Preserve Planet Earth:
Why bother?

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Preserve Planet Earth (PPE) was the Rotary International theme in 1990. Many clubs have created PPE committees that work on environmentally related issues under the umbrellas of Community Service or World Community Service. This is really a much larger issue, however, and the purpose of this presentation is make that case.

There is a historical progression of new bits of information about the human context that is not really in the public domain. The failure of our education system to incorporate this information effectively into the basic understandings of all students is partly responsible for some of the major problems affecting humanity today.

This is pretty straightforward.

Carrying capacity is the ability of an area to support a particular number of organisms at a particular level of consumption.
Non-renewable resources are mineral deposits and energy resources such as oil, gas and coal.
Renewable resources are such things as forests, fisheries, and agricultural lands.

In this context “heresies” are those discoveries that, when first presented, were denounced because they disrupted the prevailing world-view. Subsequently, the truth of these “heresies” was vindicated.

The historical progression is important, because the final conclusion depends on understanding the steps along the way. Each step builds on its predecessor.

The reader needs to “stay loose” as the story progresses.

This example of the first “heresy” is one no longer disputed by anybody. It took a century for this idea to be accepted and folks were burned at the stake for supporting Copernicus’ ideas during that century.

It is now clear that we are passengers and crew on a spaceship with limits to its habitable area and resources. Non-renewable resources will ultimately disappear for all practical purposes; renewable resources can be abused, and may be permanently lost, by over-exploitation.

Some folks are still struggling with this world-view, but the evidence for a different world-view is clear and straightforward.

Siccar Point, Scotland

This spectacular exposure on the SE coast of Scotland is the place where modern geology became a science. James Hutton, a member of the Scottish Enlightenment, was looking for a place where he could see the relationships between a series of gray bedded rocks tilted at various angles in the surrounding countryside, and nearly horizontal red rocks also found in the area. He suspected that there was more to the story of Earth's history than would fit in 6,000 years.

He convinced an Enlightenment colleague to join him in a boat to explore the coastline and came upon this exposure. It was a Eureka! moment because he saw the clear evidence that the Earth had a history vastly greater than human history, and this started the modern science of Geology.

Two views of Hutton's discovery site.

The gray sedimentary rock layers here are nearly vertical, and truncated by overlying red rocks. The basic first-grade principles of original horizontality – sedimentary rocks (made from sand, mud, gravel, etc.) must originate in nearly horizontal layers – and superposition, the logical conclusion that in any stack of layered rocks, the oldest layer is on the bottom were already known.

Also, the processes necessary to understand the story were known – deposition of materials, deformation from original horizontal attitudes, and erosion, which wears down the countryside and produces the current landscape. Knowing only those two principles and the three processes, the six events listed on the right are required, in historical order from 1 to 6, to explain the history of this area.

The vertical layers had to have been deposited as horizontal layers (1); they were deformed to a vertical position (2), erosion produced a new land surface across their upturned edges (3); the nearly horizontal red layers were deposited on this new surface (4); these were slightly deformed because they are no longer horizontal (5); and subsequent erosion (6) produced the modern landscape, which is the only piece of the story experienced by modern humans.

To Hutton this was irrefutable evidence that Earth had a history, and there was "no vestige of a beginning, no prospect of an end" – there had to be an older landscape on which the now-vertical layers had been deposited, and what before that? and the sea was wearing away at this exposure, what of the future? This was the discovery of what John McPhee calls "deep time".

So, a second “heresy” that is a truth. Nobody had any idea how much time was involved at that time, just that it was vastly more than 6,000 years inasmuch as Hadrian’s Wall, from Roman times, was built on top of the red sandstones on the present landscape.

