THE FINE-TUNED WATCH REVEALED IN THE DELICATE BALANCE OF THE EARTH'S FORCES

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Abstract

A review of several energy-matter cycles reveals that the Earth can be compared to a finely tuned watch, adjusted to the degree that minor mistuning can have critical adverse repercussions for life here. Paley's watch design argument thus applies not only to living organisms, but also to the complex entity called the Earth. We are only beginning to understand the workings of its complex balance and recycling mechanisms. In this paper I briefly review a few of the many mechanisms that exist illustrating Earth's complexity.

Introduction

The classic proof of God is the conclusion that the existence of a creation demands a Creator. In the late 1700s, William Paley published his extremely successful book titled *Natural Theology*. His theme was that the enormous complexity of the human body argues that its reality proved the existence of a Creator. He reasoned that a person who found an expensive watch lying by the roadside would know that it was engineered by an intelligent designer, and that such an object could easily be distinguished from objects lacking human design, a pebble for example. The analogy is also extremely relevant for the Earth itself, which is actually a far more intricately designed precision machine than a finely crafted watch. As the Scriptures declare, "God . . . formed the Earth. . . to be inhabited" (Isaiah 45:18) and an impartial study of the Earth soon convinces the student that tremendous meaning exists behind this simple statement.

The Earth

The Earth is the only planet circling our Sun on which life as we know it could (and does) exist. A brief glance at the Earth and all other known planets reveals many startling contrasts. Fully 98% of the physical Earth consists of iron, oxygen, sulfur, silicon, magnesium, and nickel, and the other two percent is made up of about 100 other elements. Like no other planet, ours is covered with green vegetation, blue-green oceans, streams, rivers, mountains, 500,000 islands and deserts which produce a spectacular variety of color and texture—all other known planets are covered with lifeless soil which varies only according to slight movements made by gas currents on those planets with an atmosphere (as Saturn, Jupiter, and Uranus) or by volcanoes or meteorites. Even from a distance, Earth's bright welcoming colors are quite lively-blues, white and bright greens-in marked contrast to the surface of all other known planets, which are dull and hostile. This difference is immediately apparent from the excellent photographs produced by our space program.

The Earth is immense—its equatorial diameter is 7,926 miles, and its mass is 6.6×10^{21} tons. If the Earth traveled much faster in its 595 million-mile-long orbit around the Sun, inertia would pull it away from the Sun, and if it moved too far out, all life would cease to exist. If it traveled slightly slower, the Earth would move into a path closer to the Sun, and if it traveled into an orbit too close, all life would likewise perish.

An evaluation of the properties necessary to allow life to exist has found that only an extremely narrow range of possible temperature, pressure, atmospheric composition, and even physical constants must exist in order for life to live. Scientists up to the nineteenth century recognized, and were guided by the belief that God "had so arranged the laws of nature [so] that humanity . . . derived a maximum of health and happiness . . . the laws of nature are deliberately set up in such a way that life is preserved" (Kippenhahn, 1991, p. viii). Breuer eloquently provides "an impressive list" of the many universal constants which, if different, the universe could not support life (Breuer, 1991). Many conditions are necessary for life—the existence of a molecule like H_20 which has all the traits of water, the existence of a carbon atom which has four strong covalent bonding sites, and the numerous constants of physics, i.e., gravity, and the laws of electromagnetism are a few salient examples. Any alternate physics or chemistry would not allow life to exist.

Many of these facts are well known, but Breuer eloquently shows that thousands more exist—vanadium, copper, the laws of biomolecule spatial folding, and even night and day and the neutrino, are all necessary for life to exist. This concept was first made famous by Barrow and Tipler (1986) and further elaborated by Barrow (1988, 1991). It has been shown by Harris (1992) that the discoverers of physics, chemistry, and especially biochemistry and molecular biology "reinstated the traditional arguments for the existence of God" specifically the conclusions of Paley. Ross has listed these constants in his articles and books (1994, 1993, 1991).*

The Earth is not only an extremely beautiful, but also an incredibly complex dynamic changing machine whose many parts all function in amazing balance with each other. Research in the last century is only beginning to show the extent to which the external and internal forces of the Earth balance each other in incredibly remarkable and complex ways, producing the Earth's internal harmony that we often take for granted. Its complexity and structure is also in enormous contrast to every other known planet (Ager, 1993). The conclusion is inescapable: The Earth was created for life and if certain aspects of it were slightly different, life could not exist here (Comins, 1993).

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***Editor's note: The Creation Research Society does not condone Dr. Hugh Ross's long-age approach to origins.**

Temperature Balance

For life to exist an incredibly narrow temperature range must be consistently maintained. If the yearly average temperature on Earth rose or fell only a few degrees, most life on it would soon roast or freeze. This would upset the water-ice and other balances with disastrous results. The mean Earth temperature is remarkably stable only because of a set of complex mechanisms that produce a precision balance in its energy gains and loses. These balance mechanisms are so finely tuned that the Earth's annual world wide temperature rarely varies more than a degree or so. Most of the energy that reaches the Earth's surface is primarily solar radiation, but small amounts are reflected from the moon and some even comes from the stars. A major means of energy loss is the diffusion of heat energy into outer space primarily by radiation as the Earth circles the Sun. Also, the upper atmosphere loses primarily its more energetic gas molecules, thereby cooling in the same way that evaporation cools. Loss also occurs by both conduction and convection of energy into the thin gas envelope existing in outer space surrounding the Earth (Shimer, 1968).

