Chapter 27

SUMMARY OF THE ANTHROPIC PRINCIPLE

Discovering a flood of coincidences

The more that scientists examine inanimate nature and living organisms, the more obvious it becomes that everything was designed. —And more, everything was designed for life to exist! This fitness of all things is another proof of God's Creatorship.

Consider the human brain: Each brain cell contains about 10^{11} (10 trillion) nerve cells, which make between 10,000 and 100,000 connections with other cells, making a total for the whole brain of about 15^{15}. That is 1 quadrillion connections. There are more nerve connections in the brain than there are cells in the body! The brain triggers hundreds of millions of impulses daily, more than all the world's telephone systems. The fastest nerve impulses recorded traveled at nearly 18 mph.

All this is astounding! What other wonders are there about us? —Everywhere we look, we find wonders! They are everywhere—and they are too amazing to have been produced by the unfeeling, unthinking hand of Darwinian randomness.

In this chapter, we will briefly overview at least six special marvels—each of which are too miraculously arranged to have been accidental: the marvel of light, water, air, carbon, and other elements. We will then consider briefly a few nuclear and planetary "coincidences," concluding with a small sampling of wonders in the human body—which point to a divinely guided origin.

THE MARVEL OF LIGHT

Light is part of the electromagnetic spectrum. The total range of electromagnetic wavelengths is 10^{25}. Most of it is very harmful to life. Yet the narrow portion which reaches us is extremely beneficial to plants and animals. It is the only part of the entire spectrum which is biologically useful! All the dangerous rays, which are either profoundly damaging or lethal, are filtered out by several special shields around our planet, which include earth's magnetic belts, the ozone layer, and atmospheric water vapor. The only "friendly" radiations are the near-ultraviolet rays, visible light, and near-infrared light.

Consider ultraviolet light: Radiation in the far-ultraviolet (shorter than 0.30 microns) is too energetic and highly damaging to the delicate molecular structures in living creatures. But the only ultraviolet light which reaches the surface of our planet is the near-ultraviolet (slightly longer than 0.70 microns) which is too weak to activate harmful chemical action in plants and animals. Ultraviolet rays between 0.29 and 0.32 microns are essential for the synthesis of vitamin D.

Then there is infrared light. Only near-infrared light reaches us through the skies above us—and it is immensely useful in helping to warm our planet. It warms the hydrosphere (atmosphere), keeps water a liquid, and drives the weather systems and water cycle.

Then there is visible light. How would we exist without light to see by? There would be no color, nothing but life in a dark cave. Indeed, without sunlight we could not exist.

Virtually no gamma, X-ray, microwave, and none of the dangerous portions of ultraviolet and infrared radiation reach us. This astounding "coincidence" had to be planned by an Intelligent Being.

Another blessing is the fact that water is transparent to light. All biological chemistry occurs in liquid water. Nearly all electromagnetic wavelengths, except radiowaves and light within the visible spectrum, are strongly absorbed by water. If water was not transparent to light, there could be no life in the rivers and oceans. The light which penetrates farthest into the ocean (down to 240 meters) is blue light. But, so living creatures in the rivers, lakes, and oceans could have food, it was carefully planned that chlorophyll, the basic food of life, would strongly absorb light in the blue region of the spectrum. In addition, water quickly absorbs the harmful radiation, destroying it. Infrared radiation keeps the lakes and upper parts of the oceans warm.

It is another amazing fact that the only types of beneficial radiation are close together on the very lengthy electromagnetic spectrum. Was that an accident? The wavelength of the longest type of that radiation is vastly longer than the shortest by a factor of 10^{25} (10 octillion).

Yet only beneficial rays are next to one another; and they are the only ones which can pass through our atmosphere and reach the surface of the planet. Another blessing is the fact that the radiation from the sun remains constant. If it varied by only a little, life here would cease.

Yet another wonder is the fact that the wavelengths and energy levels of visible light are uniquely fit for high-resolution vision. Ultraviolet, X-ray, and gamma rays would be too destructive to the eyes, and infrared and radio waves are too weak to be detected. The actual length of the waves in the visual region of the spectrum is ideally suited for the high-resolution camera-type eye—of the precise design and size found in all higher vertebrate species, including man.

The wavelength of the radiation, the size of the aperture (entrance hole), and distance from aperture to retina (at the back of the eye) are key factors in making it possible for the human eye to see clearly. Only when those factors are a certain size can diffraction, and spherical and chromat aberration, be reduced and clear vision become possible. It is no accident that man-made cameras are designed so that the crucial lens and inside portion—is the same size as the human eye! The size of your eye is not an accident! It is the actual wavelength of light itself which determines how big your eye must be. Yet your eye is that correct size. If the wavelength of light had been just ten times (5 microns) greater, your eye would have to be larger than your head.

