a black hole. It is from the decaying of stars that the 88 elements, not formed originally in stars, come into being and eventually lump up into planets circulating around a sun. In other words, our planet, and we humans, are made from the ashes of stars. Or, as Carl Sagan has stated, "we are made of star stuff." Admittedly, the foregoing is an over-simplification, but I trust it is a credible summary.



A Spiral Galaxy

Our Solar System - In our solar system the outer gaseous planets of Jupiter, Saturn, Uranus, and Neptune formed first. The terrestrial planets of Mercury, Venus, Earth, and Mars formed later. Our Earth is estimated to be 4.54 billion years old. A detailed account of this 4.54 billion-year evolution is printed below.

Eon	Time (millions)	Description
Hadean	4,540– 4,000	The Earth is formed out of debris around the solar protoplanetary disk. There is no life. Temperatures are extremely hot, with frequent volcanic activity and hellish-looking environments (hence the eon's name, which comes from Hades). The atmosphere is nebular. Possible early oceans or bodies of liquid water. The Moon is formed around this time probably due to a protoplanet's collision into Earth.
Archean	4,000– 2,500	Prokaryote life, the first form of life, emerges at the very beginning of this eon, in a process known as abiogenesis. The continents of Ur, Vaalbara, and Kenorland may have existed around this time. The atmosphere is composed of volcanic and greenhouse gases.
Proterozoic	2,500– 541	The name of this eon means "early life". Eukaryotes, a more complex form of life, emerge, including some forms of multicellular organisms. Bacteria begin producing oxygen, shaping the third and current of Earth's atmospheres. Plants, later animals and possibly earlier forms of fungi form around this time. The early and late phases of this eon may have undergone "Snowball Earth" periods, in which all of the planet suffered below-zero temperatures. The early continents of Columbia, Rodinia, and Pannotia, in that order, may have existed in this eon.
Phanerozoic	541– present	Complex life, including vertebrates, begin to dominate the Earth's ocean in a process known as the Cambrian explosion. Pangaea forms and later dissolves into Laurasia and Gondwana, which in turn dissolve into the current continents. Gradually, life expands to land and familiar forms of plants, animals, and fungi begin appearing, including annelids, insects, and reptiles, hence the eon's name, which means "visible life." Several mass extinctions occur, among which birds, the descendants of non-avian dinosaurs, and more recently mammals emerge. Modern animals—including humans—evolve at the most recent phases of this eon. <i>(Taken from Wikipedia)</i>

The Human Times

Homo sapiens first appeared on the scene about 200,000 years ago, after 3.5 billion years of evolution of life forms on earth. But humans with highly developed brains did not come into being until about 30,000 years ago. This became known as the “great leap forward” theory. The descendants of these early people lived for millennia as hunter-gathers foraging for food, both animal and vegetable. They cooked their food, fire having been discovered thousands of years earlier. It has been speculated that the hunter-gatherers lived happily with plenty of leisure in times when food was readily available. And it is likely that everyone was treated equally, sharing in the food that had been gathered. Hunter-gatherers were also probably the first to domesticate the dog. Were they peaceful people, or did tribal warfare exist? We cannot be certain, but

we do know that North American indigenous tribes engaged in warfare. The hunter-gatherer era in western Asia came to an end about 11,000 years ago with the beginning of the Agricultural Revolution in the area now known as Iraq. It happened in this region because animals that could be domesticated were living nearby. The first domesticated animals (after the dog) were sheep and goats, followed by pigs, cows, horses, and camels. Early varieties of wheat, barley, and rice were also available.

The Agricultural Revolution was not entirely a positive development. If indeed the hunter-gatherers had time on their hands, this leisure disappeared for the masses that comprised 90% of the population. Peasants were forced to work long hours in the fields to feed the 10% who were royalty, aristocracy, and merchant class, as well as for themselves. This situation prevailed for over 12,000 years until the Industrial Revolution was well under way and farm machinery became available.

Villages, towns, and cities began to appear as a ruling class developed. Ownership of land became important and often caused disputes. The mining and smelting of metals came on the scene with tin and copper amalgamated to form bronze. This invention ushered in the bronze age (3000-1200 BCE) followed by the iron age (1200-600 BCE) with the subsequent invention of carbon steel used for making tools and weapons. These were also the years of ancient empires. The Egyptian empire lasted from 3100 BCE to 332 BCE. The Persian from 550-350 BCE. The Greek from 776-350 BCE, and the Roman from 27 BCE to 476 CE.