The Earth's atmosphere is also heated primarily by the Sun's incoming solar radiation. Fully 40% of the incoming radiation is reflected back into outer space essentially unchanged, about 20% is absorbed by the atmosphere, and the remaining 40% is absorbed by land, rocks and sea water. The energy which is absorbed by the land, sea and atmosphere results in effectively raising the heat level to the ideal temperature for life. The world temperature averages about 15° C, and the most extreme normal ranges are from about -40° C to +40° C (Miller and Oberlander, 1984). Much of the 60% of the Sun's energy that is absorbed is eventually radiated back into outer space, producing the critical balance necessary for life to live (Skinner and Porter, 1987, p. 44).

The total amount of internal heat energy that reaches the Earth's surface and is likewise eventually radiated into outer space is estimated to be about 2,700-billion joules per second (a joule equals about l/4 of a calorie). The Sun's rays that reach the ground heat the surface soil and rocks which in turn warm the air. The heated air rises and is replaced by cooler air, a process which continually pumps heat from the Earth's surface into the atmosphere. The Earth radiates much of this energy back into outer space as long-wave-length, lower frequency electromagnetic waves. The Sun provides the Earth with a constant supply of more than 240 trillion horsepower, about 46 thousand horsepower for each current resident. Of all the energy the Sun gives off, only an estimated 0.45 billionth of its daily output is picked up by the Earth.

If the balance did not exist and the Earth radiated even just slightly more energy into outer space than it absorbed, the Earth would slowly cool, eventually becoming a frozen, lifeless mass. If the reverse occurred and Earth absorbed more heat than it lost, all surface liquids would soon boil and the Earth would likewise become a barren desert, void of all life. The critical balance of forces that drives the rain, rivers, streams, wind, waves, and glaciers would also be destroyed. The energy absorbed by sea water causes water evaporation needed to produce the vapor which is needed to form rain clouds. The wind carries the clouds over the land surface, producing the precipitation-including rain, snow and hail-that waters our crops and provides us with the thousands of food types that we need for a healthy and enjoyable life. The local surface winds are created by the land absorbing heat which warms the surface air causes it to rise resulting in the cooler air rushing in to take its place.

Heat is the end point of all chemical reactions, the eventual graveyard of all energy forms. The energy from gasoline, both that causes a car to move and that which is wasted, all forms heat. This is also true of the energy obtained from food and used to enable all life to live. Not only does the use of fossil fuels produce heat, but even food metabolism caused by life adds heat to the atmosphere. All animal movement and all kinetic energy also eventually becomes heat energy, which eventually adds heat to the Earth's total heat load.

The Heat From the Earth's Core

The Earth's surface also receives much energy from both its extremely hot but solid inner iron-nickel core (solid because of the enormous pressure existing there) and its hot molten iron-nickel liquid outer core. The Earth's interior heat energy was produced during the Earth's original formation, most of which is still present in the molecules in its liquid and solid inner cores. Another source of Earth's heat is from the decay of radioactive potassium, uranium, thorium and the other radioactive isotopes found abundantly in the Earth's crust. We know that the Earth has received much energy from these sources in the past because of the existence of comparatively large amounts of radioactive decay products. The most common radioactive isotopes found in the crust are K-40, U-235, U-238, and Th-232, and these radioactive isotopes, together with those of a few less common elements such as rubidium, are "widely distributed in tiny amounts through the crust and the mantle" (Skinner and Porter, 1987, p. 41). The core heat, plus that which radioactive elements generate, is significant enough to keep the Earth's interior "exceedingly hot" (Skinner and Porter, 1987, p.41). Yet another source of Earth's interior heat is the conversion of gravitational energy to thermal energy (Press and Siever, 1978).

Most of the heat produced or existing inside of the Earth reaches the surface by the slow but steady process called *conduction*, the transfer of energy from molecule to molecule. The average total level of heat flow from the Earth's interior is 1.5 microcalories per square centimeter per second (Mallory and Cargo, 1979). Without a balance of these many heat gains and losses, the Earth would soon be a barren planet void of all life.

The atomic energy reactions occurring in the Earth are different processes from those which occur in the Sun. The most widely accepted theory is that most of the energy produced in the Sun is from nuclear fusion, the combining of atoms. The enormous heat and pressure in the Sun forces atoms together-usually four hydrogens—to produce a net end result of one helium atom Milton, 1983). Spontaneous decay is a result of the atom's own instability and is a natural decay process, whereas the energy from fusion is not directly due to the internal conditions of the atoms involved, but to the enormous heat and pressure in the Sun which forces the smaller atomic nuclei to unite. In both of these processes *mass defection* occurs, a conversion of mass into energy according to the $E = mc^2$ relationship. Another source of the Sun's heat is the conversion of gravitational energy to thermal energy (DeYoung and Rush, 1989).