Each photoreceptor in the retina of your eye is able to respond to a single photon of light. This too is remarkable! It enables you to see the light from a distant star at night.

It is of interest that no other type of light (ultraviolet, infrared, radio waves, X-rays, gamma rays, etc.) can produce distinct, clear images. The next time you see a ultraviolet photograph of a starfield, notice how blurry it is. Only visible light can produce clear images.

THE MARVEL OF WATER

Water is amazing; yet we have been given vast quantities of it. We surely needed it! It has been called the “matrix of life.” Without it, life could not exist on our planet. The vast majority of life functions occur in water. It is the basis of all vital chemical and physical activities on which life on earth depends. It is not an accident that living creatures primarily consist of water. Most organisms are composed of more than 50 percent water. Seventy percent of the body weight of a human being is water.

Life processes could not properly take place in solid water (ice), nor in water vapor, which is too volatile. Water itself is needed.

Yet even the process by which ice is made is astounding. Water expands by heat and contracts by cold. But, if this contraction continued all the way to the point of freezing, no life could exist in ponds, lakes, and oceans beneath it. If water kept contracting as it neared the point of becoming ice, the lower parts of the water in bodies of water would freeze first. Once frozen, hardly any heat applied by the sun at the surface could warm it again.

But, instead, an amazing thing occurs: Like other substances, water contracts as it becomes colder—but then, below 4° C. (39.2° F.), water suddenly begins expanding! It continues to expand rapidly until it is frozen. Because of this, the water beneath this layer of ice never freezes. Water at the bottom will remain 4° C. (39.2° F.)

As the point of freezing is approached, the coldest water rises to the surface, where freezing takes place. But, because that ice has expanded,—it floats above the water beneath it! It is lighter in weight than the water beneath it. This unique quality of water makes it possible for liquid water to exist on our planet. Otherwise, each time more water froze, it would go to the bottom, where it would never warm—and still more and more water would freeze, until all the water in the lakes and oceans would be frozen. Too astounding to be a mere coincidence.

Let us now briefly consider eleven remarkable qualities of this amazing subtstance, water, which could not have come about by accident:

1 - The expansion of ice. As already mentioned, water contracts as it cools until just before freezing. It then expands until it becomes ice. As it freezes, the expansion continues. This is a totally unique, astounding quality. With the exception of one quite rare chemical, all other substances keep contracting when they become colder.

2 - Latent heat. When ice melts or water evaporates, heat is absorbed from the surroundings. When the opposite occurs, heat is released. This is known as *latent heat.* In the temperature range at which water freezes, the amount of latent heat of freezing water is one of the highest of all liquids. (Only ammonia has a higher latent heat when it freezes.) But water's latent heat *of evaporation* is the highest of any known fluid in the surrounding temperature range. Without these properties, the climate would be subject to far more rapid temperature changes. Small lakes and rivers would vanish and reappear constantly. Warm-blooded animals would have a far harder time ridding their bodies of heat. In the summer, heat is a major excretory product and must be eliminated by the body in large amounts. At body temperatures, very little heat can be lost by conduction or radiation, and evaporative cooling is the only significant way it can be done. There is nothing else that equals this quality of water; nothing which could be as efficient. The cooling effect of evaporation increases when the usefulness of the property is most needed.

This evaporative cooling effectively regulates the temperature of living organisms, operates powerfully to equalize and moderate the temperature of earth, and greatly helps the meteorological cycle. No other substance can compare with water in any of these functions.

3 - Specific heat. This is the amount of heat required to raise the temperature of water one degree centigrade. Remarkably, the specific heat of water is higher than most other liquids. This makes it possible for water to retain heat! This is but one of several crucial factors which make water so invaluable.

Without this one attribute of water, the difference between winter and summer would be more extreme and weather patterns would be less stable. The major ocean currents (such as the Gulf Stream, which currently transfers vast quantities of heat from the tropics to the poles) would be far less capable of moderating the temperature differences between high and low latitudes. Our bodies could not maintain a level temperature as easily.

4 - Thermal conductivity of water. This is the capacity to conduct (transfer) heat. This quality is four times greater in water than in any other common liquid. Without this attribute, it would be harder for cells, which cannot use convection (air) currents to distribute heat evenly throughout the cell, to function properly.

5 - Thermal conductivities of snow and ice. Water, in the form of snow or ice, does not conduct (transfer) heat very well. Without this quality, the protective insulation of snow and ice, which is essential to the survival of many forms of life in the higher latitudes, would be lost. This protects living things in or below the snow, or in water below ice, from becoming too chilled.

In addition, water would cool more rapidly and small lakes would be more likely to freeze completely. No aquatic life would be possible.

