the WONDERS of NATURE

Volume 2

By Vance Ferrell

HUNDREDS OF FACTS ABOUT
THINGS ALL AROUND YOU
TO HELP YOU KNOW THAT GOD MADE EVERYTHING
AND THAT HE LOVES YOU

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man

INTRODUCTION

The evolutionists fell us that man is the product of chance. Random action of chemicals produced living creatures; random changes In those creatures produced more creatures; random changes in later creatures ultimately produced man. That is how the story goes.

Man talks about exploring outer space. In this chapter we will briefly look at some aspects of inner space-inside you. Everything within your body is a wonder, an absolute miracle of structure, function, and design. We could fill 100,000 large volumes with the amount of information known by modern science about the human body. Although the following is but the briefest of overviews, as you read each point, think to yourself: "How could it happen by chance?" and then settle it in your mind: "It couldn't happen by chance! It was done by the Creator God!"

1 - BONES

Bones are the framework for your body. If you did not have them, you would lie nearly motionless on the floor like a jellyfish. Your 206 bones are all perfectly shaped to do the right job and in the right way. Each bone is somewhat different from all the others, yet perfectly designed for its task. It is connected in just the right way to perform its functions.

Your finger joints move like a door on its hinges, so are called hinge joints. Your shoulders and upper legs have ball-and socket joints, so they can turn in every direction. How could such a joint make itself by chance? You would have a difficult time working and surviving without that special joint in your shoulders and legs.

Strong, fibrous bands, called ligaments, hold your joints together, and each moving joint is lined with a membrane that secretes a fluid (synovial fluid to keep the joints "oiled" and working smoothly. The ends of each joint has over it a plate of very smooth cartilage to provide a slick surface for rotation.

Inside the bones is a spongy material called marrow. This design provides great strength, yet makes your bones much lighter in weight. Since the area inside the bones is a highly protected area, the red marrow within it contains special cells. Those cells manufacture one of the most important substances in your body: red blood!

Everyone knows that there are only 2 bones in your head: your skull and your jaw. But did you know that, at birth, you had many bones in your head? They were all movable so your head could squeeze through your mother's birth canal. Later, they fused together. Everything was planned, carefully planned.

Your spinal bones are another total marvel. The spine is divided into a vertical stack of bones (vertebra), all carefully connected, with a central vertical hole. Through that hole a cable of nerves-your spinal cord-runs down the middle, with horizontal outlets in the vertebra so nerves can pass outward to various body parts. How could that complicated arrangement invent itself?

2 - *MUSCLES*

Hold your hand out in front of you and look at it. Move the palm up, then down, and around. Then rotate it slowly from one side to the other. There is hardly a movement that you cannot do with it. Notice that those motions involve your forearm and upper arm. From your shoulder down, all the muscles and bones are working together with your hand as it undergoes various movements. Place your left hand on your right hand, as you move the right hand. Feel the bones and muscles beneath the skin responding to the messages sent from your mind. Look at your hand carefully as you move your fingers in every possible way. Do it again, but this time with your other hand on your wrist, and then your forearm. Rotate your hand again, with your other hand on the forearm bones. Feel the radius and ulna bones turning over on one another as you do it.

Now, within your shoes, wiggle your toes.

Stand up and, with your hands on your hips, slowly walk across the room. As you go feel the bones and muscles moving in perfect coordination. Notice how your legs and body do what is needed to keep you balanced as you walk.

What is this amazing machine called the human body! It is astounding!

Your muscles are attached to your bones at exactly the right places where they will give the best leverage. That took thinking! Downstairs in your family workshop, make a couple bones and several muscles, ligaments, tendons, and all the rest, and then figure out the best place to locate the ends of the muscles in order to obtain the best leverage. Oh, you say, you don't know how to make a muscle! Well, no one else can either. That which intelligent human beings cannot do, random actions of molecules are supposed to have accomplished.

One end of each muscle (the insertion) is attached to a movable bone, the other (the origin) to a less movable one. Muscles are elastic and work in pairs: Most body movements require several pairs of muscles working together. When you bend your elbow (flexion), you can feel the muscle in your upper arm grow hard and thick as the muscle fibers shorten to bring up the forearm. At the same time, the contrasting muscles, those on the back of your upper arm, are lengthened and they pull against the front ones. Now reverse the process (extension) and your arm is extended outward again.

You have two types of muscles: voluntary (skeletal, or straiteal) muscles, and involuntary (smooth) muscles. The voluntary ones change body positions and only work when you want them to; the involuntary work automatically. Work automatically! How can a muscle work "automatically"? Well, they do anyway. These involuntary muscles control motion inside the body, circulate the blood, move food along the digestive tract, make eye adjustments.

Highly-trained scientists and technicians have invented cameras with automatic focus and aperture control. But your eye has always done both functions automatically. Obviously, a highly skilled Person produced that eye. The focusing makes adjustments in the lens system; the aperature determines the size of the hole through which light enters the optical instrument. Yet in your body, it is all done "automatically." literally thousands upon thousands of other adjustments are also made in your body automatically! Thousands are made each minute in each cell in your body. (See chapter 11, Cellular Evolution, for much more on this.)

3 - CIRCULATORY SYSTEM

If I tried to put an ad in the newspaper announcing houses that come with self-manufacturing plumbing and electrical systems, they would tell me I was writing science fiction, and refuse to print it. If I tried to have it printed in a science magazine, they would laugh in my face. But that is what your body does. Before you were born, it constructed its own plumbing and electrical system-and more besides.

Your body is filled with plumbing; in fact, with several totally different plumbing systems. These include your circulatory system, which sends blood all over your body, your urinary system, which purifies the blood, and your lymphatic system, which carries on additional cleaning actions in body tissues. There are also compact plumbing systems in the liver, kidneys, mammary glands, skin sweat and oil glands, and the endrocrine glands.

Your circulatory system is composed of a blood pump (your heart), and the plumbing (blood vessels) needed to carry fluid (blood) throughout your body.

The structure of the heart is another great marvel. It is perfectly designed for what it must do, and is the hardest working muscle in your body.

In the wall of the right atrium of the heart is a small spot of tissue. Called the sino-atrial (SA) node, approximately every second this tissue send out a tiny electrical signal which special nerves quickly carry throughout the heart muscle in the right ventricle. The message it sends is: "Beat!" Instantly, a second node, the atrioventricular (A V) mode (bundle of His) is alerted and relays the message on to the left ventricle: "Bead"

And your heart beats! Moment by moment, day by day, year by year, it keeps beating. How thankful are you for that beating heart?

The heart is a powerful pump that drives 5 to 6 quarts [4.7-5.7 liters] of blood per minute through several miles of tubes in your body. During active exercise, this can go up to 20 quarts]19 liters]. Consider the complicated, yet efficient design of the pump:

Blood from all parts of your body returns through the superior and inferior vena cava (the largest veins in your body) and enters a "waiting room," the right atrium (right auricle), ready to enter the right ventricle. When the next heart beat occurs, the ventricles squeeze. The load of blood already in the right ventricle is squeezed out into the pulmonary artery (and is sent to the lungs for oxygen). None of that blood flows back into the ventricle, because the semllunar valve guards the exit. That same squeeze brought the waiting blood from the right atrium through the tricuspid valve into the right ventricle. That valve keeps it from flowing back into the right atrium.

Blood returning from the lungs passes through four pulmonary veins into the left atrium (left auricle). A mural (bicuspid) valve guards the entrance into the left ventricle. Then comes the next heartbeat which sends that blood into the left ventricle,-a split second after the blood in the ventricle has been squeezed out through the semilunar valve into the aorta (the largest artery in your body).

The blood in the aorta goes to all parts of your body. From the aorta, that crimson stream is carried to still smaller arteries, and thence into arterioles. These flow through capillaries so tiny that the blood cells must pass single file. As they do, oxygen and nutriments pass across into the cells, while carbon dioxide and wastes leave the cells and pass out into the capillaries. Still other wastes pass out into the lymph vessels to be carried away. From the capillaries, the blood passes into venules, then into veins, then into the inferior or superior vena cave, and back to the heart. Random activity of molecules is supposed to have invented all that? Why, the organism would be long dead before "natural selection" ever got started trying to figure out such complication! Natural selection is simply random activity, and nothing more; it does not have the brains to accomplish anything worthwhile.

Your blood cells are very complex. In chapters 10 and *11 (DNA* and Cells), we discuss part of the immense requirements needed to invent blood and other body cells. There are different types of blood cells; each one is vital and each one contains hundreds of key factors needed for life. Complicated enzymes must be present to prodace the crucial ingredients in those cells.

One cubic centimeter-smaller than a drop of blood contains an average of 41/s-5 million red *blood cells*. They wear out in less than a month, and more are made in the red bone marrow. That same cubic centimeter of blood contains 7,0009*,000 white blood cells,* and increases to 15,00025,000 when infection occurs. There are several types of white blood cells. That same cubic centimeter of blood contains 250,000-500,000 *blood* platelets *(thrombocytes). If* you cut your finger, these are used to quickly clot the blood so you will not bleed to death.

The above description is over-simplified in the extreme. But it is enough to take one's breath away! A Powerful, and extremely intelligent Being created you!

In addition to the blood circulatory system, there is the lymphatic system. If all your body were removed except your lymph vessels, the complete three-dimensional form of your body would still be there. That is how many lymph vessels there are in your body! Your lymphatics are used to carry away additional wastes from your cells.

4- DIGESTIVE SYSTEM

For a moment, let us consider your digestive system, a complicated structure that harmful mutations, assisted by random actions ("natural selection") is supposed to have developed Of course, evolutionary processes would have had to produce it within a few days or your first ancestor would have starved to death very quickly.

Evolutionists say that, given enough time, anything can be done. But that is not true. (1) Given enough time, randomness only increases confusion. (2) In relation to living creatures, all the complicated organs had to be in place-fast!

In or near your mouth are teeth to chew food, a tongue to move it around, and seven different salivary *glands to* produce saliva to predigest part of that food. Any one of those items would be impossible for chance to invent. It is only their great ignorance that enables people to glibly speak about how "evolution operates by mutations and natural selection." Anyone who takes time to study into the multitude of nerves leading to the tongue will be dumbfounded with amazement. All those nerves were needed, for you were purposely designed to be able to think in words and then speak them with your tongue.

From the mouth, the food is sent to the back of the throat where it passes through the swallowing *mechanism. How* may ages did it take for natural selection to figure out that you needed to swallow food without choking to death instead? Until that happened, food would all pass into the lungs instead of into the stomach!

Another little detail: Your *pharynx not* only contracts so you can swallow food properly, it also connects through *eustachian tubes* to each ear. Without those tubes, changing air pressure would quickly destroy your hearing!

Passing down the 10-inch [25 cm] esophagus, the food arrives at your stomach. The cardiac valve guards the top end, and the pyloric valve the bottom end of your stomach. Both are ingeniously-designed spincter muscles.

Within the stomach, the digestion begun in the mouth continues on. Signals are sent to the stomach wall, and its excretes an acid so powerful that it can digest meat! Why then does it not digest the stomach and everything inside your body? No one has ever satisfactorily explained that question. Next the stomach begins churning back and forth, mixing the contents with *hydrochloric* acid. All the while, the pyloric valve remains closed.

Then, something tells that valve to open, and the contents start entering the small Intestine. The upper 10-12 inches [25-30 cm] of it is called the duodenum. Within that short length of tubing, bile pours in on signal from the gall bladder. (It was oil in the food which triggered that signal.) The wall of the duodenum also signals the pancreas on the other side of the body to quickly send over some pancreatic juice. Still other types of juices come from the wall of the duodenum. All of those juices work to break up fats, proteins, sugars and starches into still smaller particles.