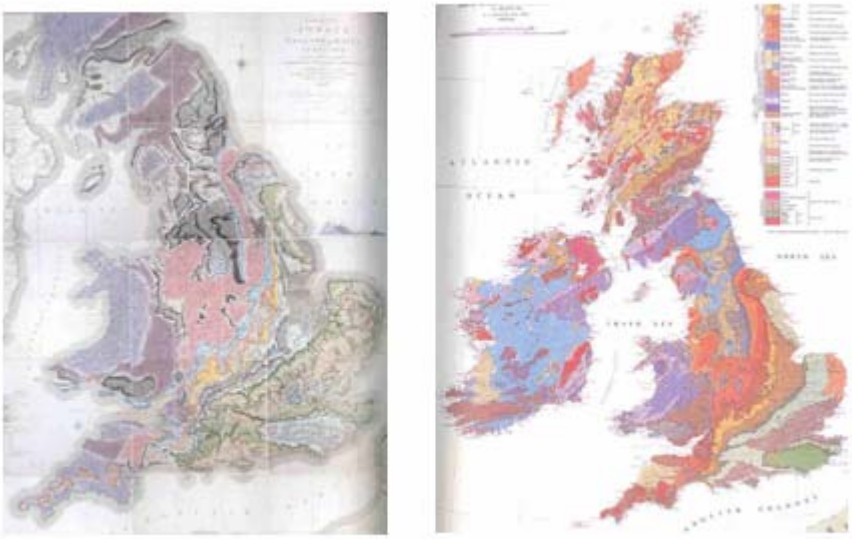
Once the evidence that earth had a history was accepted, the question of “How long?” could be addressed. It took nearly 100 years before the essential discoveries to answer that question were made, and another 50 years for technology to make develop the tools to obtain numerical ages at reasonable cost. The science of developing those numbers is Geochronology.

First, naturally radioactive materials were discovered. Then the rates of radioactive decay and the resulting products had to be identified, and the fact that these rates are not affected by natural processes had to be established.

The initial discoveries of radium and uranium were soon supplemented by several other unstable elements. The chemistry to identify and extract precise measurements of both the parent radioactive element and the stable daughter element of that decay (uranium to lead, for example) had to be developed. Minerals that contained the radioactive elements within their crystalline “box” had to be identified and extracted – usually these are found in rocks like granites that crystallized from a molten mass. As long as those mineral “boxes” were undisturbed after they crystallized (i.e. not re-melted or badly weathered), then the ratio of daughter to parent, if the rate of decay was determined, would allow a numerical age for that mineral to be calculated.

To do this chemistry efficiently had to wait until the development of mass spectrometers about the time of WWII. In the past half-century, hundreds of samples have been dated, often cross-checked because different minerals in a granite with different radioactive elements had to give comparable ages. Using geological principles such as superposition to determine relative ages also helped to keep the system “honest”; numerical ages had to be in the same order as the geological evidence suggested. We have now found rocks on earth that are at least 4 billion years old. Meteorites and moon rocks show the solar system to be 4.5 billion years old. The universe is older -- 12-15 billion years!

Back to the historical progression. The next bit of evidence came with the idea of creating a geological map.



1815 1969

Geological Map of England (William Smith)

William Smith was an engineer creating an east-west canal across southern England. He boarded in landowner's homes in rural farming areas near his work sites. The canal was being dug through sedimentary rocks with the layers tilted downward gently toward London to the east. Thus, using the principle of superposition, the layers became older in a western direction. Many were fossiliferous and the often pretty fossils were collected as curiosities by the landowners on their farms.

Smith realized that he could tell which layers in his canal yielded similar fossils and realized that he could make a map showing where those layers intersected the present land surface. By 1815, using horse and wagon, he had roughed out a geologic map of England and Wales, with colors indicating different relative ages.

The remarkable accuracy of his map is shown by comparing the images above. Using the principles of superposition, the oldest layers he found were in Wales, where the fossils they contained were totally unlike anything found today. Western England had fossiliferous rocks with mostly unfamiliar forms although things like snails and clams were recognizable, and the layers near London on the east contained shells and bones that looked little different from modern forms. On closer examination, few fossils actually had precise modern counterparts, but the evidence was clear – life on Earth also had a history; the communities of organisms on the planet had changed through time.

This is fairly self-explanatory. The testing is a normal part of the scientific process. By looking at rock successions in mainland Europe, and ultimately in eastern Asia, North America, and wherever fossiliferous rocks could be found, the same general successions of changing communities were found in

the same general historical order. This was the “hot science” of the early 1800’s.

The historical pattern of change applied to the whole planet and was reliable. This much was known by the time the first textbook of geology was created, by another Englishman – Lyell – in 1830.

The next scientific question to be addressed was “Why did the communities change?” Life as we know it today is clearly at the end of a long progression of increasingly different communities as we go backward through time. It was not the product of a single creative event at the beginning of time.