Special mention must be made of Greece. So much developed there. By 800 BCE an alphabet had been developed, and the writings of Homer are available to us even today. Athens is famous as the cradle of democracy, its impressive architecture (Parthenon), its poetry, drama, and its philosophers, Socrates, Plato, and Aristotle. Euclid was the founder of geometry and Archimedes was an early scientist.

After the conquests and death of Alexander the Great, the Romans began to expand their territory, forming a huge empire that lasted for 500 years. It was during this period that the Christian religion came into being, morphing into the Roman Catholic Church which ruled as a top down oligarchy all through the so-called Dark Ages, stifling the secular democracy, science, and philosophy of the Greeks. But things began to change for the better with the advent of the Protestant Reformation in 1517, and the beginning of the Scientific Revolution, with people like Copernicus (1473-1543), Galileo (1564- 1642), and Sir Isaac Newton (1642-1727) coming on the scene. A new era like no other had begun. An era that has come to be known as the Anthropocene because for the first time in history, the activities of humans have affected the earth's atmosphere and brought about climate change that must be dealt with on behalf of our descendants.

The Last Five Hundred Years – From 1500 Until Now

After the beginning of the Agricultural Revolution, manual labour and animal power were the main sources of energy, although wind was used to propel ships and drive windmills. Eventually waterpower was harnessed to drive mills and factories, but it was after 1800 that rapid changes began to take place. With the advent of improved equipment in textile mills and the invention of the steam engine, the Industrial Revolution was underway. Workers who transferred from farms to factories initially worked long hours, often under undesirable conditions, but eventually unions were formed and conditions gradually improved. Transportation advanced from horses and buggies and stagecoaches to trains, automobiles, and airplanes. Eventually our homes became equipped with a multitude of electrical labour-saving devices. Yes, drudgery has all but disappeared and now only a small percentage of the population lives on farms, and these few stewards of the land capably feed the rest of us. But all these advancements have come with a price. They

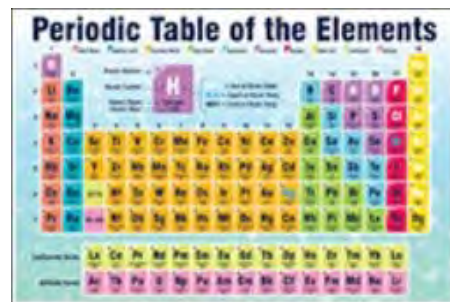
could not have come about without the use of fossil fuels that are now being recognized as a contributor to climate change. Hopefully, common sense and new technology will solve this problem.

None of this relatively rapid transformation could have occurred without amazing advancements in science and technology. The invention of the steam engine has been mentioned. These engines provided economical power to drive factories, steam ships, and locomotives. The invention of the internal combustion engine brought about the proliferation of the millions of automobiles and trucks we see today, as well as providing a power source for heavier-than-air aircraft. Now electric motors have replaced steam engines; hopefully they will soon replace internal combustion engines in cars and trucks as well.

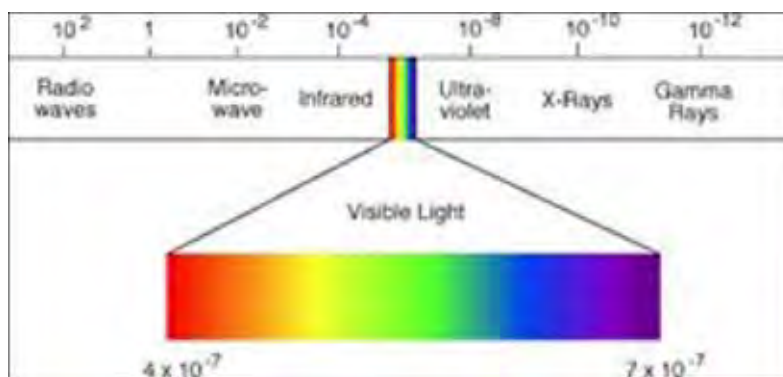
The development of the electric motor and the electric grid deserve special mention. Scientists in the late 1700s and early 1800s discovered a relationship between electric current and magnetism, and this was the start of something truly phenomenal. First, with direct current (DC) and later with alternating current (AC), thanks to Michael Faraday's discovery of electromagnetic induction leading to the transformer, the dynamo, and the electric motor. This, coupled with Nicola Tesla's invention of three-phase power, led to the electric grid and all the electric appliances we have today.