The food gradually moves downward through the small intestine, which is 11/z inches wide [3.8 cm] and 23 feet [7 m] long. Throughout its entire length, little fingers protrude from the walls. These are called villl. In the center of each is a lymph channel (lacteal), with blood capillaries surrounding it. Between the villi are additional intestinal juice glands. The villi absorb the nutriments and send them into the blood stream.

You could not design a more efficient way to do it if you tried, yet evolutionists say it all happened by chance. When asked how that could be, the reply is always the same: "long ages of time, long ages of time; anything can be done if given enough time." How did we live during all those "long ages" until our villi were invented?

The *liver is* generally classified with the digestive system, but it accomplishes a wide range of tasks. Aside from your skin, this is the largest gland in your body, and one of the most astonishing structures in your body!

The liver literally performs thousands of different functions! It is amazing how such a small organ can do so many things. Here are a few of its major activities: (1) It is a collection and filtration plant, carefully removing a variety of substances from the blood. (2) Working with waste products and nutrients brought to it in the blood stream, it manufactures literally hundreds upon hundreds of different chemical substances. Among these are bile, glycogen (stored sugar), and blood clotting aids and preventatives. (3) Since it does so much, how can the liver find room to store anything,-yet it does. It is a warehouse and stores iron, vitamins, copper, amino acids, fats, and glycogen. (4) It is a heating plant, producing more heat than anything else in the body except the muscles. (5) It is a waste disposal plant. Like the *kidneys,* it filters all your blood, removes certain waste products, and sends them off for excretion. Aside from your blood cells, the liver and kidneys are the major detoxification points in your bogy.

We will discuss the pancreas later.

6 - RESPIRATORY SYSTEM

Here is another miracle system. Air enters your nose and passes down to that same *pharynx* again. But this time, the swallow mechanism is not in operation, so the air goes directly downward into the *larynx,* past your *voice box,* and into the *trachea,* which then divides into the two *bronchi,* which then lead through the *bronchioles* into tiny air sacs called *atria.* Think of two trees with their branches continually rebranching until finally they end-in grapes! That is the appearance of the bronchi, bronchioles, and atria. Tiny projections, called *alveoli,* protrude outward from each grape-like atrium into the lung. It all does look very much like a bunch of grapes! The plan is to exchange oxygen for carbon dioxide-as much as possible and as quickly as possible. There are over 400 million alveoli; each one is closely connected with blood and lymph vessels, nerves, and connective tissue.

That is what, on the inside, your lungs look like; From the outside, the lungs appear to be two cone-shaped organs, nicely designed to fit the space in your chest. Your left one is not as large, in order to make room for the heart just below it. Your lungs hold about 31/z quarts [3.3 liters] of air, and are remarkably like air bellows, partly filling, partly emptying, partly filling, partly emptying; this goes on constantly, night and day. It should not take long for such action to wear a hole in the side of the lungs, but instead they are wrapped inside the *pleural cavity.* Moist fluid is exuded by the walls of the pleural membrane, which provides a slippery surface for the lungs to move against.

Please remember that, throughout this chapter, you are observing only the barest outline of the body systems. It is similar to lifting the top off the central processing unit of a home computer, letting you gaze within at the electronic boxes and cards neatly stacked inside,-and then concluding that you understood the complexity of a computer!

Several lengthy books could easily be written about each italicized word in this chapter.

6 - URINARY SYSTEM

Your *kidneys* are the primary filtration and removal plant in your body. They are your blood cleaning organs. Most of your kidneys consist of *nephrons. Each* one is a capillary cluster with a coiled tube attached to it. There are over a million of them in your kidneys! As the blood passes through the capillary cluster, water and waste products filter through the capillary walls and into those tubules. Most of that waste water is cleaned and returned to the blood. Your kidneys, then, are like a million little thinking machines, each one of which knows just what to remove from the blood and what to leave in it.

The waste fluid drains out into a collecting basin in each kidney called the *renal pelvis.* From each one, a tube leads down into the *bladder.* When the bladder fills to about 200 cc [12.2 cu inches], it sends a signal to the brain to void the *urine.* How can a bag send a signal? How does it know to do it at the right time?

7 - ENDOCRINE SYSTEM

The *endrocrine glands* are located in various parts of the body and pour their *secretions* directly into the blood stream. They produce chemical substances which speed up or slow down the activities of various body organs. These substances, called *hormones,* also affect each other's actions. Each endocrine gland is a fantastic organ for what it can accomplish, especially in view of its small size.

1 - The Thyroid Gland. The thyroid is in the center front of the neck, and looks something like a butterfly with wings 2-3 inches [5-7.6 cm] wide. It is just behind your voice box. The thyroid secretes *thyroxin (thyroxine),* and regulates the rate at which the cells burn food. Thus, it regulates *metabolism.* If too much thyroxin is sent out into the blood stream, all body activities are speeded up, and the cells burn food so rapidly that the body uses up its daily supply of nourishment and draws on the stored reserves. If the thyroid does not secrete enough of this hormone, the cells burn food too slowly. this interferes with body development and slows body activities.

How can the extremely small amount of thyroxin sent out by this gland get to each of the billions of cells in your body, and affect them? In what way does that fluid signal them to speed up or slow down? All this is a great mystery. Thyroxin is almost pure iodine.

2 - The Parathyrolds. Four small glands, each the size of a pea, are the *parathyroids.* There are two of them on each side of the thyroid. These extremely tiny organs secrete a hormone (parathormone) which regulates the amount of calcium in the blood. The amount of calcium in the blood directly affects nerve and muscle irritability. Too little, and muscle spasms and convulsions bring death within a few hours. Too much, and the body uses up calcium faster than it can get it from ingested food, and calcium will then be drawn from the bones and they will become soft and eventually break.

All the hormones are utterly mysterious, yet we all take them so much for granted. They are miracles; describable, but inexplainable. Each endocrine gland is as truly miraculous as any miracle found in the Bible. The endocrines are blessings to mankind sent from the same Source as all the other miracles.

3 - The Adrenals. Also called the suprarenals, these two glands are at the upper end of the kidneys. Each one is so tiny it is the size of the last joint on your little finger. Each adrenal gland is really two separate endocrine glands because its two parts produce different hormones.

The central part (the medulla) secretes the hormone *epinephrine (adrenalin), which* brings many body processes into action quickly. This is the "fight or flight" hormone. It makes the heart beat faster, raises blood pressure, increases muscle power, and makes blood clot more rapidly. -A tiny amount of fluid from part of a large bean can do all that? Emotions of fright, anger, love, grief, or pain signal the epinephrine to be sent out.

The outer part (the cortex) secretes several hormones. One of these, cortin, regulates the behavior of salts and water content in the body. Certain male and female hormones are also secreted by the adrenal cortex.

4 - The Pancreas. When the duodenum signals it to do so, part of the pancreas sends secretions to the duodenum to aid in the digestion of food. Yet another part of it contains the islets of *Langerhans, which* secrete *Insulin.* This regulates the amount of sugar in the blood. If too little insulin is sent out, sugar accumulates and the kidneys try to get rid of it through the urine.

5 - The Pituitary Gland. The pituitary is often called the "master gland." It is located in one of the safest places in the body: the center of your skull. Attached to the base of the brain in the region back of the eyes, it is only about the size of a pea, yet it secretes more potent hormones than any other gland. How can it do that when it is one of the smallest of the endocrine glands? It has two **parts, the anterior** lobe and the posterier lobe.

The posterior *lobe* secretes two hormones: The first of these, vasopressin affects the smooth muscles, raises blood pressure by constricting blood vessels, and stimulates the reabsorption of water in the kidney tubules, thus affecting water balance. The second, oxytocin stimulates contractions of the uterine muscles.

> The anterior lobe of the pituitary secretes several hormones. One regulates the thyroid, another controls the adrenal cortex, another stimulates sex and mammary gland activity, and another regulates growth of bone and fibrous tissue. It is the pituitary anterior lobe which determines how tall you will become. It is also decides how much pigment you will have in your skin.

6 - The Gonads. The gonads are the reproduction glands: the testes in men and ovaries in women. The testes secrete male sex *hormones (androgens), which* includes testosterone. The ovaries produce estrogen *and progesterone*. These **hormones are powerful in their effects** on the body, yet they come from small glandular organs.

7 - The Thymus. The thymus lies behind the breast bone (sternum), but its purpose is still not clearly understood. It apparently has something to do with attaining sexual maturity, for it atropies following puberty.

8 - The Pineal Gland. The peneal is attached to the brain and is another endocrine puzzle. Apparently it has some effect on growth. Tumors on this gland in children accelerate sexual growth.

9 - Other Hormones. The stomach wall secretes a hormone, gastrin, which affects the blood vessels and secretions of the stomach glands.

At the beginning of the small intestine, the lining of the duodenum secretes two hormones: Secretin stimulates the pancreas to send pancreatin, a digestive fluid to the duodenum wall for excretion into small intestine. A second hormone signals the gallbladder to contract and send gall into the small intestine.

The placenta is also a temporary endocrine gland which excretes hormones to regulate and maintain pregnancy.

8 - THE NERVOUS SYSTEM

There are several other complicated body systems, such as the skin and the reproductive system, but we will conclude this chapter with the nervous system.

Without nerves, your body could not send, relay, or receive any signals. Without nerves, you could not think or even live. A large part of your nerve activity is done without your conscious thought, and is called the autonomic nervous system.

Did you know that the best way to build a telephone switching station is to send in several dump trucks with sand, dirt, rock, and odds-and-ends junk? Then send in a bulldozer to scatter it around a little. After that leave it for several million years and return-and you will have a complete switching station, ready for operation? Well, that is how evolutionary theory would build one.

But within your body is a switching station and far more: a complete electronic computer system operated by something equivalent to an Intel chip 500,000. (As these words are being written, the largest home computers are Intel 486 in capacity.) Literally millions of connections are to be found inside just a pinhead of space in your brain. Main cables flow out from the brain and down through your spinal column, and then out to various parts of your body. And all that is supposed to have come about by chance?

Through a network of wires, messages come into the central switchboard, where the necessary connections are made to direct them out to the right places. Your nervous system is organized to bring messages into a center which relays them out to certain parts of the body. The brain and the spinal cord are the switchboard, and the nerves are the wires that carry incoming and outgoing messges. The deference is that thinking is a part of your switchboard system.

Your brain weighs about three pounds. It is similar to a bowl of jelly, yet it is the most fantastic creation in our world. The largest part is the cerebrum which fills the upper part of the cranium. Next is the cerebellum, located below the cerebrum. The third major part is the *brain stem,* with its pons and medulla.

The cerebrum is the main brain and is divided into two halves, one on either side, called hemispheres. The outer part is the cerebral cortex. This is soft grayish matter filled with nerve cells. Beneath it is the white matter, which has the nerve fibers, or "wiring," leading out from the gray matter. The cortex or "gray matter" is heavily wrinkled. That is done to give it a much greater area. If it was flattened out, it would cover a surprisingly large area. Some centers in the cerebrum think, some are memory. Others are related to hearing, sight, movement, and speech.

Directly beneath the left and right cerebral *hemi*spheres, and covered by them, are two other centers: the thalamus and the *hypothalamus. The* thalamus is a relay station; receiving impulses from every part of the body, it sends them to exactly the right part of the cortex. The thalamus also interprets sensations, and tells the brain whether they are pleasant or unpleasant. The main job of the *hypothalamus is* to regulate the action of various body organs in order to maintain normal conditions. For example, you shiver when you are cold because of the hypothalamus.