Other Heat Stabilizers

A major reason that the world-wide temperature remains nearly constant is that 71% of the Earth's surface consists of oceans, and the land surface also contains large reservoirs of water in snow, ice, lakes, rivers, streams, and ponds. This is critical because water has an enormous capacity to store heat, and consequently rapid and extreme temperature fluctuations on Earth are minimized (Croneis and Krumbein, 1936). The *specific heat* of water-its capacity to store heat-is among the highest of all known substances. Of all common room temperature liquids and solids, only ammonia's heat capacity is greater.

Upsetting the delicate heat balance on Earth will eventually cause many catastrophic changes on its surface. A rise in the temperature would cause some of the enormous north and south pole ice sheets to melt, raising the ocean water level to heights which could cover significant portions of the existing land mass. The rise in sea level from this melting could potentially be as much as several meters (Skinner and Porter, 1987, pp. 20,584). Considering that the average height of the Earth's surface is only 0.8 kilometers above the mean sea level, relatively small amounts of water will submerge large amounts of land. Melting of the ice sheets would allow isostatic rebound of the underlying lithosphere. Especially threatened would be the coastal areas which tend to be both at a lower elevation than the interior land, and are also the home of a large percentage of Earth's human inhabitants. Among the many other changes that will result from even a small average temperature rise include increased cooling costs (but lower heating cost) and rapid increases in certain kinds of bacteria which would thrive if the Earth was but a few degrees warmer.

We must be aware of these factors because a major activity that has the potential of slowly changing this energy balance is the huge amount of fossil fuels burned by humans. This activity not only adds heat to the Earth, but it also influences the carbon cycle by increasing the rate of atmospheric CO_2 influx from various solid carbon storage forms such as coal or petroleum. One result of this process is to increase the reservoir of atmospheric CO_2, which some conclude could contribute to a greater greenhouse effect.

The Greenhouse Effect

The greenhouse effect is necessary to produce the temperatures on Earth in which life can exist. The electromagnetic radiant energy that strikes the Earth's surface becomes *longer* wavelength and lower frequency due to energy loss from its collision with the Earth. The energy consequently moves into the heat area of the electromagnetic spectrum, and therefore much more of it becomes trapped by the atmosphere, producing what is called a greenhouse effect because this principle is used to heat greenhouses. The heat is trapped primarily because of the atmospheric water vapor, but also due to carbon dioxide and other gases which produce a "thermal blanket" that retards the escape of this now long wavelength radiation. The same phenomenon is illustrated by the rapid increase of an automobile interior temperature that occurs on a clear day: visible light passes easily through the car's glass, striking the seats and becoming lower frequency, longer wavelength electromagnetic energy, a form that tends to be trapped in the car by the automobile glass. The glass and the atmosphere thus both function as one-way valves.

Other sources of carbon gases are volcanic action, animal respiration and weathering. Past measurements indicate the concentration of CO_2 in the atmosphere has increased from 316 ppm in 1959 to 338 ppm in 1980, a 7% rise during the short 12 year span between these two measurements. Some computer simulation attempts suggest that a doubling of CO_2 may result in a surface warming temperature increase of about 4° C (Skinner and Porter, 1987, p. 583).

This small temperature fluctuation may seem minor, but the average global difference between the ice age and non-ice age sea surface temperature is only 2.3° C (Skinner and Porter, 1987, p. 573). The average is, of course, not the average everywhere-in some areas little change evidently occurred, in others an estimated drop of 14° C or more existed. Although this small increase is enough to significantly affect all life on the Earth, the Earth has several complex homeostatic mechanisms that normally mediate to reduce CO_2 unbalances. One is a sea water system that can absorb much excess CO_2, and another is higher CO_2 levels spurs plant growth-the latter effect is often ignored as a beneficial aspect of atmospheric CO_2 increases. Another, described by Kunzig, relates to the CO_2 absorbed by sea life, much of which will

> . . . sink to the bottom of the ocean-in the form of plankton corpses or plankton parts or fecal pellets excreted by the things that eat phytoplankton. Oceanographers know this carbon sinking goes on all over the world; they call it the biological pump . . . it may take as much as 3 billion tons of carbon each year-half of all the carbon we pump into the atmosphere annually with our power plants and cars—and put it out of harm's way in the deep ocean . . . [and] it might be possible to speed up the pump in places where, for lack of iron, it isn't running up to speed.

Unfortunately, though, all of these systems have limits, and this is the major debate about greenhouse gases. The concern here is not whether current human activity will upset this balance, but the fact that a balance exists as well as numerous physical mechanisms that serve to stabilize it. Others argue that since carbon dioxide is not the principle greenhouse gas—water vapor is—that we should be far more concerned with other balances and that focus on CO_2 could distract us from the core of the problem (Mims, 1995, p. 18).