Now I would like to mention two amazing natural phenomena that were discovered in the 1800s and changed the way we live. They are the Periodic Table of the Elements and the Electromagnetic Spectrum.

The Periodic Table of the Elements was first revealed by the Russian chemist Dmitri Mendeleev in 1869. In this table all the elements beginning with hydrogen are listed in ascending order with each element having one more proton and one more electron than the previous one. What amazing symmetry! Knowledge of this table aided the development of the chemical industry which now produces a multitude of chemicals, most of which are beneficial to humanity, although a few have proved harmful and production had to be discontinued.



The Electromagnetic Spectrum is truly an amazing natural phenomenon. It has brought remarkable technologies to humankind. These include radio, television, smart phones, radar, microwaves, and X rays. And of course, the visible light section enables us to see. The spectrum consists of a series of electromagnetic waves, ranging from radio waves having long wavelengths and low frequencies to very short wavelength and high frequency cosmic rays. These radiations can travel through space, and the lower frequencies are used for voice communication and the transmission of pictures. The whole spectrum was not discovered at one time. It took a while before all the pieces were put together. In 1888 Heinrich Hertz proved in his laboratory that it was possible, as predicted by physicist James Maxwell, to send radio waves through the air. The electronic age had begun.



The Electromagnetic Spectrum

The whole spectrum was not discovered at one time. It took a while before all the pieces were put together. In 1888 Heinrich Hertz proved in his laboratory that it was possible, as predicted by physicist James Maxwell, to send radio waves through the air. The electronic age had begun.

Me

I believe I have provided a fairly realistic summary of how it is that, 13.77 billion years after the big bang, I am able to live comfortable in my home, surrounded by conveniences that are the results of the ingenious minds of scientists, inventors, technologists, engineers, and others. But how did it happen that I personally arrived on this third rock from the sun, that sits in the so-called goldilocks zone 93 million miles (150 million km) from the sun, on May 20, 1930, in Guelph Ontario Canada? Yes, I am fortunate to be a Canadian.

I know from family tree research and DNA testing that my roots go back principally to England, with a bit of Scottish influence thrown in. My mother's immediate ancestors came to Canada in the late 1800s and my father's grandparents and parents arrived in Canada in the early 1900s. My mother was born in Guelph, Ontario in 1905 and my father in Fergus, Ontario in 1907. They were married in 1929. I was the first born. Thus, it would follow that I am the chance result of untold numbers of copulations that go way back to the long history of the British Isles and who knows, likely to hunter-gatherer days as well.

My life began sometime in 1929 as a zygote formed in my mother's womb after the union of my mother's ovum and my father's sperm. This zygote divided countless times until I was born as a fully developed conscious human being. To me this is a miracle, and I state without fear of contradiction: *the development of a human being in a mother's womb is the greatest miracle in the universe*. How is it that DNA from two parents contains the instructions for forming bones, muscles, limbs, organs and, above all, a complicated amazing brain? A miracle? Yes indeed! Surely the birth of a child is sacred in a secular sense, and surely it should be the aim of all humanity to guarantee that every new-born child in the world is provided with clean air, potable water, food, clothing, and shelter. What a laudable challenge for humanity to strive for.

So, here we are, humans sitting at the top of our world's animal kingdom. We have the ability to learn and speak languages, to reason, to make decisions, to feel emotions like love, compassion and forgiveness, to enjoy the company of others, to invent and create, to build things, and to enjoy the wonders of nature and the arts. Lots of good things to be thankful for.

But there are also bad and even evil things. Humans can be greedy, lazy, hate others, especially those not like themselves, destroy things and go to war, degrade the environment, and ignore warnings about climate change. The need for improvement in the way some greedy and destructive people behave is obvious.

We know that the human brain has evolved to its present state over millennia, enabling the majority of people to live ethical and moral lives, so is there any reason not to think that the human brain will continue to evolve and result in individuals being less greedy and less inclined to go to war? We can hope so.

Today we are facing a new revolution. It is called the Digital Revolution with the coming reality of artificial intelligence (AI) that we must learn to use for the benefit of all humankind, not just a few. We are living in turbulent times with increasing populism and even oligarchy at the expense of democracy, and it will require clear-thinking leaders with intelligent brains to guide the future of humanity toward a better world on our precious blue dot. I hate to end on a negative tone, but I see very few such leaders in sight.

Before concluding, I must say that it would have been impossible to compose this *Enlightenment* without extensive use of Wikipedia. For a number of years, I have been making an annual donation to Wikipedia, and I urge all readers who make use of Wikipedia to do the same.