The cerebellum maintains body balance and coordinates groups of muscles. It is because of the cerebellum that you can walk across the room, or reach down and pick up a book. Skill in sports is related to good cerebellum connections.

At the top of the brain stem is the *midbrain,* which is an important reflex center. A reflex is an action that takes place automatically when something happens. If you look into a mirror and shake your head, your eyes will keep looking forward. It is the midbrain that tells them to do that.

The pons is the bridge between the cerebral cortex and the cerebellum, carrying messages from one to the other.

The medulla is just below the pons and is on the very bottom of the skull. It connects the brain with the spinal cord. It also controls certain factors on its own. One of these is the amount of carbon dioxide in the blood. The medulla, in some mysterious way, knows that percentage,-and then sends out signals instructing you to breath faster or more deeply. It also guides the rate of heartbeat. It even affects the muscles in the smallest arteries. The spinal nerves from the two halves (hemispheres) of the cerebrum cross over in the medulla before proceeding on down to the body.

The spinal cord is a long mass of nerve fibers reaching down through the central holes in all the vertebra in your spine. The spinal cord does two things: (1) conduct impulses from the brain to the body, and (2) operate as a reflex center apart from the brain. When you touch something hot, the spine sends the message to move your hand back quickly. That arrangement was wisely planned, for the nerve impulses warning of terrible danger did not have to travel as far before a message could be sent back to take proper action.

You have different types of nerve cells; we will not take the space here to describe them. Suffice to say that they are extremely complicated. Each nerve connects with thousands of other connections in nearby cells. The result is a massive electronic circuit board arrangement,-and all connected to part of a thinking mind.

The major nerves for your body exit the brain and travel down through the spine and then go outward at various points. There are 12 pairs of cranial nerves and 31 pairs of spinal *nerves. The* cranial nerves attach directly to the brain, and most of them carry impulses to and from the brain and various structures about the head (sensory organs, swallowing, speech, hearing, sight, tongue, jaw, etc.). However, other cranial nerves connect with organs in the thorax and abdomen.

The spinal nerves are attached to the spinal cord, and carry impulses from the skin and some internal structures to the central nervous system.

But now, forgetting all the rest; let the evolutionists satisfactorily explain the brain, the nerves, and and spinal cord-on the basis of random actions ("natural selection") and harmful accidents ("mutations"). We await their reply.

CONCLUSION

We have not taken space in this chapter to discuss the sense organs, and they are just as wonderful, if not more so, than some of those we have already discussed.

The eye we discussed in some detail in chapter 13 (Natural Selection). The ear has some of the most delicately complex structures to be found anywhere in the body. For example, consider this: Blood bathes every part of your body, and flows next to and into every cell,-with one exception: the cells in the ear which are involved in hearing. Why is that? If blood capillaries flowed next to those particular cells, you could not hear properly! You would hear the faint beating sounds of the blood rushing along as it is pushed by the heart pump. So, instead, fluids containing no blood are sent that final short distance to bathe, nourish, and clean those hearing cells.

That was done by chance? There would be no reason for random activity to do that.

Why do you have eyelashes? They keep dust out of your eyes, but are in no way needed for survival. A thinking Creator would bestow eyelashes upon His creatures; the chance workings of so-called "natural selection" would never produce these perfectly-located little helpers.

Why do you have odor-detecting cells in your nose? Why can you taste with your tongue? Why does food itself have built-in flavor? The food and your tongue were designed for one another!

> There are three semicircular canals, shaped like small horseshoes, that are close to each ear. Each is partly filled with fluid that is set in motion by head or body movements. Sensitive nerves send signals from this fluid to the brain. Without those structures and those signals, you could not maintain body balance; you could not stand up without falling down. Think about the semicircular canals for awhile; how could they arise by merest chance?

Everything is a miracle; an absolute miracle. It all came from a God of miracles; your heavenly Father. He made you for purpose: to live a good, clean, unselfish life. He alone can help you live such a life. Come to Him just now; tell Him your needs. Let Him give you forgiveness for the past, and help for the present and future. He is waiting, just now.

The Creator's Handiwork

MORE WONDERS OF NATURE

INTRODUCTION-

The French physicist, ReneAntoine de Reaumur (1683-1757) was so impressed by the geometrical perfection of the hexagonal cells made by worker bees in their beehives, that he urged scientists throughout the world to adopt the cross-sectional measurement of this six-sided cell as the fundamental unit of measurement) So flawless, so perfect is this cell, and so uniform is it in size throughout the works, that de Reaumur declared it to be the ideal worldwide basis for measurement. There is nothing— anywhere on earth—that man makes, de Reaumur said, which has the consistency of dimension to be found in the cell of the bee.

What is this astounding creature that it is able to combine both complexity and perfection of design? Let us consider the bee:

BEE COLONY—Bees live in colonies, called a swarm, and may number from 10,000 to 60,000 or more individual bees. Considered singly or together, they are a masterpiece of creation.

Although they all came from eggs of the same queen, there are three different types of bees in the hive, and each knows exactly what its task is. There is the queen (female), the drones (males), and the workers (undeveloped females). Interestingly enough, the queen does not rule the colony) No one rules it! Each one does its job as if it had

gone through a training school, graduated, and then had work supervisors to guide and keep it at its work. Yet the bees live and work with no schools, managers, or supervisors.

BEE STINGER— People fear being stabbed, so they leave the bee alone to go about its work. A bee's stinger is a spear located on its rump. A bee's stinger has nine barbs on each side and is split down the middle. The two halves slide back and forth on each other. This double spear is enclosed in a sheath worked by strong muscles. The two halves slide back and forth with a pumping action.

When the spear enters flesh, the barbs hold fast. A bee is so lightweight that it cannot get a good hold on that which it stings. But the stinger does it for the bee. It pumps itself in.

When the bee tries to pull away, it is fatally wounded. Bees are not anxious to sting people. They only do so when frightened or angry. (If you are stung by a bee, scrape the stinger off immediately, for it is attached to a muscle that continues pumping after it is in your skin. By acting quickly, you will reduce the amount of poison that enters the wound.)

BEE EYES —A bee has five eyes. There are three small ones in a triangle on top of its head, and a large compound eye is located on each side of its head. Each compound eye is a marvelous interconnected arrangement of thousands of single eyes placed close together. With their eyes, bees can distinguish blue, yellow, and ultraviolet.

The bee is largely guided by what is called "the polarity of light." The eyes of the bee operate something like a compass, for they are sensitive to the polarity of sunlight. Waves of light, streaming from the sun in all directions, travel directly outward; each beam in a single direction. As the earth turns on its axis, each animal and insect views this direction of light from a constantly changing angle from sunrise to sunset. That tiny angle of each shaft of sunlight is analyzed by the eye and brain of the bee, telling him directional information: where the sun is, where the bee is, and where the hive is. Because of certain information given it back in the darkness of the hive, it also uses sunlight to tell it where its food is!

BEE WINGS—The bee has two pair of amazingly efficient, powerful wings that work too well to have occurred by chance. The bee has a large, bulky body with wings that seem too small to match it.

Why are the wings so small? They are small because the bee has many duties to do inside the hive and it could not do them if it had wings that protruded out the back far enough to properly bear its weight in flight. As a result, scientists have concluded that the wings of a bee are too small for it to fly! Bees laugh at this, for they fly anyway —the equivalent of thousands of miles in their brief lifetime.

The solution to the aerodynamic design of the bee's wings is this: The larger front wing on each side has a ridge on its trailing edge with a row of hooks on it. These hooks attach to the rear wing when in flight. In this way four small wings on the ground convert into the equivalent of two large wings when flying! Upon larding, the two wings are unhooked and again overlap, greatly reducing their size) How is that for wing design?

In addition, the honeybee wing beats a fabulous 200 times a second. This is extremely fast in view of its large size. The mosquito is 600 times a second, but it is so much smaller than the bee. Some small beetles beat as fast as 55 beats per second, but that hardly compares with the honeybee. Yet the Designer saw that the honeybee would need its larger size in order to carry so much special equipment around with it, while needing small wings for its many crowded duties inside the hive.

The wings, and muscles attached to them, have been so carefully planned that in flight the wings move in a figure eight design, which makes it possible for the bee to go any direction—up, down, sideways, backwards, forwards, or any combination of those directions. It can remain motionless, hovering before a flower as a hummingbird does. It is all keyed to a figure eight wing motion, and when the shape of the figure eight is changed by the muscles which control the set of the wings) the wing beat changes from up, to down, to sideways, etc.

This arrangement of muscles and wing structure is complicated in the extreme, yet the result is one of the most efficient flight systems on earth!

When the bee arrives at the flower, it is able to crawl inside. If it had fixed wings like a dragonfly, it could not do so. But instead, it has wings that quickly fold together—and into the flower it goes!

BEE ANTENNAE -—There are two slender, jointed feelers which are attached to the head of the bee. Such exquisitely tiny things surely cannot fulfill any useful purpose. But wrong again! On the top of each of those little threads, which the bee uses to smell and touch with, are miniature sense organs. Down the center of the antennae a nerve passes from that detection device to the brain of the bee, relaying information.

Bees talk to each other by several methods, one of which is their antenna. They will touch them together and thus communicate. Special warnings of danger and other messages are communicated in this way.

BEE MOUTH —In front of its head are four structures which are two jaws. In front and between them is a tongue. This tongue, or proboscis, is a flexible tube which the bee uses to suck up water, nectar, and honey into its mouth. It can be shortened, lengthened, and moved in all directions. When not in use, it is curled up under the head.

The jaws are used as pliers to grip with. In addition to holding onto leaves and petals, the jaws mainly work with wax and pollen.

Peer closely into the face of a bee as it works on clover blossoms, and wonder how those tiny mouth structures can do all that they have to do. Think of how perfectly they are designed, and the delicate nerves attached to them.

BEE LEGS The bee has three legs on each side of its thorax. Each leg has five main joints, plus tiny segments that make up the foot. With five joints, each leg can twist, turn, and move in just about any direction needed. The very small parts of the foot are exactly suited for standing and walking in relation to the bee's size and weight, even when fully loaded with pollen, nectar, honey, or wax.

The honey bee has sharp tips on its claws on each foot, to enable it to walk along on any rough surface. Between its claws it has a little pad or cushion called the pulvlllus that enables it to walk on smooth, slippery surfaces, such as glass. That is a well-designed foot!

The bee is continually using its legs and feet to clean off its body and work with pollen and wax. On two of its legs are "pollen baskets," but more on that later.

When the bee inserts its head into flowers, the antennae frequently become coated with bee glue or other substances—It is very important that the bee have some way to clean its antennae. On the front legs is a movable piece of tough tissue, which can be raised like a lid, making an opening. On the edge of this opening are short, stiff hairs. The bee bends an antenna toward the left, opens the leg gate, inserts the antenna, closes the gate, and then draws the antenna back and forth between the stiff hairs. Quickly and simply, that antenna has been thoroughly cleaned! Then the other antenna is cleaned.

How did evolution produce the tiny, specialized equipment needed for that task, and then teach the bee how to go through the process?

HEAVY FREIGHT TRANSPORT —These Little black-and-yellow balls of buzz are amazing creatures. A drop of honey is a high-octane fuel that gives the bee power to go from flower to flower. The bee must tank up with exactly the right amount of honey when it leaves the hive and travels to the flowers. If a mistake is made, it will not return alive. —More later on how it knows how much honey to take.