The Tidal Energy

The consistency of the Earth's spinning is maintained by a balance in losses and gains in rotational energy. It loses rotational energy from such sources as friction with the molecules around the Earth's orbit. The Earth gains rotational energy from sources which include the ocean tides which are in turn a result of the Earth, moon and Sun rotation system (Berger, Loutre and Laskar, 1992). The movement of tidal water also produces enormous amounts of kinetic energy, much of which ends up as heat. The tides are caused principally by the effect of the moon's gravity pulling on the Earth plus the Earth's rotation on its axis. The result is a periodic rise and fall of the Earth's major bodies of water—as well as a similar rise and fall of the Earth's bulk (Stacey, 1992, p. 115). This produces a high tide on both sides of the Earth, the side facing the moon as well as on the opposite side, and a low tide on the two sides in between. The Sun opposes the moon's pull when it is at right angles to it, *reducing* the effect of its tide, but when it pulls in the same direction, it *increases* the moon's effects (Shimer, 1968).

The tide flow moves forward in the ocean area largely unhindered until it runs into the continents, resulting in water crashing up against the continental borders. Consequently, the coast line "runs into a mass of water at every high tide" a collision that causes the Earth to lose rotational energy (Skinner and Porter, 1987, p. 44). Since the loss of rotational energy from this process may affect the Earth's rotation speed, some claim that its speed is slowly being reduced. The conclusion that the Earth's rotation rate is not slowing down is supported by measurements that indicate new sources of kinetic energy are being added by the motion of the solar system. Measurements for the last three centuries support this conclusion, finding that the length of the Earth day has at most increased by only 0.002 seconds per century, if that. This calculation could also be the down swing of a cycle; only long term data collection can answer this. As a result of the absorption of outside energy, such as from the other planets, the Earth's rotation energy loss is balanced. Consequently, the Earth's 365 day, 6 hour, 9 minute and 9.54 second a sidereal year) 66,600 mile an hour round-trip varies from the mean by less than an estimated hundredth of a second! If it rotated much slower on its axis, all life would in time die, either by freezing at night because of lack of heat from the Sun, or by burning up during the day from too much Sun.

The Miracle of the Atmosphere

Air, after it is warmed, rises-and the air close to the surface of the Earth is heated via light energy from the Sun. The air near the surface then rises upward, allowing the air near the Earth's surface to maintain a temperature in which life can exist. The movement of warm air from the surface rising upward creates air currents (wind) which are an important part of the Earth's ecological system. They carry carbon dioxide from areas which over produce, such as cities, and move oxygen to areas in need of it, as large urban population centers.

If air acted the same way that water below 4°C did, the temperature on the Earth's surface would be unbearable-and life could not survive for very long. The temperature a few hundred feet above the surface, on the other hand, would be quite cold and, likewise, life could not exist there either. The only habitable region would be a thin slice of air, but even there life could not exist for long. Plants and trees which would be necessary to support the life in the atmosphere could not survive as they would be in the cold zone. Thus birds would have no resting place, or food, water or oxygen. But air rises when heated, and thus life can exist on Earth.

The mixture of gases usually found in the atmosphere minus the human pollution is perfect for life. If it were much different (more oxygen, less carbon dioxide, etc., or the atmospheric pressure was much lighter or if our atmosphere were thinner, some of the millions of meteors which now are burned up by friction with the atmosphere would reach the Earth‘s land surface, causing fires and destruction.

Balance in the Earth's Chemical Cycles

Balance is not only necessary for energy gain and losses, but also for the Earths numerous chemical cycles. The carbon and water cycles are well known, but at least 50 other mineral cycles are all equally important to all life on Earth. Much phosphorus, which is a critical mineral to both plants and animals as part of the ATP energy transfer system and in hydroxyapatite in the teeth and calcium-phosphate skeletons, among other uses, would become chemically or physically bound up in rocks, and thus removed from the cycle if it was not for the constant weathering of rocks. This weathering breaks down the rock, allowing the phosphorus it contains to become available for use by plants. The plants are in turn consumed by the heterotrophs, and consequently the phosphorus again becomes part of the cycle.

Reservoirs of phosphorus exist not only in rocks, but also in the ground water, the biosphere, the soil, and the ocean. The importance of a rock source of phosphorus is illustrated by the fact that the mining of phosphate rock for fertilizer has added huge amounts of phosphorus to our lakes, rivers and coastal marine waters. Humans have upset this balance, resulting in an increase in biological activity-which is positive for the farmer, but since much of the phosphorus goes into the lakes and rivers, it has caused massive growth of certain kinds of algae and water plants. This offsets the balanced cycle because algae suppresses other life forms which are critical in the food chain, adversely effecting the whole chain. The end result of excess algae growth is that many higher animals will not be able to survive, producing major alterations in the cycle elsewhere. Excess phosphorus can also contribute to general *eutrophication*, excessive water plant growth of all types. When the plants die, they accumulate in thick layers on the lake bottom and their decomposition results in greatly diminishing the dissolved oxygen level in the water effecting the survivability of fish and other lake and river life.