Thus, another “heresy” that is really a truth. – life on our planet also has a history. This discovery led to the development of what we now call evolutionary biology.

The process of learning more about the history of life and changing communities begins when Darwin is given a first edition of the geology text to read on his voyage as a naturalist on the Beagle in 1831. He accepted the convincing evidence that communities on the planet had changed through time, but why? He had bred dogs and pigeons and knew how to create change artificially, so he wondered if a natural process could do this, now that a vast amount of time for Earth history had been recognized (although numbers were not yet known). He noted that all individuals in any animal community were not identical and he conceived the idea that perhaps a process of natural selection, given enough time, could select those better fit for changing conditions (or lucky enough to survive local disasters) and thus bring about change. This was the basis for his theory of evolution. It grew from the earlier recognition that Earth had a history and that life on Earth also had a history.

Any good theory is reinforced by the discovery of new facts unknown to the proposer of the original idea.

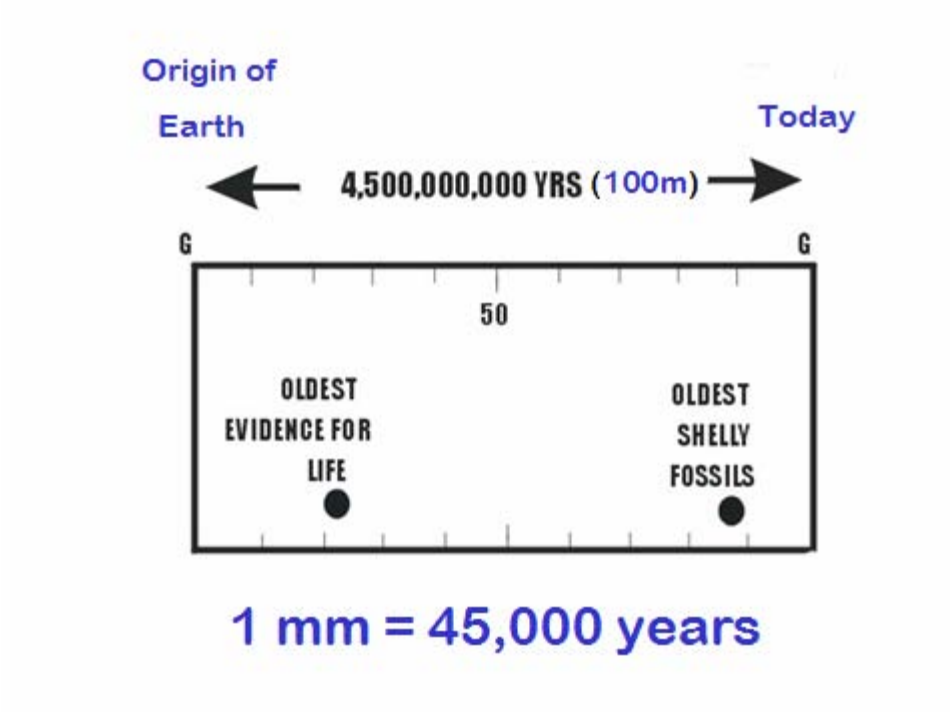
Genes, which explain variability within populations, were first discovered by the monk Gregor Mendel when experimenting with peas. His paper was largely ignored until they were rediscovered in the early 1900’s by workers experimenting with fruit flies. At that time, nobody knew anything about the chemistry or molecular structure of genes. It took another 50 years before Watson and Crick discovered the double-helix structure of DNA and started the modern biological revolution. This is at the core of all modern medicine and molecular biology.

It is now known that we share genes with mice, lizards, bacteria, etc. and they produce the same or similar proteins and other organic molecules, and sometimes are involved in production of the same structures (limbs, eyes, etc.) in these organisms. At the molecular level, all modern organisms are interconnected to some degree. Some fossils also retain scraps of DNA, and thus the historical record of life is all interconnected at the molecular level.

Life, in the grandest sense, is part of a historical continuum, with no clear vestige of a beginning and no clear prospect of an end.

We thus can add another “heresy” that is clearly a truth. But how do we fit in?