A bee is the only flying creature built to carry heavy freight. It has storage space and lifting power to transport syrup, pollen, and varnish. It easily manages heavy airborne cargoes. Everything else that flies—birds, bats, insects—carry only themselves through the air, except for relatively light mail, such as twigs and worms which birds carry in their beaks occasionally.

Men build small cargo planes and giant ones. Some carry passengers, while others carry heavy freight, such as jeeps and trucks. But all of them only carry a pay load of about 25 percent of their weight. In contrast, a bee can carry a cargo almost equal to its own weight; an almost 100 percent pay load!

Man-made planes have powerful wings for lifting, but there is no power in those wings to move forward. They can lift only when engines drive the plane forward fast enough to make suction on their top surfaces. The bee has short wings on a fat body, but it can move up, down, sideways, or hover. It does not have to move forward for its wings to lift. It needs no propeller nor jet, for its wings provide both lift and power!

SCOUTS— Now it is time for our bee to go out and gather some honey. But where will it go? How does it know where the flowers are? It is vital that this information be obtained, for it needs to know how much honey to tank up on for the flight.

The bees do not leave the hive to bring back honey until they know the kind of flowers, and the direction and distance to those flowers. Somebody must give them flight instructions. This will not be the queen, for she never issues an order. Entirely preoccupied with laying eggs, she knows nothing about flowers, pollen, or nectar. She might spend an entire year in a hive, and yet go out into daylight only twice in her life. The job of gathering nectar and pollen belongs to the worker bees.

(The worker bee inherited all its knowledge from its mother, the queen. Yet she knows nothing about the abilities and duties of a worker bee.)

Bees are marvelous honey-gathering workers and they should not spend their valuable time looking for honey. So, instead, they send out a few of their number—the scouts—to survey the territory for miles in every direction. These scouts bring back immediate reports on the prospects for honey. Availability of nectar this morning will be different than yesterday afternoon—or later this morning or afternoon. Scouting continually goes on, and report are continually being brought back to the hive.

Perhaps a dozen bees will leave the hive and fly off in different directions. Scouting the countryside, they fly around in the vicinity of the hive in ever-widening circles. The honey may be near or some distance away. The scouts may have to search across miles of countryside. When one of these scouts returns, it will tell the others exactly what

kind of flowers are open, and give them a compass bearing for the direction, and also announce the distance to the spot. Many other creatures can communicate, but few can tell it with the clarity of the bee.

Wait a minute! We are talking about insects with brains as big as pin heads! How can they learn such information-or impart it to others? How can all this knowledge of how to fly, clean antennae, make honey, bee bread, bee cells, and all the rest;—how can all that knowledge be in those tiny pinheads? How can they all work together, with no boss to organize and tell them what to do? This situation of the bees is becoming more impossible, the more we learn about it!

But it is so! The bees do all the above and much, much more. And they do it regularly, day after day, month after month, year after year.

BEE DANCE—The Austrian naturalist Karl von Frisch, spent most of his adult lifetime studying the bees. He learned so much that he is well known among scientists for his investigations.

Von Frisch placed dishes of nectar in certain locations. When the bees came to them, he would paint marks on their backs. Back at the hive, he would then study how the returning scouts "talked" to the other bees, in order to tell them where to go to find that honey!

From his experiments von Frisch learned that the bees could distinguish certain colors —including ultraviolet (but not red or infrared) —which they communicated with one another by means of a dance on the honeycombs. He discovered that the nature of this dance and the vigor with which it was done—told the direction and distance of the food dish, and even how plentiful or scarce was the food supply. It was von Frisch that discovered that it was polarized light in the sky that the bees used to tell directions. It was his research that opened up entirely new vistas of information in regard to the language of the bees.

As mentioned earlier, the bees do not go after the honey until they are first told the kind of flowers, direction, and distance to those flowers. How are they to learn that information? The bees are all descended from the queen, yet she knows nothing about gathering honey, having never done it. All she does is lay eggs. It is the worker bees that must locate and gather the nectar and pollen.

When a scout strikes it rich, the little bee fills its tank, packs its baskets, and returns with the news. Immediately, there is excitement among the waiting bees and they are anxious to learn what has been discovered. So anxious are they that they often crowd too near, and the bees closest to the scout have to push the others back to give the scout room to explain!

Now the time has come for the scout to tell what has been found:

Climbing onto the side of a comb, first, the scout begins with a weaving dance, veering to this side and then to that as it goes. By this the scout is telling the others, "There is plenty out there!" The amount of weaving back and forth reveals how much abundance is at that certain location. The direction of the weaving walk tells the angle of polarized light from the sun to that flowery location.

Seeing this weaving dance, the bees crowd up excitedly, touch the scout with their antennae to pick up the odor of the flowers they are to look for, and then fly off.

But if the treasure is a long way off, and if it is only a single tree or a small patch of flowers, —then the dance is different. The information must be much more carefully given since the bees might get lost searching for those flowers.

So the scout, instead of weaving, runs along a straight line, wagging its abdomen as it goes. At the end of the line (which is only an inch or so, since there is not much space cleared in the crowd), it turns left and walks a partial circle back to the starting point. Then it runs straight forward again along that same line, circling right this time back to the starting point —where it does it again!

Its dance communication forms a figure eight, with the cross points of the "eight" at the center. That gives the direction of the nectar in relation to the sun. As the bee dances on the wall of the honeycomb, the position of the sun is always down. If the bee moves up the comb wall at 19 degrees to the left of vertical, that means the honey source is located 19 degrees to the left of the sun. This information can be given even on a cloudy day, since the bees are able to see ultraviolet light, and UV light from the sun penetrates the clouds. Imagine that! This tiny creature can sense the slant of UV light on its body!

The straight line points directly at the flowers.

The speed with which the speaker circles tells the distance. The farther off the flowers are, the more slowly does the scout circle back. If it makes 10 circles in 15 seconds, the flowers are about 300 feet [914 dm] away. If it returns in slow motion (two circles in 15 seconds), the flowers are around four miles [6.4 km] away!

The wagging of the abdomen tells the amount of honey or pollen that is available at that specific location. If it shakes vigorously, the supply is abundant. If it shakes lazily, there is only a little, and just a few bees should go. In that case, the others will wait for another scout's arrival.

So there is a round, weaving dance to indicate nearby nectar, and a tail-wagging figure-eight dance to indicate distant nectar. There is more to it than the simplified description given above, but this should be enough to afford you an idea of the bee dance.

And it is all done in the dark, for the scout gave them that information in the darkness of the hive, not outside in the sunlight!

Very specialized information about distance, quantity, exact location, and type of flower—is all given in the dark to bees who are obtaining those facts in the dark! Yet life and death to the bees and to the hive depends on their obtaining the correct information! Before departing, they must fill their honey bucket with just the right amount of fuel—not too much or too little. Yet how can they learn anything in the dark? There is no ordinary light, and no ultraviolet light in the hive, and they are not able to sense infrared light from the heat of the moving body of the bee weaving before them.

A 1990 Princeton research report disclosed that bees can detect tiny movements of air around their bodies. It is thought that, perhaps, by detecting air movement, bees are aided in "hearing" the bee dance as it is performed. It is thought they "hear" the sound movements with organs located at the base of each antenna. But more than air movements are needed for the bee to grasp the waggles, speed of walk, directional angle, and other factors involved in the complicated bee dances. So the mystery remains.

NECTAR AND POLLEN- In order to properly understand the work of the honey bee at the flower and in the hive, we need to understand what it does with the nectar and pollen:

As it goes from flower to flower, the bee cross-pollinates the flowers. It somehow knows that, at any given time, it must only go to flowers of the same species. Why would it know to do that? Yet because it does, the flowers are cross-pollinated. If that one factor was missing, after several years there would be no more flowers for the bees to obtain nectar and pollen from.

In the chapter on plants we have discussed many of the ways in which plants put their pollen on bees and other insects. Bees and flowers must have been brought into existence at the same time. They could not live without one another.

Ants are not interested in pollen, but would like to have the nectar. Yet they do nothing to pollinate flowers. Ants cannot make pollen mush as can the bees, but they like nectar. They lick sweet juices off leaves, sap coming from a wound in a stem, and sweet syrup exuding from other insects. Ants would take nectar from flowers if they could, but the Designer of the flowers placed ant barriers to keep them *off.* Bristles will be erected which act like barbed-wire entanglement. Some flowers defend nectar with gummy places, for no insect can walk if its feet are stuck. Others dangle flowers from shaking, slippery stems, which knock *off* an ant before it can get to the flower. Ants are not concerned, for they have many other sources of food. Thus the nectar and pollen is saved for the bees and those other insects which do pollinate flowers.

In the iris, the bee must pass the projecting stigma and brush some pollen on it. After the bee has passed, the stigma springs back in place. Its weight pulls down the anther, thus giving the bee a shower of pollen onto its back, to carry to the next flower. In the mountain laurel, the anthers are held in pockets. When the bee enters, the anthers are released. The filament snaps upward, and it is showered with pollen.

The milkweeds have their pollen in masses shaped like saddlebags. When the bee arrives, its feet become tangled in it and part of it is carried about for hours, pollinating other milkweed flowers. The horse balm has four small petals and one larger one. The bee lands on the large petal and immediately slides off. Coming back in a second of stamens hanging from overhead, and pollen falls on the bee.

The lady's slipper lets the bee enter, but once inside the bee is trapped, for the entrance door has closed. There is one way out: a small opening at the back. Crawling through it, the bee must brush against the pistil and then against the stamens.

The worker bee gathers not only nectar but pollen as well. There are bristle-like hairs all over its body to initially catch the pollen. (Drones are not hairy, since they have no need of a hairy coat to collect pollen.) Worker bees do not mix different kinds of pollen together. Each kind is stored separately. Bees that gather honey one day may gather pollen the next, but they do not mix their honey and pollen gathering. Flowers would not otherwise be properly pollinated.

The honey bee gathers pollen as well as nectar, for the pollen is part of its food. But how can it carry pollen back to the hive? Simple; the bee was given specially designed legs for this purpose!

This marvelous flying machine has three places for storing cargo. One is the tank inside its body, which it fills by sucking up nectar syrup through a long tube from the inside of the flower. The other two are baskets on its hind legs for carrying pollen. Who ever heard of a plane carrying freight on the landing gear? But the bee has been doing it for thousands of years.

The bee also carries freight in only one direction. Outward bound, it needs only a speck of honey for fuel, enough to reach the goal, where it can find plentiful stores of honey and refuel. Honey is so powerful that a pinhead-sized speck of it will whirl the bee's wings for about a quarter of a mile.

At the flower, the little bee sucks in nectar and collects pollen. To collect honey, a bee dives into a flower, scrambles around, rolls over like a child playing in the surf. The splashing throws pollen grains all over its body, where they stick to feathered hairs.

But when the bee specifically is after pollen, it does not have to jump around inside the flower; its body picks up pollen just by brushing past the pollen boxes that are usually held out in front of the flower on long, thin stems.

After getting the nectar, pollen will cling to the hairs on its legs and body. Most of this, the bee transfers to its pollen baskets. Pollen baskets! Yes, pollen baskets. These "baskets" are composed of a peculiar arrangement of hairs surrounding a depression on the outer surface of the hind legs. Look at bees as they buzz from flower to flower, and you will see that some have a small yellow ball on the front of each hind leg, while others have a large ball.