The Nitrogen Cycle

The nitrogen cycle is one of the most important, which, along with the phosphorus, potassium, and sulfur systems, cycle critical elements needed by plants and animals. The air consists of about 78% nitrogen, but it is not in a form that can be used by plants. The triple bond in the N_2 nitrogen molecule found in the air is far too strong for most plant metabolic systems to break.

Nitrogen fixing bacteria in the soil, though, are able to break the bond and assemble nitrogen in a form in which it can be used by plants, which in turn allows it to be used by animals. Nitrogen is critical in compounds used to synthesize protein. Certain types of nitrogen-fixing bacteria form a symbiosis with green plants including clover, alfalfa, beans and peas. The bacteria are found in grape-like clusters on the plants' roots and live there in a symbiotic relationship—the plant furnishes the sugar which the bacteria needs to live, and the bacteria furnish fixated nitrogen which they obtain from the air or soil. The protein made by the bacteria is in turn used by the plant to build protein in its own cells.

For this reason, crop after crop of clover, alfalfa and other legumes can often be produced without the farmer needing to nitrogen fertilize his fields. Some farmers "rotate" their crops and plow in the soil the nitrogen-fixating plants which often releases enough nitrogen in the soil to grow other crops for several years without adding more nitrogen fertilizer. Understanding this cycle has enabled humans to learn how to fix nitrogen and hydrogen to form ammonia (NH_3). Of course, when plants and animals die, nitrogen is also released back into the soil, a recirculating process so effective that the soil in many regions of the world has been able to sustain flora for centuries. When plants and animals die they no longer have an active repair or immune system, consequently, their bodies are rapidly broken down by bacteria, resulting in free nitrogen, ammonia and other compounds which fertilize the soil. Plant and animal rotting and decaying is therefore part of the necessary cycle which allows nitrogen to be endlessly reused. Further, natural fertilizers have always been recognized as superior—it is now known that natural fertilizers contain not only nitrogen and other essential nutrients, but also hormones which facilitate increasing the efficiency of the whole process.

This research has inspired the development of a new field called *chemurgy* which is the science of the industrial use and recycling of organic farm products, allowing tons of farm waste to be converted into valuable raw materials. Examples include the use of grains and even potatoes to produce alcohol and other chemicals by the action of bacteria and casts. Even plastics can now be made from waste substances, including soybean, wood pulp, milk and animal wastes. Corn stalks can be converted into products such as sound deadening wall board, and peanut oil into vegetable shortening, oleo margarine, explosives, rubber substitutes, dyes, various face powders, inks, linoleum and the hulls for fiberboard and soap.

The Miracle of Water*

Another example which illustrates the rigidity of environmental variations needed for life to exist is that of water. The Earth is the only planet with huge bodies of water—about 70% of its surface area consists of oceans, lakes, and seas which surround huge bodies of land. The amount of water is so great that it is estimated that if the continents were leveled, water would cover the entire surface to the depth of a mile and a half! The few planets that have water contain only moisture floating as vapor on their surface or in the soil or relatively small amounts of surface ice, not numerous large bodies of liquid water as found on Earth.

Water is unique in that it absorbs huge amounts of heat with comparatively little alteration in its temperature. Its absorption capacity (specific heat) is also extremely large—about 10 times greater than steel. During the day, the seas rapidly soak a great deal of heat, and consequently the land surface stays fairly cool. At night, the oceans release some of the vast amount of heat that they received during the day which, combined with atmospheric effects, prevents large areas of it from becoming too cold at night. If it were not for the tremendous amount of water on the Earth's crust, far greater day and night temperature variations would exist. Many parts of the surface would be hot enough to boil water in the day and the same place would be cold enough to freeze water at night.

When materials are heated, they expand, and when cooled, contract. Consequently, given two objects of the same size and material, if one is cooler, it will be denser. This may not seem like a problem, but it would be in the case of water if it were not for a rare chemistry anomaly. Water, as does almost all other substances, contracts when cooled but, in contrast to virtually all other materials (the few exceptions include ammonia, rubber and antimony), it contracts only until it reaches 4° C, then it *expands* until after it freezes. If water continued to contract when cooled, it would become denser and thus sink to the ocean bottom. Further, when water turned to ice, it would likewise sink to the ocean bottom as does most all substances. As a result the oceans would eventually become largely solid ice as more water froze on the surface and sank, accumulating at the bottom.

Because of this anomaly, the ice that forms in seas, oceans, and lakes stays near the surface where the Sun and the warm water below can melt it in the areas that have summers. Water that is warmer than 4°C is carried by various wind and water currents to the bottom which helps to warm the ocean depths. This process of surface water warming the bottom, plus the Coriolis effect, helps to produce the ocean currents. These currents and other factors insure that most of the ocean stays in the liquid form.