We now know the age for our planet. If we scale this to a soccer field (100 meters), one millimeter (the thickness of your thumbnail) represents 45,000 years. On our “ruler” we have geological evidence that life, in the form of simple bacteria or other single-celled creatures, has been around for at least 3 billion years. The earliest shell-bearing fossils, like those found by William Smith and his colleagues in Wales are only slightly older than 500 million years. Lets look at the record of humans.



Now another area of science comes into play. Archaeologists have determined that the oldest skeletally modern humans (Homo sapiens) are about 200,000 years old. This would be about 4 mm on the soccer field of Earth history. But lets enlarge just that last millimeter, representing 45,000 years. By 15,000 years ago, humans were all over the planet – on all continents and most large islands – but until 10,000 years ago they were all hunter-gatherers, living in dynamic balance with the rest of the environment. Then we invented agriculture and began to exploit the planet’s natural resources, creating cities and cultures and leading to where we are today. All of that “modern” cultural history is in slightly less than ¼ of a millimeter (a blade of grass) on our soccer-field “ruler” of Earth history.

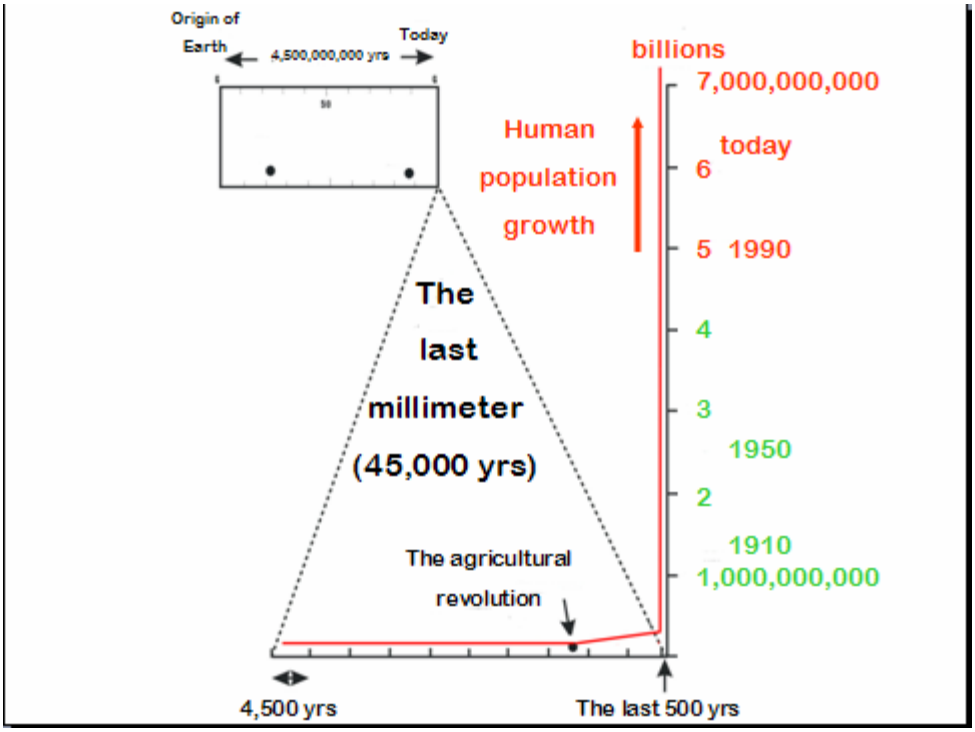
We can now add two more “heresies” that are really truths.

It is clear that humans are (or were) a fundamental part of Earth's ecosystem and are a part of the interconnected continuum of ever-changing life that stretches back at least 3 billion years. We are not, in the literal sense, special creations.

Lets look at one more critical aspect of human history.

There's good reason to worry about the present state of the human enterprise, but the news is not all bad. However, we'll start with that.

Lets show, on the history of that last millimeter, the human population curve. Until the early part of the 20th century, the global human population was well below 1 billion people.