In addition, the bee carries around with him several tools. There is a tool to put the pollen into the baskets. On the middle pair of legs at the knee is a short, projecting spur, used to pack pollen into the pollen baskets. On the inner part of the hind leg are a series of side combs used to scrape the body hairs of the bee—and gather together chunks of pollen. The combs are used to give final collection to the pollen and then put it into the baskets; the spurs are used to pack it down in!

So then, the worker bee has four different types of tools to help him stow away pollen into the pollen baskets: (1) Long hairs on the front pair of legs remove pollen from its mouth and head. (2) The middle pair of legs scrape pollen off the thorax and front legs. (3) The stiff comb hairs on the third (rear) legs comb the abdomen and also take the accumulated pollen off the middle legs, and then push it into the baskets. (4) Finally, the spurs go to work and pack it down tight.

In the process, the pollen is moistened by the bee in order keep it from blowing away or falling out in mid-air. It also has to be evenly balanced with the same amount of pollen in each basket.

This entire process had to be carefully thought out in advance, and structures had to be predesigned, built into the bee, and knowledge given to that bee!

The legs of a honey bee provide a complete set of tools for collecting, shifting, packing, and storing heaps of pollen! Without that collected pollen, the bees could not live, for it is an important part of their diet.

GETTING A LOAD— Watching the little worker, this is what you will see:

The bee leaves the flower, and, while hovering in mid-air, or swinging below the flower and hanging by one claw, it combs its face, the top of its head, and the back of its neck with its front legs. Even the bee's eyes collect pollen, as hairs grow out of the eyeballs! The bee has a specially soft brush to remove that particular pollen.

A reverse gulp brings up a speck of honey from the honey tank to moisten the pollen. The middle legs scrape off the middle of the body, reach up over the back. Rapid combings and passings to the rear get the pollen onto the hind legs. The scrapings are caught in a comb with nine rows of bristles.

Immediately, the bee doubles up its legs, —and a huge rake passes through the rows of bristles, pulling the pollen into a press made by the knee joint. When the bee bends its knees, the jaws of the press open; when it straightens its leg, the jaws close, and the pollen is pressed and pushed up into the pollen basket—that shallow trough in the middle of the hind leg.

To hold the load securely, there are many curving hairs around the edges of the basket. There is also a single rigid hair in the center of the basket. This makes it possible to build twice as big a load.

As the pollen ball grows bigger and bigger, the curving hairs surrounding it are pushed apart, and the load mounts above them. The long, rigid hair in the center gives the load a solid core to build on. Farmers use the same principle when they put a pole in the center of a haystack so later winds will not knock it over.

If the nectar is flowing strong and anthers are bursting with pollen, a bee can suck up a load of syrup in a minute. It can build two big, bulging loads of pollen in the baskets on its hind legs in three minutes. Considering all the procedure the bee had to go through to do that,—that is fast!

Often it may carry water in its honey tank, if the hive is thirsty. It may scrape resin off sticky buds and twigs, especially, poplar, horse-chestnut, willow, and honeysuckle buds, and load this into the pollen baskets. This resin will be made into varnish to coat tree hollows, making all surfaces perfectly smooth, even at the points where the hive is attached. resin is used also to stop up cracks and crevices.

When it is finally loaded up, the honey bee will fly home at 14 miles [22.5 km] an hour with a tank of nectar inside, and two bulging bags of yellow pollen swung below.

When the worker is ready to return to the hive, fully loaded, it makes a "bee line" home! It goes in as straight a line as possible to the hive. This bee line proves that the bee is fully aware of directions at all time. Navigational information is continually being fed into its brain through its several eyes, just as, on a ship at sea, a sailor keeps checking the compass and using the sextant to get their bearings.

All this knowledge and equipment came from the DNA code placed by the queen bee in her eggs. Yet she is not passing on information that she does, for she never goes out and gathers any nectar and pollen, nor does she make any bee bread, wax, nor cells. Not once does she ever dance the honey dance or even bother to watch it being done. Yet she is the one that passes along all the coding for all the parts**,** processes, and accomplishments of all the bees in the hive.

Researchers at Princeton University thought they might be able to outsmart the bees, but how well and how long, they were not certain. After the bees learned where their food source was, the scientists moved it 50 meters (656 yd] farther away from the hive. They were surprised to find that it took the bees less than one minute to find the moved food. So they moved it again, this time a second precise 50 meters [656 yd] farther away. It still took the bees less than a minute to locate it!

But then the scientists discovered the bees were smarter than they were) The bees were apparently carrying on advance research into the research habits of researchers) When the researchers moved the honey source a third time,—the bees were waiting at the exact location it was to be moved to—before the researchers arrived with the food!

HONEY FACTORY— Bees have two stomachs: They have a special "honey stomach" that is entirely separate from their own food-digesting stomach! Each bee carries the nectar gathered from the flowers in this honey stomach.

While the nectar is in a bee's stomach, certain chemicals are added to it as the bee flies around! Arriving back in the hive, the bee places the nectar in honey storage cells. The water in the nectar evaporates and the chemicals change the nectar into honey. Workers then put wax caps on the honey-filled cells.

This honey contains levulose, dextrose, other sugars, dextrines, gums, vitamins, proteins, calcium, iron, copper, zinc, iodine, several enzymes, and other nutritional factors.

To prove that a bee never digests its food alone, but rather that the whole hive digests the food together, scientists fed radioactive honey to six bees in a hive of 24,500. After two days, all the bees in the hive were radioactive. That was the result of having passed honey from mouth to mouth for processing.

(Bees do not suck honey from flowers; they suck nectar. Nectar and honey are chemically distinct. Honey is much more concentrated, and is nectar, plus added chemicals from the worker bee's stomach.)

GLUE FACTORY-- Bees also make "bee glue." This is called propolis. They obtain the raw materials from the sticky covering on special plant buds. There are certain things on which they place this bee glue. One is mice!

If a mouse gets into the hive, the bees sting him to death. But they do not drag him out of the hive for he is too heavy, so instead they coat him with bee glue. This forms an airtight sack around him so no odor or contamination will come from his decaying body.

The glue is something like a cement, and the bees normally use ft to repair cracks in the hive.

WAX FACTORY-- Down on the abdomen of each worker bee, there are four little pockets. Here is where the wax is made! Wax! You mean that they make that, too? Yes, the little bees make everything they need, and almost the only raw materials for all their productions come from what they find in flowers!

When the bees decide to start making wax, they get hot! First, a cluster of bees gathers together in a large pendant mass, their wings buzzing rapidly. They hang vertically from one another, and this seems to stretch their bodies. After 24 hours, each one begins sweating wax! A white substance begins coming out of their pores. This is called "wax scales," and each bee removes it with a special tool! This is a pair of pincers found on one knee joint on each side of its body.

Each bee generally makes eight flakes of wax at a time. This wax is taken off, and chewed in its jaws. It becomes a soft paste which can be easily molded into the six-sided cells. This wax is only made when the bees need wax to build a honeycomb.

Soon, wax scales litter the floor below the hanging bees, and other bees regard it as loads of stacked lumber: they pick it up and use it to make the comb and cells. Skilled chemists have never been able to match the quality of beeswax! This special wax contains a variety of special substances, and has a higher melting point (140°F [60°C]) than that of any other wax known in the world.

This high melting point enables the bee hive to withstand a lot of heat without softening and flowing, ruining all the cells.

As if that is not enough, the bees also make a second type of wax, with a different chemical formula. This very special wax is used to seal over the top of cells in which eggs have been placed by the queen. Why is a special "cap wax" needed? The cap wax permits air to pass through so the larva will not suffocate.

How long did it take for evolution to come up with cap wax? Before that time, all the bee larva died. As with all other plants and animals in the world, every little detail is crucial in the life of the bees.

BABY FOOD FACTORY-Bee bread is a highly nutritious food, made from pollen by the bees. Worker bees, upon emerging from the comb, must eat bee bread so their glands will produce food for the queen and the developing larvae. Older worker bees only need honey for their food.

What made the difference? Scientists decided there must be additional nutritional factors in the bee bread. After careful study, they better understood the bread-making process. As the bees collect the pollen, they add secretions from special glands to it-even while they are out in the field collecting pollen! They also add microorganisms which produce enzymes which release a number of important nutrients from the pollen. Other microbes are added to produce antibiotics and fatty acids in order to prevent spoilage. At the same time, unwanted microbes are removed. If you have ever made bread, you know it requires special attention. In addition to the other ingredients, the bees also add a little honey here and nectar there, and a little more honey and nectar so the bread will stick together just the right amount!

A sophisticated knowledge of microbiology, nutritional chemistry, as well as general biochemestry was needed, in addition to some high-tech equipment-all located inside the bee!

ROYAL JELLY FACTORY- When it is decided to produce a queen instead of merely a worker bee, the bees have a way of doing ft.

Young worker bees make a special substance in their bodies which is called "royal jelly." It is regularly fed to all their grubs for the first 48 hours after they hatch from eggs. Royal jelly is a creamy substance, rich in vitamins and proteins. It is formed in ductless glands in the heads of young worker nurse bees.

When a queen is desired, royal jelly is fed to a grub for five days instead of only two. In all other cases, royal jelly is fed to the grubs for only 48 hours, and then an exact (exact!) 50-50 mixture of honey and pollen (called "bee bread") is fed to those grubs for an additional three days.

So a five-day diet of royal jelly is given to a grub which will later mature into a fully-developed female-a queen bee. But the two-day diet of royal jelly, followed by a three-day diet of bee bread, is given to the other grubs. They will later develop into an undeveloped female-a worker bee. (Worker bees are also called neutral bees.)

SILK FACTORY- After the grub is sealed into its wax cell, the larva spins a silk cocoon for itself. How does it know to do that? When it later emerges as a bee, it can never again make silk. That ability was only there while it was needed.

HIVE AND CELLS- There is also a hive and cell factory. That is also made by bees, using material from within the hive!

Out in the wild, the hive with its cells will be built in a hollow tree. But if the queen with her swarm of bees is placed in a man-made square beehive, they will produce honey for people.

Whether it be in a tree or in a square hive, the worker honey bees make some beeswax and shape it into a waterproof honeycomb. The honeycomb is a mass of six-sided compartments called cells. As soon as the workers have completed a few cells, the queen lays eggs in them. The workers keep making more honeycombs with their cells, and the queen keeps laying more eggs.

All the while, thousands of other bees are busy flying out of the hive, gathering nectar and pollen, and bring it back to the hive. This provides food for the adult bees and their babies. It also provides the raw materials with which the bees manufacture honey, glue, wax, royal jelly, bee bread, honeycombs, and cells.

The cells containing the eggs and developing bees are kept in the most protected part of the hive-near the center. That area is called the "brood nest." Around it, more cells have been made and pollen has been stored in them. Above the pollen cells, more cells have been built, and nectar has been placed in them. Enzymes from the bees gradually change that nectar into honey.

Each six-sided cell is a work of perfect craftsmanship) The bees have no architects to help them, no drawing boards, no blueprints, no compasses, or rulers; but the job is well-measured, strongly made, and flawlessly executed.

Did you know that the wax structures in the beehive have been reinforced? Wax is reinforced by drawing long thin threads of varnish through it! The wax hardens around the threads, like concrete reinforced with wire.

Cell walls are only 1/350th of an inch [.007 cm] thick! This would make a sharp top cell edge, even for bees' feet,-so the top edge is given a final extra coating of wax to thicken it, giving it a rounded coping, and bringing it up to 1/80th of an inch [.03 cm] in thickness.

Fluid materials pushed together from all directions form into six sides. That shape makes them cling the closest together without spaces between. Bees crawl into the cups and press them into shape-each one the size of an adult bee.