The preservation of large bodies of liquid water in the oceans ensures temperature stability worldwide, which in itself ensures climatic stability on which the existence of larger plant and animal life depends. These qualities are vital, because liquid water is essential to all life on earth.

6 - Surface tension. Water has a very high surface tension. Because of this, it draws water up through the soil within reach of the roots of plants, and assists its rise from the roots to branches in even the tallest of trees. If water was like other liquids, large plants—including all tall ones—could not exist. This quality enables liquids—including, very importantly, the lipids—to pass in and out of cells.

It also draws water into the narrow cracks and fissures in the rocks, and assists in the process of weathering and washing chemicals and particles from rocks, so additional soil can be formed. This remarkably high surface tension is also found in liquid selenium—a rare substance which is only liquid at very high temperature.

7 - Solvency of water. Water is excellent at dissolving chemicals. Life would not be possible if there was not a universal fluid which could do this. In past centuries, chemists searched for, what they called, an *"alcahest"*—a fluid which could dissolve every type of chemical. In water, they found a substance which can do it better than anything else. Nearly all known chemicals dissolve in water to a slight, but detectable extent. Without this attribute, important minerals could not be distributed throughout the rivers, lakes, and oceans. Without this solvent power, waste could not be eliminated from the human body. Over 200 different compounds have been found dissolved in urine.

8 - Reactivity of water. Because it is a universal solvent, water is an extremely reactive substance. It catalyzes almost all known substances. Yet it has the advantage of being less reactive than, for example, many well-known acids and alkalies. They will dissolve substances in seconds—yet, during the process, they chemically unite, exhausting themselves and consuming the solutes. Water is ideally structured, so that it unites with some substances while enabling others to do their work—while the water remains a catalyst, frequently not becoming part of the chemical transformation.

It should be mentioned here that an apparent weakness of water is another of its valuable attributes. Lipids (including fatty acids) are virtually insoluble in water. But this has to be in order for life processes to occur! In addition, many synthetic reactions in the cell must be carried out in the absence of water. The insolubility of hydrocarbons makes it possible for this to occur. Water, inside the cell, is carefully kept in certain watertight compartments and never permitted to flood the cell. (An exception is a cancer cell, which is flooded with water, due to an invasion of chloride. A low-salt diet is one among many factors helping your body avoid such a problem.)

9 - Viscosity of water. Something that is viscous is thick and syrupy; it is resistant to flow. Examples of highly viscous substances would be tar, glycerol, and olive oil. In contrast, water has a very low viscosity; indeed, lower than almost any other fluid. As a rule, only gases (such as hydrogen) have viscosities markedly lower than water.

If the viscosity of water was much lower, delicate structures would be easily damaged and microscopic ones could not survive. If it was much higher, fish and microorganisms could not swim in water. Cell division could not occur. All the vital functions of living things would essentially become immovable.

10 - Diffusion rates of water. Because of its lower viscosity, water enables molecules within it to spread, or scatter outward—without the application of external force,—mixing with other substances and being absorbed by cells and microorganisms. If water did not have this quality, life could not exist in our world.

Diffusion rates in water are very rapid over short distances. One example would be oxygen, which will diffuse across the average body cell in a hundredth of a second. This diffusive ability of water makes it possible for tiny microorganisms to obtain their nutrients and dispose of waste by diffusion alone—without needing a circulatory system.

However, the diffusion of molecules in any liquid is very slow over longer distances. Because of this, larger creatures need a circulatory system—which has conveniently (and not by accident) been provided to them. In mammals, billions of carefully designed, wisely located, tiny capillaries permeate all the tissues of the body, transporting the necessary nutrients to the cells. Because diffusion is so ineffective over large distances, no active cell can survive in a mammal unless it is within 50 microns from a capillary. There are so many capillaries (miniature blood vessels) within a body, that 15% of the muscles consist of them! These capillaries are so small that 10,000 tiny parallel tubes could fit inside a cylinder the size of a pencil lead. Yet the fluid pumped through these extremely narrow capillaries would have to be very low in viscosity—or it could not flow! The wall of each of these tiny tubes is so thin that it consists of only a single thickness of cells. This providential “accident” permits the nutrients to easily diffuse out through the walls to the cells, and let waste flow in.

11 - Density of water. With the exception of lipids and fats, many organic compounds which are part of living cells have densities very close to that of water. Density determines weight. Many common minerals are much more dense than water. (Two of the heaviest are mercury and gold.) If water was denser, then no living creatures could be very large—for they would weigh too much and would need immensely larger muscles. Water that was less dense would cause a variety of serious problems.