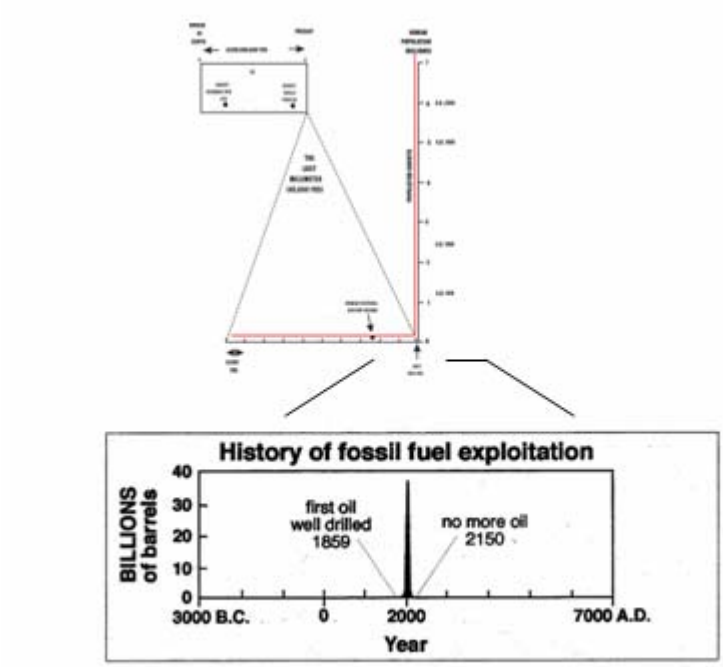


We passed the billion mark by about 1910, we were at 2.5 billion by 1950, we passed 5 billion by 1990, we are currently at about 6.2 billion, and by 2050, the latest medial estimate for global population is about 9 billion. On a geological time scale, population growth is a rocket!!

The green numbers represent the probable optimistic figure for the long-term carrying capacity for humans on this planet at some reasonable quality level of life (that's about the population of 1970). And remember, we are all crew on Spaceship Earth – there is no place else to go. At the present population size and a current growth rate of 1% a year, population is increasing at about 200,000 net new people every day!

Now, one additional cause for worry.

Below the population curve, also on a 10,000 year scale, is the energy "window".



We drilled the first oil well in 1859 and we will be out of oil for all practical purposes by 2150. The peak of global oil production is sometime between now and 2040. We began using coal a bit earlier and the world supply may last another 200 years, but on the 10,000-year scale, that spike would only be a little bit wider. Notice that the spike coincides remarkably with the population rocket. What's going to happen to population when this energy source, which makes our current global economy possible and literally fuels our cities, is no longer available?

The news is not totally bad. There is hope.

We know from the fossil record that there have been several major crisis events in the history of life. The last big one was the wipeout of the dinosaurs and much other terrestrial and marine life about 65 million years ago. There were four comparable earlier events. On our soccer-field "ruler", where 10,000 years is a blade of grass, the loss of species in the last 10,000 years, largely due to human activities, is comparable to the wipeout at the time of the dinosaurs. We are in the midst of the next great extinction.

The good news is that those extinctions were not complete. There were survivors, and the global communities of organisms were re-built, changed, but richer in variety. There were basically no flowering plants, very few birds, relatively few modern fish, and only a few small mammals before the wipeout of the dinosaurs. Thus, although things may be a mess in this century, there will be a substantial number of human survivors – remember "blessed are the meek, for THEY shall inherit the Earth". If we learn anything

at all from this experience, then we may end up with a more humane world for the 22nd century.

There is a message to come from this analysis of the evidence for the human context that points the way for the future.

Note the remarkable parallel to what Jesus said were the two greatest commandments. In Matthew's Greek and in the Hebrew words from the Torah that Jesus quoted, the words we translate as "love" have the clear connotation of meaning "care for", or "care about".

Thus, honoring our ecological context means to care for all of "God's creation" with all our hearts, minds, souls and strengths.

And living within the limits of our renewable resources in a way that will allow a reasonable quality of life for all humans, means that we really care for our "neighbors" as much as we care for ourselves – a core teaching of most of the world's religions.

This will require some serious re-thinking of our current world-views, a critical change in attitudes, and a collective effort on the parts of all of us to get through this century as humanely as possible.

This is our challenge today.

The future for our grandchildren and their grandchildren, and for the human enterprise is at risk. Many of us who are now retired or close to retired are probably "home free".

BUT, through the leadership skills represented in this great organization of Rotary we can begin to make a difference now in how we view our world and how we might achieve a sustainable future for all humans.

We have the option of choice. Choosing to do nothing may be our most dangerous option.