The structure of the honeycomb is astounding. Only three shapes could possibly be used: the triangle, the square, or the hexagon. Any other shape would leave wasteful open spaces between the cells. Testing out the three, we find that the hexagon holds more honey in the same space than the other two. It also uses less wax to construct, and the shared sides require even less wax. After calculus was invented by Isaac Newton, scientists discovered that the shape of the cell is still more marvelous: The cap at the end of each cell is a pyramid composed of three rhombuses. Complex mathematics reveals that this shape requires less wax than any other, and it enables the cells to be butted up closely against one another, with no loss of space. So we have here a ten-sided prism.

AIR CONDITIONING -Maintaining temperature control in the hive is equally amazing. The bees have air-conditioned hives! They keep the hive at a constant 95°F [35°C]. When the weather is cold, the bees congregate at the center of the hive and generate extra heat by increasing their metabolism. How they do that? By breathing faster! Other bees collect all over the outer walls and provide insulation to the hive! If the weather remains cool, the bees in the center rotate with the bees on the walls.

When the weather becomes too warm, some of the bees go to the entrance and begin rapidly fanning their wings. This brings in cooler air from the outside into the hive. If the weather becomes still warmer, other bees fly out of the hive and bring back water-and wet the inside of the outer walls of the hive! At that point, the fanning of the other bees rapidly cools the walls as the water evaporates.

What bee is smart enough to figure out all that?

QUEEN BEE- Yet another factory is the queen herself: she is an egg factory!

She walks around all day laying eggs. That is all, just laying eggs. Helper bees follow her, feed her (she works so hard, she must be fed constantly), go ahead of her to get empty cells ready, follow after and feed the grubs, and later cap grub cells when the feeding time expires and cocoons are to be formed.

If the queen is not in the hive, all the workers become excited and disorganized. When she leaves the hive, bees follow her out. More on that later. They have reason to be excited. Without her, the hive of bees will soon perish.

DRONE -This is the male honeybee. These are clumsy creatures and somewhat larger than workers. They sit around all day and are totally dependent on the workers, which even have to feed them!

Their most striking feature is their large eyes. They have 13,090 little eyes in each compound eye globe; which is more than twice as many as the 6,300 which worker bees have. Why do drones have such large eyes? One would think that the workers would reed them more; they do so much work. But a little thought reveals that worker bees have so many other functions which they must do, and so many chemicals which they must produce in their heads, they do not have space for larger eyes. In contrast, during the mating flight the drones must not lose track of the queen as she flies up into the sky.

Drones have no sting and do no work. Drones develop from unfertilized eggs. Their only task is to mate with a young queen. Before mating, that young queen can only lay drone eggs. The queen need only be fertilized one time-and she will be able to spend the rest of her life laying worker eggs which, with royal jelly, can be turned into queens.

If something happens to the laying queen, the workers can easily use diet (royal jelly) to change a baby worker into a queen, which will lay drone eggs until she has mated. The arrangement is a perfect one. It is perfect because it was carefully thought out before any bees existed.

WORKER BEES-The worker bees are well named. They work hard during their brief lives. The youngest clean empty cells, care for the young, help build the comb, and take care of nectar.

When a worker is 10-14 days old, it begins flying to the fields where it collects nectar, pollen, and water for the young in the hive. The worker lives about 6 weeks during the busy summer, but several months during fall, winter, and spring when it has less work to do.

Several guard bees stand at the entrance. Any creature not belonging to the nest is not permitted entrance, with the exception of drones. The guard bees smell every bee that enters.

Ventilation bees stand at the entrance and fan air into the hive to aerate it. (In case of a grass or forest fire, all the bees fan their wings in an effort to save the hive.)

In the winter, the workers gather over the honey cells and move their wings to produce heat. When the temperature reaches 50-60°F [1015.5°C], they stop heating the hive till the temperature drops again. (In the summer, the brood area temperature will rise to about 93°F (33.8°C.)

EGG To LARVA- Worker bees place a little royal jelly in the bottom of a cell. The queen then lays a pearly white egg in it. The egg is as big as a dot over an "i." Three days later a small wormlike larva crawls out of the

egg, but it remains in the cell. Worker nurses immediately begin feeding it: royal jelly for 48 hours; after that the 50-50 honey/pollen mixture called beebread. Scientists tell us that, while the nurses are feeding the larvae, each larva is fed over a thousand times a day! They eat and eat and grow rapidly.

Five days after the larva hatches, the workers place a wax cap over its cell. Inside the cell, the larva spins a cocoon and changes into a pupa, which then develops into an adult bee. A full, mysterious metamorphosis-with all its complicated chemical changes-takes place at that time in the body of the creature. (The larva and pupa stages of honeybees are collectively known as the

Twenty-one days after the egg was laid, the adult bee chews off its larval skin and bites its way out of the cell. (Twenty-one days: 3 as an egg, 6 as a larva, and 12 as a pupa.) It immediately begins work, without ever having been taught what to do.

I say "immediately begins work;" what do you think its first untaught duty is? As soon as the bee emerges from the cell, it turns around and cleans up that cell! Once done, the new member joins the colony in all its' varied work. How does a newly-hatched bee know that its first duty is to clean up its cell and get it ready for the next generation? Where could that knowledge have come from? How can it know what to do after that?

Everywhere we turn in nature, we find the guiding hand of a super-powerful Intelligent Being. And throughout it all, we see so many evidences that that Being is kind and loving.

OCCUPATIONAL SELECTION- How does a bee decide what it will do? There are a variety of different activities that worker bees are involved in; what determines the adult employment of each newborn worker bee? One researcher was very patient. He glued tiny, numbered, color-coded tags to the backs of 7,000 living honey bees! His objective was to figure out how the bees decided their lifetime work.

Typically, the queen bee mates with over a dozen mates before settling down to a year or two of continuous egg-laying. In one study, the queen was only allowed to mate with a "guard bee" and an "undertaker bee" (whose job was to dispose of dead bees). The discovery was made that, 8 times out of 10, bees do what their father did. So that aspect is another result of DNA coding. The mating with a variety of bees means that the queen will lay eggs for all types of worker occupations.

NEW QUEEN- in some unknown way, the workers select certain larvae to become queens. The old queen is becoming feeble or disappears, or may have left with part of the hive. For this purpose, a larger cell is made to house the future queen.

About 5 1/2 days after hatching, the queen larva becomes a pupa, and 16 days after hatching, she emerges as an adult. But the workers ignore her as long as there is a laying queen in the hive. The young queen will fly away—swarm—with some of the bees, or will fight to the death with an older queen, or the older queen will swarm with part of the hive. (Just before swarming occurs, several worker bees will leave as scouts in the hope of finding a location for a new hive.)

When two queens fight, they are able to sting repeatedly. Only the queen has a smooth stinger, able to be used without injuring herself. (The worker bees have barbed stingers, so each sting brings death to the worker. The drones have no stinger.) When the fight begins, one or both queens will often sound a high, clear note as a battle cry. The sound is made in anger by forcing air through ten little holes in the side of the queen. The sound is a signal to the entire hive. Everyone stands back and waits for a single queen to emerge.

Often the older queen wisely leaves, taking part of the bees with her, as soon as she learns that a new queen is in the hive.

At swarming time, the hive becomes terribly excited. All work stops. Out of the hive shoots a terrifying ball of, say, 35,000 bees. After swirling around crazily, it heads off. Landing on a tree limb or the side of a tree, it waits while scouts search out a location for a new hive. Then it flies there, makes wax, and begins building the new hive. In the midst of such apparent confusion, why would the bees give any attention to what returning scout bees have to tell them? It truly seems impossible that returning scouts would even be noticed.

The new queen then has a mating flight with one or several drones, and, after fertilization, will return to the hive a half-hour later, ready to lay worker eggs for the rest of her life. She may live as long as 5 years, or as little as a year.

Every day she may lay 2,000 eggs (more than the weight of her own body!), more than 200,000 eggs each season, and up to a million eggs in a 5-year lifetime.

(The mating flight of the queen does not occur until the scouts return to the waiting bees, and the entire swarm has then moved to the new location. But while the swarm is waiting in a tree for the scouts to return, they can easily be persuaded to move into artificial quarters-such as a bee hive, -merely by shaking the swarm, with its queen, into the container.)

SOLITARY BEES- We have told you about the "social bees" which make beehives. There are also "solitary bees" which live alone. We will not take the time to describe these, but included among them are carpenter bees which build nests in dead twigs or branches, leaf-cutter bees which cut pieces of leaves and pack them into small nests in tunnels, miner bees which dig tunnels in the ground, mason bees which build clay nests in decaying wood, or on walls or boulders, and cuckoo bees which lay their eggs in other nests.

Each of these five types of solitary bees lead very unusual lives. For example, the female of one species living in the ground always builds an underground nest next to another female bee. Tunnels connecting the two are then made, so they can visit and socialize from time to time.

Sometimes they even lay their eggs near each other and raise their young together. Often one female bee will baby sit both sets of young while the other goes shopping for groceries.

ANATOMY LESSON-In review, consider some of the special parts of a worker bee:

(1) Compound eyes able to analyze polarized light for navigation and flower recognition. (2) Three additional eyes for navigation. (3) Two antennae for smell and touch. (4) Grooves on front legs to clean antennae. (5) Tube-like proboscis to suck in nectar and water. When not in use, it curls back under the head. (6) Two jaws (mandibles) to hold, crush, and form wax. (7) Honey tank for temporary storage of nectar. (8) Enzymes in honey tank which will ultimately change that nectar into honey. (9) Glands in abdomen produce beeswax, which is secreted as scales on rear body segments. (10) Special long spines on middle legs which remove the wax scales from the body. (11) Five segmented legs which can turn in any needed direction. (12) Pronged claws on each foot to cling to flowers. (13) Glands in head make bee bread out of pollen. (14) Glands in head make royal jelly. (15) Glands in body make glue. (16) Hairs on head, thorax, and legs to collect pollen. (17) Pollen baskets on rear legs to collect pollen. (18) Several different structures to collect pollen. (19) Combs to provide final raking in of pollen. (20) Spurs to pack it down. (21) Row of hooks on trailing edges of front wings, which, hooking to rear wings in flight, provide better flying power. (22) Barbed poison sting to defend the bee and the hive. (23) An enormous library of inherited knowledge regarding: how to grow up; make hives and cells; nurse infants; aid queen bee; analyze, locate, and impart information on how to find the flowers; navigate by polarized and other light; collect materials in the field; guard the hive; detect and overcome enemies; -and lots more!

How can a honeycomb have walls which are only 1/350th of an inch [.007 cm] thick, yet be able to support 30 times their own weight?

How can a strong, healthy colony have 50,000 to 60,000 bees-yet all are able to work together at a great variety of tasks without any instructors or supervisors?

How can a honey bee identify a flavor as sweet, sour, salty, or bitter? How can it correctly identify a flower species and only visit that species on each trip into the field-while passing up tasty opportunities of other species that it finds on route?

All these mysteries and more are found in the life of the bee. A honey bee averages 14 miles [25.5 km] per hour in flight, yet collects enough nectar in its lifetime to make about 1/10th of a pound [.045 kg] of honey. In order to make a pound of honey, a bee living close to clover fields would have to travel 13,000 mites [20,920 km], or about 4 times the distance from New York City to San Francisco)

NO EVOLUTION- With all this high-tech equipment on each bee, surely it must have taken countless ages for the little bee to evolve every part of ft. Yet, not long ago, a very ancient bee was found encased in amber. Analyzing it, scientists decided that, although it dated back to the beginning of flowering plants, ft was just like modern bees! So, as far back in the past as we can go, we find that bees are just like bees today!