—In summary, in every single one of its known physical and chemical characteristics, water is uniquely and ideally adapted to serve as the fluid needed for life on earth. Not in just one but many ways. Only a few of these vital properties have been discussed here. We are here viewing only part of a long chain of crucial factors—each one of which had to be planned in advance! Surely, in water we view a miracle.

THE MARVEL OF AIR

1 - Oxidation. Only an atmosphere with very specific qualities can support living creatures. A major requirement for life is energy; and much of this comes from a variety of chemical reactions. Yet most of them are classified as oxidations. This is because oxygen is needed for them to occur.

Because the oxidant in this reaction is oxygen itself, the process can only occur in an aerobic (oxygen) environment. This key reaction provides many, many times more energy than any of the possible alternative energy-generating reactions! This fact is truly astounding. Another example of the God-given wonders all about us, that we rarely consider. Without oxidation, living creatures could not exist. In higher life forms, the energy generated is used to make ATP (adenosine triphosphate) in the mitochondria of the cell. The procedure by which that is done is called oxidative phosphorylation, a process that is complicated in the extreme and requires a large number of complex steps; yet, like the production of complicated proteins or duplication of DNA, it occurs repeatedly each microsecond.

Oxygen is far better, in the amount of energy liberated, than any other chemical element except fluorine. Yet fluorine is extremely dangerous at regular temperatures. While hydrogen and oxygen combines to form water, fluorine combines with hydrogen to form one of the most dangerously reactive of all acids: hydrofluoric acid. Let no one tell you that it is safe to put even diluted fluorine in your mouth.

Compounds of carbon and/or hydrogen—the two most common atoms in organic compounds—each release vast amounts of energy. Yet oxygen, hydrogen, and carbon are extremely common in nature. This is more than a coincidence.

If the atmosphere had only a little more oxygen—everything would burn up when fires started. If it had less, needed chemical reactions could not as easily occur.

Interestingly enough, our bodies—although filled with oxygen—do not burn up because it is in the form of dioxygen (O_2), which requires enzymes to produce the needed catalytic reactions requiring oxygen. Because of the limited chemical reactivity of dioxygen, living systems can utilize this massive energy source in a controlled and efficient manner. Everything in nature is in perfect proportion!

2 - Solubility of oxygen. The solubility and rate at which oxygen diffuses in water is crucial to its usefulness in keeping us alive. If oxygen was either insoluble in water or chemically unstable in a liquid, it would be useless.

The amount of oxygen that dissolves in water is dependent on the solubility of oxygen (how easily it can disperse itself into the water) and the partial pressure of the oxygen in the air above the water. Complex factors are involved here,—yet we find that both are exactly right for organisms to utilize oxidation as a means of energy generation! If the solubility of oxygen was any lower, it could not be extracted from an aqueous solution at a sufficient rate to satisfy metabolic needs. If it was any higher, other problems would develop. Yet, even as it is, very complex functions—which the randomness of evolution could never produce—must occur, so those energy needs might be supplied. In addition, the circulatory and respiratory systems must work closely with the oxygen-carrying blood pigment, hemoglobin.

A related factor is temperature. The solubility of oxygen, and the amount of oxygen that can be in the water, drops rapidly as the temperature of the water increases. Add to this the problem that the metabolic demand for oxygen doubles with every ten-degree rise in temperature. This greatly narrows the temperature range in which higher forms of life can live. While single-cell forms of life can exist at all temperatures at which water is a liquid, complex multicellular life forms—which depend on the energy released from the complete oxidation of reduced carbon by free oxygen—is limited to a temperature range between 0° C (32° F) and 50° C (122° F). Everything has to work according to extremely close tolerances.

Large, complex organisms are entirely dependent on the energy released from the complete oxidation of reduced carbon, so carbon dioxide can be produced. This entire reaction could not occur if oxygen did not have the precise properties that it has.

3 - Air pressure. Researchers have discovered that the density, viscosity, and pressure of air is also crucial for life to exist on land or underwater. If the viscosity and density of air was not so low, it could not be inhaled and then circulated. As air pressure increases, so does the density—and breathing becomes more difficult. The range of pressure in the air about us is exactly right for us to live.

4 - Other factors. Oxygen also provides the ozone layer in the upper atmosphere, which protects us against lethal levels of ultraviolet radiation. Only the beneficial portion of the electromagnetic radiation reaches us.

We should not forget photosynthesis, which produces most of the oxygen on the planet, as it makes sugars from water and carbon dioxide. As animal life uses up the oxygen, it is continually replenished by the plants!