The Balance of the Earths Crust

The shape of the Earth is also a result of a delicate balance of many separate powerful forces. The Earth's gravity pulls the Earth's entire mass *towards* its center, pulling equally along all possible radii, producing a spherical shape (Watt, 1982). The *forces opposing* this effect include the centrifugal force that results from the Earth's spin. The force consistently acts perpendicular to the axis of rotation, producing a bulge at the equator and giving the Earth its slightly ellipsoid shape. The source of the centrifugal force in this case is Newton's first law of motion which says objects travel in a straight line unless acted on by an outside force. This movement is resisted by gravity and the various adhesive and cohesive forces in the Earth, producing a balance which results in the equator bulge. The bulge is slight; the difference between the diameter at the poles and the equator is only about 42 kilometers.

***Editor's Note: Readers will be interested in an earlier Quarterly article on the *designed* properties of water, DeYoung, D. B. 1985. The water of life. *CRSQ* 22:107-114.**

It was once thought that the continents were non-movable, firm land masses. Modern research indicates that the Earth's crust is now in a state of dynamic equilibrium. Evidence now exists that its top layer, the *lithosphere,* works like a conveyor belt. The *mid-oceanic ridge* produces new lithosphere as the old lithosphere disappears back into the mantle at a zone called the *edge of consumption* (the subduction zone). The lithospheric plate does not move through the Earth as an intact unit, but is reheated as it is absorbed and melts, slowly blending in with the mantle material. At the oceanic ridge, the molten magma rises to form a new oceanic crust which solidifies, and thus the plate is formed anew at this point. The density of the continental crust must also be balanced. It is not subducted into the Earth because it is less dense than that part of the mantle it floats on called the *asthenosphere.* The continental crust is just buoyant enough so that it resists being pulled down into the sea floor trench at the subduction zone.

The most obvious balance relates to the continental movements, a field called *plate tectonics.* Their shape indicates that at some time in the past the major continents have broken and moved away from one super continent called *Pangea* (Cailieux, 1968). An example of the evidence which argues for this conclusion is the good fit of the eastern South American coastline into the western African coastline. Evidence of their movement that is observable on the Earth's surface is the edges that slide past each other at vertical fractures called *transform faults.* The most famous of these is the huge San Andreas fault in California. One result of these two plates sliding past each other is the movement of Los Angeles northwest in the direction of San Francisco. Another major evidence of plate tectonics is the highly deformed lithosphere areas called mountain ranges which are a result of one plate crashing into another one. The most well known example is the Australian Indian Plate which produced the Himalayan Mountains north of India. Interestingly this research also hypothesizes that a smaller Earth existed in the past:

> If we pick a diameter for the globe of about 80 percent of the present figure, and reconstruct the fit of South America and Africa, the correspondence this time is excellent! Not only do the big bumps and indentations match up, but the little features on them do as well. The gores disappear, and the resulting picture is thoroughly satisfying to a geographer's mind (Ritchie, 1988, p. 61).

While much has yet to be learned about the earth's crust, that it is a dynamic, complex process is not in doubt (Chatterjee and Hotton, 1992).

Balance of the Land Mass Height

Other internal processes such as uplift which builds up the Earth's surface, and yet others, such as erosion, wear it down, maintaining the balance. Scientists once assumed that the height of the land is static, yet research has found that billions of tons of sediment are carried into the world's rivers and oceans annually. The reason that the Earth is not worn flat is because the rock cycle

> brings new rock to the surface as fast as old rock is removed by erosion. The balance between internal and external activities provides indirect evidence that materials inside the Earth must be capable of movement; for without internal movement to counteract erosion, how could the continents remain above sea level? (Skinner and Porter, 1987, p. 406).

Much other evidence exists for this internal movement which produces equilibrium, and also that there must be an elaborate mechanism much like a fine watch that allows this balance to produce the general steady state that we now know exists. Further discoveries have helped us to realize that this amazing balance is fine-tuned to such a degree that few persons have even suspected that these tearing down and building up forces existed. An analogy is being on a train which runs so smoothly that the passengers do not know it is moving until they look around to explore the question.

The Earth's Dynamic Balance

Another aspect of the finely tuned clock is the Earth's rotation. Its tilt averages 23.5° which deviates plus or minus 1.5° during an estimated 41,000 year time span. Secondly, the Earth's orbit changes-called the *precession of the equinoxes*— which will slowly cause the day and night length and spring and autumn equinoxes to change. The day length is now the longest in the summer, shortest in the winter. One full cycle is estimated to take 23,000 years, and at the half cycle point, the spring equinox would then have the *shortest* day, the autumn equinox the *longest* day. Further, the shape or eccentricity of the Earth's orbit changes so that the orbit would become more and more circular until an estimated 100,000 years from now its circularity would peak, then it again will become more eccentric as the cycle progresses, eventually reaching its maximum eccentricity as it progresses toward repeating the cycle. This cycle may also be highly interconnected with global climate and many other aspects of earth history (Hays, Imbrie, and Shackleton, 1976, p. 1131).

The Role of the Moon

If the Earth was not tilted 23° on its axis, but was at a 90° angle in reference to the plane of the Earth's orbit, we would not have four seasons. Without seasons, life would soon not be able to exist here—the poles would lie in eternal twilight, and water vapor from the oceans would be carried by the wind towards both the north and south, and would freeze when it traveled close enough to the poles. In time, huge continents of snow and ice would accumulate in the polar regions, leaving most of the Earth a dry desert. Eventually the oceans would disappear and rainfall would cease.