ONE FLAW- In all the above, we find absolute perfection in design and execution. But there appears to be one flaw: Why was the queen bee given a smooth stinger so she could sting repeatedly, while the worker bee was only given a barbed stinger-with which he can sting but once?

Evolutionists point to that "flaw" as evidence that there was no preplanning in the life and work of the honey bee.

But it is not a flaw. The queen can repeatedly sting so only one queen will emerge as the new queen. But the worker bee can only sting once when you come near his hive. Would it be wise planning to have each worker bee able to sting repeatedly? If you are stung by five bees, you can quickly remove the stingers and neutralize the wounds with mud or dampened charcoal. -But what if each of those five bees had stung you 10 or 15 times? You might die.

No flaws. When the Creator does something, He does it right.

2 - THE PALOLO WORM

At random, we will select one of the hundred or more creatures briefly mentioned In an earlier design chapter, and give It a fuller discussion. The astounding fact Is that the startling information below on this tiny deep-sea worm could be matched by extended write-ups on any one of thousands of other living creatures.

The palolo worm is totally incredible. Randomness could only rearrange; it could never produce something new. Neither natural selection nor mutations could invent the palolo worm.

Palolo worms live in coral reefs off the Samoan and Fijian Islands in the southern Pacific. Twice a year, with astounding regularity, half of this worm develops into another animal with its own set of eyes, floats to the surface on an exact two days in one or the other of two months in the year, and then spawns!

Yet these worms live in total darkness and isolation in coral holes deep within the ocean,. have no means of communicating with one another, nor of knowing time-not even whether it is night or day! How can they know when it is time to break apart for the spawning season? *Here Is the story* of the palolo worm:

The Palolo worm *(Eunice vlrldis)* measures about 16 inches (41 dm] long. It lives in billions in the coral reefs of Fiji and Samoa in the south- western Pacific. The head of an individual worm has several sensory tentacles and teeth in its pharynx. Males are reddish-brown and females are bluish-green. These worms go down into the ocean and chew their way, head-first, into deep coral atolls, and riddle ft with their tiny, isolated tubes. They also burrow under rocks and into crevices. Once settled into their new homes, these creatures catch passing food-small polyps with their "tails," while their heads are buried inside the coral or between rock.

The body of one of these worms is divided into segments, like an earthworm's, and each contains a set of the organs necessary for life. But reproductive glands only develop in rear segments.

As the breeding season nears, the "brain" of the little worm, inside the coral, decides that the time has come for action. The back half of the palolo worm alters drastically. Muscles and other internal organs degenerate, and the reproductive organs in each segment grow rapidly. Then the palolo worm partially backs out of its tunnel, and the outer half breaks off. By that time, the outer half has grown its own set of eyes. Once separated from the rest of the worm, the broken-off half, swims to the surface. (Down below in the coral, the "other half" grows a new back half and continues on with life.)

On reaching the surface, the free-swimming halves break open and their eggs and sperm float in the water and fertilization occurs. The empty skins sink to the bottom, devoured by fish as they go. Soon, free-swimming larvae develop and, becoming full-grown palolo worms, they sink deep into the ocean and burrow into the reefs.

We have here a creature which stays at home, while sending off part of itself to a distant location to produce offspring. That is astounding enough. But the most amazing part is the clockwork involved in all this! The success of this technique depends upon timing. If the worms are to achieve cross-fertilization, they all must detach their hind parts simultaneously. So all those worm segments are released by the palolo worms at exactly the same time each year!

Swarming occurs at exactly the neap tides which occur in October and November. (Some of the spawning occurs in October, but most in November.) It occurs at dawn on the day before and the day on which the moon is in its last quarter.

Suddenly, all the half-worms are released into the ocean. Swimming to the surface and bursting open, the sea briefly becomes a writhing mass of billions of worms and is milky with eggs and sperm.

The timing is exquisite.

People living in Samoa and Fiji watch closely as these dates approach. When the worms come to the surface, boats are sent out to catch vast numbers of them. They are shared around, festivals are held, and the worms are eaten raw or cooked. In Fiji, the scarlet aloals and the seasea flowers both bloom. This is the signal that the worms are about to rise to the surface!

Then, each morning, the natives watch for the moon to be on the horizon just as day breaks. Ten days after this-exactly ten days-the palolo worms will spawn. The first swarm is called *Mbalolo lailai* (little palolo), and the second is *Mbalolo* levu (large palolo). On the island of Savaii, the swarming is predicted by the land crabs. Exactly three days before the palolo worms come to the surface, all the land crabs on the island mass migrate down to the sea to spawn.

Throughout those islands, the natives know to arise early on the right day. An hour or so before dawn, some will begin wading in darkness, searching the water with torches for evidence of what will begin within an hour. Even before the night pales into dawn, green wriggling strings will begin to appear in the black water. Flashlights reveal them vertically wriggling upward toward the surface. Shouts are raised; the palolo worms have been seen!

People who have been sleeping on the beaches awake. Gathering up their nets, scoops, and pails, they wade out into the water. Dawn quickly follows, and now the number of worms increases astronomically! Billions of worms have risen and are floating on large expanses of the ocean's surface. The sea actually becomes curded several inches deep with these tiny creatures,-yet only a half hour before there were hardly any, and absolutely none before that for nearly a year. The people ladle them into buckets, as large fish swim in and excitedly take their share.

People **a**nd fish must work fast; an hour before there were none,—and already the worms are breaking to pieces. As their thin body walls rupture, eggs and sperm come out and give a milky hue to the blue-green ocean. Quickly, the empty worm bodies fall downward into the ocean and disappear.

Within half-an-hour after the worms first appear, they are gone,-and only eggs and sperm remain.

Scientists have tried to figure out how the palolo worm calculates the time of spawning so accurately. But there is just no answer. The worms cannot watch the phases of the moon from their burrows. They are too far down in the ocean to see light or darkness, or note the flow of the tides. The only solution appears to be some kind of internal "clock"!

But wait, how can that be? An internal clock would require that the action be triggered every 365 days, but this cannot be, since the moon's movements are not synchronized with our daynight cycle, the movements of the sun, nor with our calendar. As a result, the moon's third quarter in October arrives ten or eleven days earlier each year, until it slips back a month.

Nor can it be that the worms in their holes are somehow able to judge the phase of the moon by its light, for they spawn whether the sky is clear or completely overcast.

Well then, it must be that the worms send signals to each other through the water! But that cannot be, for palolo worms on the reefs of Samoa split apart at exactly the same time as the worms at Fiji-which are 600 miles away! If some kind of signal could indeed be sent over such a vast stretch of the ocean, it would take weeks to arrive.

Indeed, the timing appears to have been predecided for the worm. There is no celestial or oceanic logic to ft. The Pacific palolo spawns at the beginning of the third quarter in October or November, whereas the Atlantic palolo - near Bermuda and the West Indies- also spawns at the third quarter; but always in June or July instead of October! (Far away from both, a third pololo worm also spawns yearly at the beginning of the third quarter in October or November.)

At any rate, the advantages are obvious. All the eggs and sperm are together for a few hours, and a new generation is produced. Some other sedentary sea creatures also reproduce within narrowed time limits. This includes oysters, sea urchins, and a variety of other marine animals. But, with the exception of the California coast grunion, none do it within such narrowed, exacting time limits as the palolo worm.

3 - PORTRAIT FROG

For our third exhibit in this chapter, we will review a living creature discussed In an earlier design chapter: the false-eyed frog, also called the portrait frog.

First, we will reprint our earlier write-*up on this humble creature, and then we will consider the implications:*

FALSE-EYED FROG- The South American false-eyed frog is an interesting creature. Generally about 3 inches [7.62 cm] long, it is brown, black, blue, gray, and white! Drops of each color are on its skin, and it can suddenly change from one of these colors to the others, simply by masking out certain color spots.

The change-color effect that this frog regular produces is totally amazing, and completely unexplainable by any kind of evolutionary theory.

The frog will be sitting in the jungle minding its own business, when an enemy, such as a snake or rat, will come along.

Instantly, that frog will jump and turn around, so that its back is now facing the intruder. In that same instant, the frog changed its colors!

Now the enemy sees a big head, nose, mouth, and two black and blue eyes!

All of this looks so real-with even a black pupil with a blue iris around it. Yet the frog cannot see any of this, for the very intelligently-designed markings are on its back!

The normal sitting position of this frog is head high and back low. But when the predator comes, he quickly turns around so that his back faces the predator. In addition, the frog puts its head low to the ground, and raises hind parts high. In this position, to the enemy viewing him, he appears to be a large rat's head! In just the right location is that face, and those eyes staring at you!

The frog's hind legs are tucked together underneath his eyes-and they look like a large mouth! As he moves his hind legs, the mouth appears to move! The part of the frogs body that once was a tadpole's tail-now looks like a perfectly formed nose, and it is in just the right location!

To the side of the fake face, there appear long claws! These are the frog's toes! As the frog tucks his legs to the side of his body, he purposely lifts up two toes from each hind foot-and curls them out so they look like a couple of weird hooks.

And the frog does all of this in one second!

At this, the predator leaves, feeling quite defeated. But that which it left behind is a tasty, defenseless, weak frog which can turn around quickly, but cannot hop away very fast.

The frog will never see that face on itself, so it did not put the face there. Someone very intelligent put that face there! And the face was put there by being programmed into its genes.

Well, there it is. And it is truly incredible. How could **that small,** ignorant frog, with hardly enough brains to cover your little fingernail, do that?

Could that frog possibly be intelligent enough to draw a portrait on the ground beneath it? No it could not. Could it do it in living color? No!

Then how could ft do *it on its own back?*

There is no human being in the world smart enough-unaided and without mirrors-to draw anything worthwhile on his own back. How then could a frog do it?

It cannot see its back, just as you cannot see yours. The task is an impossible one. And, to make matters more impossible, it does it without hands! Could you, unaided by devices or others, accurately draw a picture on your back? No. Could you do it simply by willing colors to emerge on the skin? A thousand times, No.

"Portrait frog"! This is the motion-picture frog! And the **entire process occurs on its back** where it will never see what is happening! And it would not have the brains to design or prepare this full-color, action pantomime even if it could see it.

Someone will comment that frogs learn this by watching the backs of other frogs. But the picture is only formed amid the desperate crisis of encountering an enemy about to leap upon it. Only the enemy sees the picture; at no other time is the picture formed.

All scientists will agree that this frog does not do these things because of intelligence, but as a result of coding within its DNA. How did that coding get there? It requires intelligence to produce a code. Random codes are meaningless and worthless. Codes producing ordered structures and designs never arise through random activity. They require intelligent planning. Genetic codes within living creatures are the most complicated of all, and are far above the mental capacities of humans to devise and fabricate.

The facts are clear: God made that frog, and He made all other living creatures also. Only His careful thought could produce and implant those codes and **the physical systems** they call for.

There can be no other answer.

Remember the honey bee and all its technology, equipment, and know-how. Consider the palolo worm and its astonishing ways. View the portrait frog, which not only can produce the image of a large rat's head, but even move its body in such a way to simulate motion by the rat!

Yet the frog can see nothing of what it is doing. A man can never learn a skill If he can never see whether he is succeeding in utilizing the skill properly. The term for this is educational feedback. The little frog never has any feedback. Yet it executes the function perfectly each time. And it does it on but a moment's notice. Instantly, the fully-formed picture is there, and it is set in motion.