The end products of oxidative metabolism must be non-toxic and easy to eliminate—and so it is! The primary end product is carbon dioxide, which is breathed out from the lungs. An average man exhales two gallons of carbon dioxide daily. All this must be rapidly removed from the body; and it does so, leaving in a simple, harmless manner. Most food you eat produces acids. Yet they are changed into water and bicarbonate (a form of carbon dioxide, plus a little hydrogen), both of which are totally harmless, easily eliminated, and useful in the environment. Without carbon dioxide, photosynthesis could not occur in the plants. They give us oxygen, and we give them carbon dioxide. Everything is ideally arranged; a result of careful, highly intelligent preplanning.

Every detail of the plan is perfect. Here is another of these little details: Carbon dioxide mixes with water very slowly. But this is crucial; for if it happened quickly, carbonic acid would be produced in the body—which would release hydrogen atoms and subject the cell to violent fluctuations in acidity—which could result in death.

Carbon dioxide is the oxide of carbon richest in oxygen, while being extremely stable. It is exactly what we need.

The three basic chemical reactions (on which all higher life depends) use carbon, oxygen, water, and a little hydrogen. These three chemical reactions are oxidation, photosynthesis, and regulation of acidity. Let us now consider the special properties of carbon.

THE MARVEL OF CARBON

The chemical properties of the carbon atom are uniquely structured to form the complex molecules required for life. In addition, there is an abundance of it. Here, briefly, is the story of this amazing substance.

All the basic chemical building blocks utilized in the construction and maintanence of living organisms are organic compounds—molecules composed of the atom carbon (C), in combination with a handful of other atoms which include hydrogen (H), oxygen (O), and nitrogen (N). The world of life is the product of the compounds of carbon. Every living thing, and every part of every living thing, is composed of the three linked to carbon. The very word, "organic," in chemistry means a compound linked with carbon.

Carbon is atom 8 in the periodic table, and is unique in the myriad ways it can link together with other atoms to form massive numbers of different compounds. Over a quarter of a million have already been isolated and described. When carbon combines with other atoms to form organic compounds, the bonds between atoms are known as *"covalent bonds."* Covalent bonds are formed when atoms share electrons in their outer electron shell in an attempt to complete the shell.

Carbon, linked with hydrogen, forms the vast family of hydrocarbons. The diversity within this family is great. And it includes petroleum, waxes, turpentine, etc. The carbohydrates (starches, sugars, cellulose, etc.) are another subfamily.

When nitrogen is added to the compound, another family is formed; this includes amino acids, the building blocks of proteins.

Yet carbon is remarkably stable and inert. This is another critically important quality bestowed on it by the Designer. Because of this, no organic (carbon-based) substance is as violently reactive as sulfuric or nitric acid; and no bases are as corrosive as caustic soda.

In addition to their mildness, carbon compounds are "metastable"; that is, they can liberate free energy while themselves lasting a long time.

However, carbon compounds can only chemically react within a narrow temperature range, which happens to be the same range that living creatures can tolerate (0^o C [32^o F] to 50^o C [122^o F])—which also happens to be the same as that of liquid water!

It is an aphorism of chemists that "if carbon did not exist, it would have to be invented." But, of course, without carbon compounds, there would be no people to invent it.

THE MARVEL OF OTHER ELEMENTS

Many different elements are used in living things; and, in many cases, life is critically dependent on these elements having precisely the properties they possess. Of the 92 naturally occurring elements, 25 are presently considered essential for life.

Most of the elements used in living organisms occur in the first half of the periodic table of elements, from the first element (hydrogen), to molybdenum, the forty-second. Beyond that, only selenium, iodine, and tungsten play any significant role in living things. And even those elements are not essential in most organisms. Nearly all the elements in the second half of the table of elements, which are essential to life but in far smaller amounts, are also very rare. The elements which are the most important to life (from hydrogen to iron) are relatively abundant. There is a striking correlation between the abundance of the elements and their crucial need within living bodies. This is no accident.

Every one of the cycles essential to life on earth—the carbon cycle, oxygen cycle, nitrogen cycle, phosphorus cycle, sulfur cycle, calcium cycle, sodium cycle, etc.—involves a large number of different compounds and processes. As usual, everything has been planned out.

In view of the vast diversity of chemical compounds, and enormous range of their chemical and physical properties, it is astounding that so many of the elements can be so efficiently cycled. Yet so it is. If the properties of just one key compound in any one of the critical cycles could be changed—carbon-based life would be impossible. All of these cycles are interdependent; all are needed.

The temperature factor is also crucial to these cycles. Life is only possible over a very narrow temperature interval. And this range of temperature is only found on a planet at approximately the distance that the earth is from the sun!

The size of our planet is just right—not too small, that its gravity would be too weak to hold its atmosphere, and not so large that its atmosphere would have too great a pressure. If it were smaller, it would lose its water into the atmosphere and on into outer space.