Research has found that the moon apparently functions as a gravitational gyroscope which helps to stabilize the Earth's 23° axis tilt—the slight skew that produces the seasons on our planet. The Earth is the only inner planet that has a large enough satellite to achieve this axis tilt (Murray, 1993). Research indicates that without the moon's effect, the Earth, like the other inner solar system planets including Mercury, Venus, and Mars, would tilt as much as 85° off vertical with the plane perpendicular to the Earth's orbit around the Sun. A tilt this large would be catastrophic because the seasons would not occur (Laskar and Robutel, 1993).

Murray (1993) noted that a tilt greater than 54° would also produce enormous differences in the Earth's temperature pattern—so much that the equator would receive even less sunshine than the poles. He concludes that the influence of the moon is so critical that, "variations as small as ± 1.3° may trigger ice ages" consequently, "the forecast for a moonless-Earth would have been bleak" for life (p. 586).

The effect of the moon on the Earth's tilt can be studied by the evaluation of other planet systems, specifically how their moons or lack thereof affects the planet. We have found from this research that the moon applies a slight torque which shifts the axis when the planet spins. For example, Mars has two very small moons which researchers calculate cause chaotic tilt estimated at from 0° to 60°, and its current 25° is not stable (Comins, 1993). Further, the moon is believed to play a "vital role" in the development of the atmosphere which allows the Earth to support life—and no other planet in the solar system to do so.

Comins (1993) also concludes from his study that lack of our moon would have drastic consequences for the Earth's ability to support life for other reasons. Even if the moon was much closer, farther away or had a different rotational speed, it would radically affect the Earth—and, depending upon the deviation from the ideal position it is currently in, these changes could be lethal to life on the Earth. If the moon were much nearer to Earth, one result would be huge tides which would overflow onto the lowlands and erode the mountains. Even moonlight is so important that its lack would drastically change life. Nocturnal animals, an important animal group in the Earth's ecological balance, require moonlight to survive. Another example that Comins gives is moon light initiates the changes that convert some freshwater species such as salmon into fish that can live in salt water. Yet, another important role of the moon long known to be critical is to function as a clock to control the life cycles of many animals.

The Principle of Uniformity

The research into the dynamic balance found everywhere in the natural world has now seriously challenged the *principle of uniformity,* the assumption that geological processes in action today have been in operation essentially unchanged during much of the Earth's history and that "the present is the key to the past." This principle* was critical to geology because it was a major means used to understand and interpret the past. This science concludes that the older rock was likewise formed in the same way as was modern rock. If a certain modern rock was formed by sedimentation and a similar but far older rock has the same physical morphology and chemical composition (and consequently is judged to be the same type of rock) we may assume that it was formed in similar ways. This principle, while incredibly helpful, is not infallible (Allmon, 1993).

Nineteenth century geologists wrongly assumed high consistency of geology rates from the uniformity doctrine, and consequently erroneously concluded that "rates of deposition remained constant and equal to today's rate of deposition." For this reason, they erroneously calculated past sedimentation rates based on today's rate (Skinner and Porter, 1987, p. 35). Historical events or conditions could have either retarded or accelerated a given sedimentation rate, thus the current average (arithmetic mean) does not directly apply to many historical situations.

The assumption of consistency is now known to be incorrect, but it was so widely accepted that this view was erroneously incorporated into the *Principle of Uniformity* which guided interpretation of geological history for generations. We now know that

> the more that is learned of the Earth history, and the more extensively the timing of past events are determined through radiometric dating . . . the clearer it becomes that the rates of the cycles have not always been the same (Skinner and Porter, 1987, p. 36).

In the words of Davies:

> We are rewriting geohistory. Where once we saw a smooth conveyor belt, we now see a stepped escalater. Upon that escalator the treads are longer periods of relative quiescence when little happens. The risers are episodes of relatively sudden change when the landscape and its inhabitants are translated into some fresh state. Even the most staid of modern geologists are invoking sedimentary surges, explosive phases of organic evolution, volcanic blackouts, continental collisions and terrifying meteoroid impacts. . . . Catastrophism was originally born during the seventeenth century in an attempt to cram some inkling of the complexity of geohistory into the pint pot represented by biblical chronology. I suspect that the catastrophists of that distant age might well find themselves far more at home in our modern departments of geology than would their uniformitarian successors in the nineteenth century (Davies, 1993, p. 115).

Consequently, to achieve the fine balance needed, the dynamic Earth needs far more complex and radical balancing systems than we concluded a few years ago were needed, and we are only now beginning to understand these forces. Scientists have recently begun to tell the story of the fine tuned watch-like Earth we live on, but have uncovered enough evidence to demonstrate that Paley's conclusion is as valid for the Earth as it is for the human body.

