

APPENDIX D

MOTHER EARTH CAN BE A CHALLENGE

Mother Earth is not static. She is restless and dynamic. She has no respect for life, or mankind. She blindly obeys the Laws of Physics and Chemistry. Mother Earth's forces are millions of times more powerful than those of man. Man has the power to destroy life in local areas and we should take every reasonable precaution to insure future generations have the beauty of nature that we enjoy. But man must not be so naive that he thinks he can control the way Mother Earth behaves. The naive will only waste their assets on a fool's mission!

Continent Formation. The Earth recycles its continents about every 500,000,000 years, forming a supercontinent, and then eventually breaking apart. (A supercontinent is a single continent that includes all of the land above the ocean.) In the past 3.6 billion years, geologists have traced the formation of 7 super-continents that they named: Vaalbara, Ur, Kenorland, Columbia, Rodinia, Gondwanaland (Pannotia), and Pangaea. (See *Supercontinents*--Wikipedia.)

Breakup of the last supercontinent, Pangaea, into various plates allowed the formation of North America, South America, Eurasia, Africa, Antarctica, Australia, Madagascar, India, New Zealand, and Greenland. It resulted in the formation of the Atlantic Ocean, the Indian Ocean, and the Japanese Sea, as well as the formation of the Appalachian Mountains, the Alps, and the Himalayas over a period of time.

The Earth's present crust consists of 8 large and 20 smaller tectonic plates. These plates slide on the athenosphere, which is 1% molten, and acts as a lubricant over the hard, but viscous, mantle.

Ocean Floor Recycling. The ocean floor totally recycles itself about every 200 million years, by one plate being subducted under another.

Ice Ages. Ice ages were thought to have started about 2.7-3.3 billion years ago. There were 4 **Major** Ice Ages between 750 and 580 million years ago. The worst, about 600 million years ago, resulted in permanent sea ice, one-half mile thick, forming almost to the Equator (Neoproterozoic period). The Earth became a virtual "Snowball" and remained so for tens of millions of years, according to some experts. Volcanic eruptions, increasing CO₂

levels to 350 times our present level, are credited with reversing the ice age, driving the average Earth temperature to ~120F. Some scientists say it took tens of millions of years to recover, others say that only 10,000 years of heating was required. This period was followed by a resurgence of life (Cambrian Explosion), and led to the first appearance of multi-celled animals in 11 major phyla between 600 and 500 million years ago.

Ice Age Cycles (Glacial Periods). (The following information is a summary of information found in the Ice Age section and may be skipped if you read it). Figure 12 on page 34 shows four glacial periods in which Ice Age Cycles took place. These occurred between 470-425 million years ago (mya), 325-270 mya, 175-110 mya, and 50 mya to the present. The ice-age cycles are followed by “interglacial periods” during which the Earth recovers and warms up. It takes up to 90,000 years to make an Ice Age, but only about 10,000 years to destroy it. This is because, during warming periods, the ice sheet melts from the top. During cooling periods, cold water sinks, driving warm water to the surface during the formation of ice sheets, and hence, cooling of not only the surface, but deeper water, must occur.

During our last Ice Age which ended about 20,000 years ago, glaciers, typically 1.2-1.8 miles thick, covered Northern United States, Canada, Europe, and Western Siberia. By 12,000 years ago, half of the ice had melted and carved out the Great Lakes, the Finger Lakes in New York, and tens of thousands of lakes in Minnesota, Wisconsin, Michigan and Canada. Debris from the ice age formed Long Island. Warming has been occurring for the last 11,000+ years, with a few minor reversals, such as the “Little Ice Age” which occurred in the 16th century. (See Figure 2, page 17.)

Hurricanes and Tropical Storms.

The average hurricane has the energy of about 8000 megatons of TNT per Reference 2, page 97. Reference 6, page 281, quotes the energy of the average hurricane at 1 million megatons! (The largest hydrogen bomb is on the order of 50 megatons, which is 3850 times that of the Hiroshima atom bomb.)

Hurricanes result in severe winds and heavy rains, often heavier than an area can accommodate. Record rainfalls recorded from tropical storms are those in La Reunion Island in the Indian Ocean (Reference 2):

<u>Duration</u>	<u>Inches</u>	<u>Location***</u>	<u>Date</u>
12 hours	45.00	Foc Foc	1/7-8/1966*
24 hours	71.80	Foc Foc	1/7-8/1966
48 hours	91.10	Aurere	4/8-10/1958
72 hours	127.60	Grand-Ilet	1/24-27/1980**
10 days	233.50	Commerson	1/18-27/1980

* Cyclone Denise

** Cyclone Hyacinthe

*** I can't locate these names on La Reunion Island in the Atlas, so I think they must be local posts.

The ten most intense storms to strike US from 1900-1994 had between 26.35 and 27.49 inches of rain. Alvin, Texas, on 8/1/77 had a US record of 43 inches in 24 hours (not associated with a hurricane). Hurricanes are accompanied by **storm surges** which turn out to be extremely devastating. Storm surges in the US can reach 20-25 feet. Storm surges as high as 40-42 feet have been recorded in other parts of the world. In 1737, a storm surge in the Bay of Bengal (40 feet) drowned an estimated 300,000 people.

For more information on US hurricanes, see Section I on page 37.