Our sun is a "main sequence star," the type that provides a uniquely constant and ideal source of radiant energy to energize the water cycle and provide rain, on which life depends.

Special elements are extremely important. For example, iron and copper are essential for the manipulation of oxygen, molybdenum for nitrogen fixing, calcium and phosphorus for bone formation. And on and on it goes. Everything is just what is needed, and in the right proportions. Chlorophyll could not exist without magnesium, nor the hemoglobin in red blood cells without iron. Iron and copper have exactly the properties necessary for the nerves to carry an electrical circuit. The oxygen-carrying capacity of blood is only possible because of iron. No other metal could mimic the properties of iron in the hemoglobin. The destructive effects of oxygen in the body are eliminated by a copper compound, so oxygen can be safely utilized. Because it is extremely fast in diffusion, and can be high in concentration—calcium is the ideal element for triggering muscle contractions, transmitting nerve impulses across the synapse, signaling hormone release, initiating the changes following fertilization, etc. It is also extremely important in protein functions.

All of these various elements have been ideally structured for the functions they produce in maintaining life. Not one, nor several,—but all the conditions necessary for life have been ideally structured for the particular biological purposes they serve

How many other wonders are there? Too many to count. The universe is full of them. After you have explored the earth, explore the heavens—and you will find many more.

> "A handful of sand contains about 10,000 grains, more than the number of stars we can see on a clear night. But the number of stars we can see is only a fraction of the number of stars that exist . . The cosmos is rich beyond measure: The total number of stars in the universe is greater than all the grains of sand on all the beaches on Planet Earth."—**Carl Sagan, Cosmos, 1980.*

NUCLEAR AND PLANETARY MARVELS

Here are a few more of the wonderfully planned, perfectly designed things of nature,—and each of them existing within a very narrow range. The following list could be greatly enlarged:

Strong nuclear force. If it were larger, there would be no hydrogen which is essential for life. If were smaller, there would be no elements except hydrogen.

Weak nuclear force. If larger, too much hydrogen would be converted to helium. If smaller, too little hydrogen.

Electromagnetic force. If larger, insufficient chemical bonding; elements larger than boron would be unstable to fision. If smaller, insufficient chemical bonding.

Ratio of electron to proton mass. If larger or smaller, insufficient chemical bonding.

^{12}C to ^{16}O nuclear energy level ratio. If larger, insufficient oxygen. If smaller, insufficient carbon.

Ground state energy level for ^{4}He. If larger or smaller, insufficient carbon and oxygen.

Decay rate of ^{8}Be. If slower, heavy element fusion would generate catastrophic explosions in all the stars. If faster, no element production beyond beryllium, and thus no life chemistry possible.

Mass excess of the neutron over the proton. If greater, neutron decay would leave too few neutrons to form the heavy elements essential to life. If smaller, proton decay would cause all stars to rapidly collapse.

Polarity of the water molecule. If greater, heat of fusion and vaporization would be too great for life to exist. If smaller, fusion heat and vaporization would be too small for life; liquid water would not be solvent enough for life; ice would not float—and everything would freeze up.

Mass of our sun. If greater, luminosity would change too quickly and burn too rapidly. If less, range of planet distances for life would be too narrow; tidal forces would disrupt our planet's rotational period; ultraviolet radiation would be inadequate for plants to make sugars and oxygen.

Color of our sun. If redder, photosynthetic (chlorophyll producing) response would be insufficient. If bluer, phytosynthetic response would be insufficient.

Distance of our planet from the sun. If farther, planet would be too cool for a stable water cycle. If closer, planet would be too warm for a stable water cycle.

Gravity of our planet (escape velocity). If stronger, the water atmosphere and oxygen dome would not extend far enough above us. If weaker, the atmosphere would lose too much water.

Inclination of our orbit. If too great, temperation differences would too extreme.

Seasonal swing of our orbit. If too great, seasonal temperature differences would be too intense.

Rotation period (length of each day). If longer, diurnal temperature differences would be too great. If shorter, atmospheric wind velocities would be too massive.

Earth's magnetic field. If stronger, electromagnetic storms would be too severe. If weaker, our ozone shield would be inadequately protected from hard stellar and solar radiation.

Thickness of earth's crust. If thicker, too much oxygen would be transferred from the atmosphere to the crust. If thinner, volcanic and tectonic activity would be too great.

Ratio of the total amount of reflected light falling on earth's surface (albedo). If greater, runaway glaciation would develop. If less, a greatly accelerated greenhouse effect would occur.

Oxygen-to-nitrogen ratio in atmosphere. If larger, advanced life functions would proceed too quickly. If smaller, those same life functions would proceed too slowly.

Carbon dioxide level in atmosphere. If greater, a massive greenhouse effect would gradually develop. If less, plants would be unable to maintain efficient photsynthesis.