The outer planets have also been found to be essential to produce the solar system stability required for life on Earth (Laskar, 1994). Not only are the Earth and solar system fine-tuned for life, but the entire "universe is fantastically hospitable to life" and the list of factors which cause the universe to be hospitable to life are now "simply too long to ignore" (Greenstein, 1988). This presents major problems for evolutionary naturalism because how we get here

> . . . cannot be a matter of life seeking out the appropriate location in which to flourish, for the evidence refers not merely to the Earth, but to the cosmos as a whole—to all reality. It cannot be a matter of evolution surmounting obstacles strewn

*Editor's Note: For a recent creationist interpretation on this so-called principle see Williams, E. L. 1995. Providence Canyon, Stewart County, Georgia–Evidence of recent rapid erosion. *CRSQ* 32:37-40.

in its path by the environment for it is the fitness of the environment itself that is at issue. Neither of these suffices to explain how . . . the laws of nature, came to be so anomalously suited to the requirements of life. "How did it happen that, with what seem to be so many other options, our universe came out just as it did?" George Wald has asked. "From our own self-centered point of view, that is the best way to make a universe . . ." (Greenstein, 1988, p. 188).

Adaptation to Environment or the Creation of the Environment for Life?

If evolution works to evolve life to fit the existing environments, why has it not equally conquered all of the environments here and elsewhere? Earth is far better suited for life than any other planet, yet most of the environments *even* here are either too wet, too hot or cold, too far under-ground or above ground to support such life. In the several thousands of miles of changing environments from the center of the Earth to the edge of its atmosphere, only a few feet are ideal for life, and consequently almost all creatures are forced to live there.

Although of all the planets in our solar system, only the Earth was made to be inhabited. Even on the Earth only a thin slice is ideally suited for life. This section, though, is teeming with plants and animals. It is estimated that an acre of typical farm soil, six inches deep, has several tons of living bacteria, almost a ton of fungi, two hundred pounds of one-cell protozoan animals, about one hundred pounds of yeast and the same amount of algae. And an estimated two to 10 million species live on our planet.

Yet, *some* type of life is found in almost every niche on the Earth. Even in the extremely cold Antarctica, penguins and seals wander, large numbers of hardy microscopic creatures exist in ponds, tiny wingless insects inhabit the patches of moss and lichen found there, and even two types of plants flower yearly. From the top of the atmosphere to the bottom of the oceans, from the coolest part of the poles to the warmest part of the equator, life persists everywhere. However no sign of life has ever been found on any other planet.

Objections to This Argument

Many of those who philosophically hold to a naturalistic world view are aware of the numerous books and journal articles which have eloquently documented how precisely the universe is designed for life. In one critique, Silk endeavors to put to rest "the notion that because the universe is hospitable to life, it was designed to harbor life" by arguing that this analogy is "like a flea's believing that a dog's back was designed to harbor fleas," (Silk, 1993). This view is both egocentric and naive. In fact, a flea is remarkably adapted to living on a dog in an incredibly complex way—actually to the degree that the flea's *only* habitat is on the skin of a habitable animal. Without the dog's back, or that of another similar animal, the flea would become extinct. It has the numerous adaptations, physiological, biochemical, and behavioral, specifically designed so that the flea can survive in its habitat-and it survives there quite well as any dog owner knows. The flea is itself actually an eloquent argument for design. Many such relationships are not parasitic, but symbiotic and hundreds of examples have been elucidated in the literature as excellent examples of design (Perry, 1983). Thus, rather than negating the design argument, examples that its critics use actually eloquently support the design hypothesis.

Conclusions

The chances of a planet being just the right size, the proper distance away from the right star, and having the many necessary variables to support life in other areas are extremely small. Even if some stars have planets circling them, as some speculate, the mathematical odds that all of these and other essential conditions exist there are astronomically minute. Of the likely several hundred billion galaxies in the universe, depending on how the dark matter controversy is resolved, an estimated one atom exists for every 88 gallons of space. This means that most of the universe (the vast majority actually) is largely empty space! The extremely fine line between an environment where life can and cannot exist produces tolerances that are extremely small, and if there are any other planets in the universe, it is *unlikely* that any of them could support life, even if it were created on them, due to the extremely rigid conditions necessary for life to exist.

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PHOTO ESSAY

Hubble Space Telescope Photographs Distant Galaxies*

The three images on the back cover represent select portions of the sky photographed December 18 to 28, 1995 in the Hubble Space Telescope's "Deep Field Observation." The never before seen galaxies are nearly 30th magnitude. Six of the galaxies in the Hubble Deep Field have redshifts between 2.5 and 3.4, but most of the estimated 1500 galaxies in this field have not yet been measured. If distance goes with faintness, then these galaxies would have to represent an early time in the history of the universe. (Photograph courtesy NASA.)

*Eugene F. Chaffin, 715 Tazewell Ave., Bluefield, VA 24605.

Quote

Isaiah 40

21 Do you not know? Have you not heard? Has it not been told you from the beginning? Have you not understood since the earth was founded?

22 He sits enthroned above the circle of the earth, and its people are like grasshoppers, He stretches out the heavens like a canopy, and spreads them out like a tent to live in.

Holy Bible, New International Version, NIV publishers.