Tornadoes. Tornadoes occur along cold fronts, where warm air is rising and condenses into a line of thunderstorms (squalls). The energy liberated by the water condensation fuels the cyclonic low. Tornadoes move parallel to the cold front. Highest winds are measured in the 250-300 mph range. In a typical year, 750-800 tornadoes touch down in US, mostly in the middle part of the country (Texas, Oklahoma, Missouri, Kansas, and Ohio).

Though tornadoes can be devastating, the average tornado has the energy of only 200 # of TNT or about 1/1000th that of the average thunderstorm (Reference 2).

Volcanoes. Volcanoes occur at the intersections of tectonic plates. Between 800 and 1500 volcanoes have erupted in the past 10,000 years. At any one time, 8-12 volcanoes are erupting world-wide. Major eruptions can change the world's climate for up to ten years because of the particles and sulfuric acid droplets thrown into the upper troposphere and stratosphere.

The Laki volcano erupted in Iceland in 1783, killing 9000 Icelanders, releasing 3 cubic miles of lava and 120 million tons of sulfurous gas. This changed the rainfall patterns in Egypt, weakened the seasonal rains in Africa

and India, resulting in massive drought and famine in Egypt, India, and Japan. Japanese rice crops were devastated and up to 1,000,000 died. Egypt lost 1/6th of its population due to famine while thousands died in Europe. North America experienced the coldest winter on record (an estimated 8.6 F drop in temperature.)

In 1980, Mount Saint Helens erupted throwing out 0.12 cubic miles of debris (275,000,000 tons of Earth) and 20,000,000 tons of SO₂. In 1991, Mount Pinatuba erupted, shooting 2.5 cubic miles of debris into the atmosphere (20X as much as Mount St. Helens). The debris cloud remained in the atmosphere for 3 years and a 1°F temperature drop was recorded world-wide. In 1883, Krakatau erupted in Indonesia, blowing 6 cubic miles of debris into the atmosphere. The shock waves circled around the world for 5 days. The energy of the explosion was equal to 200 million tons of TNT.

Supervolcanoes. In the past 2 million years, 4 supervolcanoes have erupted, spewing out more than 180 cubic miles of magma in a “single” explosion;

<u>Location</u>	<u>Years Ago</u>	<u>Volume of Debris</u>
Yellowstone, WY	640,000	240 cubic miles
Long Valley, CA	760,000	180 cubic miles
Mt. Toba, Sumatra	75,000	672 cubic miles*
Mt. Taupo, N.Z.	187	280 cubic miles

*Reference: Wikipedia—Mount Toba

The Mount Toba eruption was 5600 times larger than the Mount Saint Helens eruption. During a one million year period in Siberia, enough lava flowed to cover the entire area of the Earth with lava approximately 10 feet deep.

Ocean Rise. The oceans sea levels have risen and/or fallen by a total of 1300 feet in the history of the planet (Reference 5). Since the last ice age 20,000 years ago, melting glaciers have lifted sea level by 394 feet. That’s not very pleasant if you have a home along the coast! The continental shelf was flooded in the process!

Earthquakes/Tsunamis. Earthquakes occur due to tectonic plates sliding by each other or the subduction of one of the plates. These can result in tsunamis like the one near Sumatra, Indonesia, in December 2004 where the tsunami drowned more than 226,000 people. Earthquakes kill many people, especially in areas where housing is marginal. In Tangshan, China, in 1976, 255,000 perished in an earthquake registering 8.0 on the Richter scale. In 1556, in Shaanxi, China, 830,000 perished. There are 9 different earthquakes in recorded history in which 200,000 or more people have perished (Reference 9).

Floods. When rivers overflow, it can be disastrous for those in the vicinity. *The greatest loss of life ever recorded in a single flood was the loss of 3,700,000 Chinese in August 1931 with the overflow of the Yangtze River (Reference 9).*

Major Atmospheric Changes. The first atmosphere on earth was nearly 100% carbon dioxide at over 1600 psi pressure, having roughly 300,000 times the CO₂ levels we experience today. The carbon dioxide dissolved in rain water, forming carbonic acid and reacted with the silicate minerals to form carbonates, gradually reducing its pressure. Soon after the Archae bacteria formed on the Earth, they were able to react CO₂ with hydrogen to generate methane and the methane content in the atmosphere rose significantly.

About 3.3-3.5 billion years ago, cyanobacteria started photosynthesis, converting CO₂ and H₂O into glucose (C₆H₁₂O₆) and oxygen (O₂). Over the next 2 billion years, the current atmosphere, containing 21% oxygen, emerged and allowed for multi-cellular animal life to exist.

Mass Extinctions. The Earth has undergone at least 6 major mass extinctions in the last 600 million years, in some cases, wiping out 70% of the species. These occurred at Cambrian-Ordovician transition, the Ordovician-Silurian transition, the Devonian-Carboniferous transition, the Permian-Triassic transition, the Triassic-Jurassic transition and the Cretaceous-Paleocene transition. (Reference: Wikipedia—*Mass Extinctions*). Over 99% of all species that existed on the Earth no longer exist. There are, at least, 13 possible scientific explanations of these extinctions. Without these mass extinctions, man, and many of today's species would not have evolved! Life continues to evolve, and the survival of the fittest seems to rule!

Conclusion. *It should be obvious that Mother Earth is oblivious to the survival of life. It is we who must adapt to this planet, regardless of what changes it undergoes. It is, as far as we know, the only place in the Universe where life exists.*