Water vapor level in atmosphere. If greater, runaway greenhouse effect would develop. If less, rainfall would be too meager for advanced life on the land.

Ozone level in the atmosphere. If greater, surface temperature would be too low. If less, surface temperature would be too high; there would be too much ultraviolet radiation reaching the surface.

Oxygen quantity in the atmosphere. If greater, plants and hydrocarbons would burn up quickly from fires. If less, advanced animals would have too little to breathe.

MARVELS OF THE HUMAN BODY

We began this chapter by considering the human brain. Then we turned our attention to the perfect planning required for some things that most people do not consider: light, water, air and oxygen, carbon, some other elements, plus nuclear and planetary design factors.

Earlier in this book, we considered the wonders of protein, the human cell, and several other astounding biological structures. Here are a few more to thank your Creator for!

As you read the following, keep in mind that it all came from two cells which had the ability to divide *and change into any random structure!* It is not possible that, without help from an outside Source, they could produce such exquisite, interconnected complexity!

Muscles and bones. In addition to more than 100 joints, the adult human body contains approximately 650 muscles. An adult has 206 bones, all of them perfectly proportioned for the work they must do, and nicely connected to tendons and cartilages. A baby has 300 bones at birth, but 94 of them fuse together during childhood. For supporting weight, human bone is stronger than granite. A block of bone the size of a matchbox can support 10 tons, or four times more than granite can. Yet that massive strength is needed for pounding and lifting.

Heart. The heart beats more than 2.8 billion times during the average human life span; and, in that time, it will pump around 60 million gallons of blood—the fluid of life. Even during sleep, the fist-size heart of an adult pumps almost 80 gallons per hour—enough to fill an average small car's gas tank every 9 or 10 minutes. It generates enough muscle power every day to lift a small car about 50 feet.

Pulse. The average pulse rate is 72 beats per minute at rest for adult males and 75 for adult females. The rate can increase to as much as 200 beats per minute during extremely active exercise. Resting pulse rates for athletes can be much slower than the normal 72 to 75 range. Missing just one or two beats—and you would be dead.

Lungs. The lungs contain about 300 million little air sacs called alveoli. If the alveoli were flattened out, they would cover an area of about 1,000 square feet. Without lungs and accessory air pumping equipment, you could not survive more than a few minutes.

Kidneys. The body of the average adult contains 79 pints of water, which is about 65 percent of a person's weight. Each kidney contains some 1 million individual filters; and between them the two kidneys filter an average of about 8 quarts of blood every hour. The waste products are expelled as urine at the rate of about 3 pints a day.

Blood. In general, the larger you are, the greater your blood volume. A 155-pound person has about 11 pints of blood. The body's entire blood supply washes through the lungs about once every minute. Human red blood corpuscles are created by bone marrow at the rate of about 2 million corpuscles per second! Each lives for 120 to 130 days. In a lifetime, bone marrow creates about half a ton of red corpuscles. All this is supposed to be accidental?

Skin. The body's largest organ is the skin. In an adult man it covers about 20 square feet; a woman has about 17 square feet. The skin is constantly flaking away and being completely replaced by new tissue about once every 4 weeks. On average, each person sheds about 105 pounds of skin and grows about 1,000 completely new outer skins during a lifetime. Without skin, you would be in an agony and die.

Stomach. Digestion is a precarious balancing act between the actions of strong acids and powerful bases. The stomach's acids are strong enough to dissolve zinc; yet they are prevented from destroying the stomach lining by bases in the stomach. To avoid damage, the cells of the stomach lining are replaced quickly: 500,000 cells are replaced every minute, and the whole stomach lining every three days.

Retina. The retina at the back of the eye covers only 1 square inch (650 sq mm), yet contains about 137 million light-sensitive cells: 130 million rod cells for black and white vision, and 7 million cone cells for color vision. —All that in one square inch of surface! The focusing muscles of the eye adjust about 100,000 times a day. To exercise the leg muscles to the same extent would require walking 50 miles (80 km). The optic nerve contains about 1 million nerve fibers.

Ear. The smallest human muscle is in the ear; it is a little over 0.04 inch long. Amazingly—yet urgently needed—the cells in the part of the inner ear where sound vibrations are converted to nerve impulses—have no blood vessels! Instead, they are fed by a constant bath of fluid instead of blood. Otherwise the sensitive nerves would be deafened by the sound of the body's own pulse.

Kidneys. A pair of organs, situated on the rear wall of the abdomen, are responsible for osmoregulation (water regulation), excretion of waste products, and maintaining the ionic composition of the blood. Over a million filtering units, called nephrons or kidney tubules, filter small molecules in the blood plasma with a molecular mass of less than 68,000 (water, salts, urea, glucose, and other wastes) while letting larger ones (proteins and blood cells) pass on through. (Otherwise your kidneys would quickly excrete all your blood cells!) The cleaned blood then leaves the kidney through the renal valve.

Nerve impulse. A neuron (nerve cell) transmits information rapidly—at up to 525 ft (160 m) per second—between different parts of the body. The neuron's dendrites receive incoming signals. Its axon transmits signals outward. Each unit of transmitted information is called a "nerve impulse." This is a traveling wave of chemical and electrical changes inside the membrane of the nerve cell. The chemical changes partly consist of the passage of sodium and potassium ions moving across the membrane. As this movement continues, sequential changes occur in the permeability of the membrane to positive sodium (Na^+) ions and potassium (K^+) ions. These produce electrical signals called "action potentials." These impulses are passed along as a pulse of electric charge. When the impulse reaches the next neuron, it is received at the synapse, which is a specialized area closely linked to the next cell. Upon reaching the synapse, the impulse releases a chemical substance, called a "neurotransmitter." This diffuses across to the neighboring cell, en route to its final destination, where it stimulates another impulse of the effector cell. —By the way, with trillions of possible nerve cell paths, how does the impulse, originating in my brain, have enough sense to select its way, from among many alternative routes, to my finger—so I can type a single letter of this sentence?

—More could be added about the wonders of the liver (with over 2,000 chemical production and storage functions), the lungs (which contain 300 million air sacs; and, if spread out, would cover a 730-square-foot area), the hormones (nearly a dozen glands producing 19 different hormones and regulating 28 different body functions), and dozens of other marvels in the human body.

Thank God every day of life for His blessings, and never deny His existence. He is the best Friend you could ever have. We will conclude this chapter with a description by a microbiologist of many years experience, of how a single protein, that has been synthesized in the cytoplasm of a tiny cell, is sent from one part of the cell to a lysosome in another part. This is a brainless wonder, guided by a Divine Hand:

> "An RNA copy (called messenger RNA, or just mRNA) is made of the DNA gene coding for a protein that works in the cell's garbage disposal—the lysosome. We'll call the protein 'garbagease.' The mRNA is made in the nucleus, then floats over to the nuclear pore. Proteins in the pore recognize a signal on the mRNA, so the pore opens, and the mRNA floats into the cytoplasm. In the cytoplasm the cell's 'master machines'—ribosomes—begin making garbagease using the information in the mRNA. The first part of the growing protein chain contains a signal sequence made of amino

acids. As soon as the signal sequence forms, a signal recognition particle (SRP) grabs onto the signal and causes the ribosome to pause. The SRP and associated molecules then float over to an SRP receptor in the membrane of the endoplasmic reticulum (ER) and stick there. This simultaneously causes the ribosome to resume synthesis and a protein channel to open in the membrane. As the protein passes through the channel and into the ER, an enzyme clips off the signal sequence. Once in the ER, garbagease has a large, complex carbohydrate placed on it. Coatomer proteins cause a drop of the ER, containing some garbagease plus other proteins, to pinch off, cross over to the Golgi apparatus, and fuse with it. Some of the proteins are returned to the ER if they contain the proper signal. This happens two more times as the protein progresses through the several compartments of the Golgi. Within the Golgi an enzyme recognizes the signal patch on garbagease and places another carbohydrate group on it. A second enzyme trims the freshly attached carbohydrate, leaving behind mannose-6-phosphate (M6P). In the final compartment of the Golgi, clathrin proteins gather in a patch and begin to bud. Within the clathrin vesicle is a receptor protein that binds to M6P. The M6P receptor grabs onto the M6P of garbagease and pulls it on board before the vesicle buds off. On the outside of the vesicle is a v-SNARE protein that specifically recognizes a t-SNARE on the lysosome. Once docked, NSF and SNAP proteins fuse the vesicle to the lysosome. Garbagease has now arrived at its destination and can begin the job for which it was made."*—Michael J. Behe, Darwin's Black Box (1996), pp. 107-108* .

The entire above process takes place in a split second. The various signals and checks (by over 25 different structures without brains—count them!) occur in order to make sure that only certain substances, no longer needed, are sent to the lysozyme.

By now you are wondering what a lysozyme is. Nothing complicated, just a tiny packaged structure (organelle) inside a cell that, among other things, has enzymes which break down proteins and other biological substances for excretion into the bloodstream. Lysozymes also play a part in digestion and in white blood cells (phagocytes), where they tear captured enemy bacteria to pieces.

You did not know that all this was in you. But God did, for He put it there. Out of thousands of different types of substances inside you, if only the seemingly insignificant lysozymes were not included in your body's blueprint, you would be dead within a week.