God made the honey bee, the palolo worm, the portrait frog- and everything else In our world. May we acknowledge Him, honor Him, and serve Him all the days of our life. He deserves our truest, our deepest worship and service, for He Is worthy.

He is our Creator.

More Wonders of Design # 1

An unforeseen delay of over a year occurred before the printing of this set of books. During that time, additional research studies in natural history were made. Just prior to publication, these nature nuggets were placed in three additional chapters, each one located just before the allocated table of contents for each of the three books.

Every fourth chapter in the main text of these books is filled with natural wonders. The following design factors found in nature are additional evidence that God created this world and everything in it. They provide the thoughtful reader with powerful evidence for Creation and against evolutionary theory.

It is obvious that the wonders in our world were made by the Creator.

MATHEMATICS OF A SWIFTLET'S CLICKS

Swiftlets are small birds that live in southeastern Asia and Australia. They make their nests far back in dark caves. It is not difficult for an owl to fly through the woods at night, for a small amount of light is always present and owls have very large eyes. But the situation is far different for a swiftlet. There is no light in caves! And swiftlets have small eyes! How then is this little creature able to find its way through a cave, without running into the walls? Yet he does it.

Designed with fast-flying wings, such as swallows and swifts have, the swiftlet flies at high speed into its cave. Somehow it knows which cave to fly into. But, once inside, there is no glimmer of light to guide it. Yet rapidly and unerringly, it flies directly to one tiny nest. Arriving there, it is confronted with hundreds of nests which look exactly the same. How can it know which one is its own? Nevertheless, flying at top speed, the bird flies across even the largest cavern in only a few seconds-and then lands at the correct nest.

Part of the mystery is solved when we consider that the swiftlet has been given a type of radar (sonar) system. But this discovery only produces more mysteries. As the little bird enters the cave, it begins making a series of high-pitched clicks. The little bird has the ability to vary the frequency of the sounds; and, as it approaches the wall, it increases the number of clicks per second until they are emitted at about the rate of about 20 per second. The time required for the clicks to bounce off the wall and return reveals both the distance to the wall and its contours.

Scientists tried to figure out why the clicks vary in frequency as the bird gets closer to the wall. After applying some complicated mathematics, they discovered that the tiny bird-with a brain an eighth as large as your little finger-does this in order to hear the return echo! The problem is that the click must be so short and so exactly spaced apart, that its echo is heard by the ear of the bird-before the next click is made. Otherwise the next click will drown the sound of the returning echo.

FOG-DRINKING BEETLE-How can a wingless beetle, living in a desert, get enough water? This one does it by drinking fog.

Onymacris unguicularis is the name of a little beetle that lives in the rainless wilderness of the Namib Desert, close to the southwestern coast of Africa. This flightless beetle spends most of its time underground in the sand dunes, where temperatures remain fairly constant. But when thirsty, it emerges from its little burrow and looks about. There is no water anywhere; rain comes only once in several years. The little fellow is not discouraged, but climbs to the crest of a sand dune, faces the breeze, and waits. Gradually fog condenses on its body. It just so happens that this beetle is born with several grooves on its face. Some of the water trickles down the grooves into the beetle's mouth. Happily, the little fellow goes searching for dry food and then returns to its burrow for a nap.

ELECTRICAL IMPULSES OF KNIFE FISH- The Amazon knife fish is a strange looking creature. It has no fins on the side, top, or tail; all its fins are beneath it-in one long, single wave of fin from front to back! Indeed, this eight-inch fish has no tail at all. The fish looks somewhat like a sideways butterknife, which narrows to a spear point at its hind end.

Its one, long ribbon-like fin undulates from one end to the other-something like millipede legs which move it through the water. As it travels, it can quickly go into reverse gear and swim backwards with that fin.

But the most unusual feature of this little fish is its lateral line. This horizontal line of cells on its side is an electrical generating plant, producing impulses which are sent out into the water to both one -side and the other. These 'impulses bounce off objects and quickly return where they are sensed by other receptor cells in its skin. The voltage of these cells is low, only about 3 to 10 volts of direct current. Yet the frequency of the impulses is high-about 300 a second. As these impulses go outward, they create an electrical sending/receiving field of signals, which tell the fish what is around it-in front, to the side, and even to the rear.

But imagine the problems which ought to occur when two knife fish come near each other! Both fish are sending out signals, and the resulting incoming confusion of patterns would be expected to "blind" both fish. But, no, the Designer gave these fish the ability to change wavelengths! As soon as two knife fish draw near to one another,

they immediately stop transmitting impulses for a couple moments, and then both switch them back on-but this time on different frequencies to each other!

UNDERGROUND FLOWERS-We all know that flowers never grow underground; but here are two that do:

There are two Australian species of orchid which, not only produce flowers under the earth's surface,-but the entire plants are there also! The only exception is a tiny cluster of capsules which is occasionally pushed up to disperse the dustlike seeds.

How can these plants live underground? Both species feed on decaying plant material in the soil, breaking it down with the aid of fungi. They do all their growing and blooming beneath the top of the soil. Their flowers are regular orchid flowers!

The first, Rhizanthella gardneri, was discovered by accident in 1928 by J. Trott, a farmer who was plowing a field near Corrigin, western Australia. The second, Cryptanthemis slateri, was found by E. Slater in 1931 at Alum Mount in New South Wales. The little plants keep so well hidden that few have ever been found since then.

KNOWING WHERE TO JUMP-Gobies are small fish which, during low tides, like to swim in rock pools on the edge of the ocean. One species, the Bathygobius, enjoys jumping from one tidal pool, over rocks exposed above the water, into another rock pool on the other side. Researchers finally became intrigued by this habit and decided to investigate.

They discovered that this little fellow always jumps just the right amount, at the right place, and in the right direction-without ever landing on rock! How can this fish know where to leap out of the water, and in what direction? It cannot see from one rock pool to the next. Surely it does not have the locations and shapes of all the rock pools pre-memorized in its tiny head! Although much of the area around a pool is exposed rock, with no nearby pools beyond it, yet the Goby always jumps at exactly just the right place. The scientists have guessed that, perhaps, when the tide earlier came in and covered all the rocks, the fish swam around and memorized all the bumps and hollows on the rock, and thus later know where to do its jumping. But, if that was true, then the mystery would only deepen even more. How could this very small fish have enough wisdom to go about in advance and learn all that?

VARIETIES OF ROSES-In chapter 13 (Natural Selection) we discuss the wide range of possibilities to which each natural species can be bred. Because of this, large numbers of subspecies can be developed. The making of new subspecies is not evolution.

An example of this would be the rose. More than 8,000 varieties of rose have been developed for garden cultivation, yet all of them are descended from only a few wild forms. Although roses have been cultivated by the Persians, Greeks, Romans, and Europeans, there were only four or five rose types by the end of the 18th century. This included the dog rose, musk rose, and red Provins rose.

Modern varieties, such as the hybrid tea rose (single-flowered) and floribundas (clusterflowered), began to be bred only around 1900, after the European species were crossed with cultivated oriental Chinese imports.

MIGRATING LOBSTERS-Spiny lobsters live and spawn near coral reefs of the Bahamas and the Florida coast. But each fall, the lobsters know that it is time to leave. Storms occur throughout the year; yet, for some unknown reason, at the time that one of the autumn storms stirs the waters, the lobsters quickly know that migration time has come. Within a few hours they gather in large groups.

Then they form into long, single-file lines and begin marching out into the ocean. They always know to move straight out, and not sideways. As they travel on the sand, each lobster touches his long antennae on the rear of the one in front of him. There is no hesitation about these marches; the creatures gather and immediately depart. As they go, they travel surprisingly fast, yet maintain their alertness. They can never know when their main enemy, the trigger fish, or another predator may suddenly dart down through the clear waters. Indeed, the lobsters are easy to see, for the tropical sands beneath them are often white.

When a trigger fish does arrive, the lobsters instantly go into action. They form into circles, with their pincers held outward and upward in a menacing gesture. When the trigger fish, decides it is not worth getting pinched and leaves, the spiny lobsters reform into a line and continue their march. Finally, they reach a lower level and remain there throughout the winter. Since less food

is available during the winter months, at these lower levels the colder water temperature helps slow their metabolism and they go into semihibernation until spring returns. Then they march in lines back to their summer feeding grounds. Who put all this understanding into the minds of the little lobsters? Could you train a lobster to do all that?

POP GOES THE MOSS-The various sphagnum mosses (the kind you purchase at garden supply stores as mulch) grow in peat bogs. These mosses have a special way of ejecting their seeds.

In the final stage of ripening, the spore capsules shrink to about a quarter of their original size, compressing

the air inside, and reshape into tiny gun barrels, each with its own airtight cap. Each barrel is very small-about 0.1 inch in length.

Then the cap breaks under pressure, and the trapped air escapes with an audible pop, firing the packet of spores as far as 7 feet. How could this tiny plant devise a battery of natural air guns to disperse its dustlike spores?

Evolutionists glibly tell us it all happened "by accident." But, first, it could not happen by accident. Only a fool would believe that (and the Bible defines a "fool" as one who does not believe in God [Psalm 14:1; 53:1]). Second, it could not even happen by human design. It would be impossible for a person to get a plant to do the things these little mosses regularly do in the process of preparing their seeds, packing them in for firing, and then shooting them off.

SPIDER MAKES HIS DOOR-Although only an inch long, the female trap-door spider makes excellent doors and latches. After digging a burrow six inches deep into soft ground, she lines the walls with silk, and then builds the front door.

This is a circular lid about three-quarters of an inch across. A silken hinge is placed on one end, and gravel on the bottom. In this way, as soon as the lid is pulled over, it falls shut by its own weight. The top part of the door exactly matches the surroundings; and, because it just happens to have a carefully made bevelled edge, the door cannot by the closest inspection be seen when closed. Throughout the day, the door remains shut, and the little spider inside is well-protected from enemies. When evening comes, the door is lifted and the little creature peers out to see if it is dark enough to begin the night's work.

With the door open wide, the spider sits there, with two front feet sticking out, awaiting passers-by. When an insect happens by, the door is shut and lunch is served.

Sometimes the spider locks the door. This is especially done during moulting time, when the door is tied down with ropes of silk. The males build similar tunnels.

FAST-GROWING TREES-It is always a marvel how a tiny seed can grow into a mighty tree. But, although it takes time for a tree to grow, some trees grow very rapidly.

The fastest-growing tree in the world is the AIbizzia falcata, a tropical tree in the pea family. Scientists in Malaysia decided to measure how fast one could grow, and found it reached 35.2 feet in 13 months. Another in the same region grew 100 feet in five years. The Australian eucalyptus is also a speedy grower. One specimen attained 150 feet in 15 years.

BABY GLUE GUNS- Ants have discovered that babies make good glue guns.

The green tree ants of Australia make their homes out of living leaves. Several workers hold two leaves together, while others climb up the tree trunk carrying their children (the little grubs which will later change into adult ants). Arriving at the construction site, these ants give their babies a squeeze, and then point them toward the leaves. Back and forth they swing their babies across the junction of the leaves, and out of the baby comes a glue-like silk which spot-welds the leaves together. It looks as if a white, silken network is holding the leaves together. When the building project is finished, the ants move into their new home. Perhaps they thank their young for providing the nails to hold the house together.

MILKING THE TREES- That is what they do in Venezuela: milk trees.

The South American milk tree (Brosimum utile) belongs to the fig family and produces a sap that looks, tastes, and is used just like cow's milk. Farmers go out and collect it. The trees are easy to care for; it is not necessary to chase after strays, string barb wire, round up the herd and put them into barns at night, or teach the young to drink out of pails.

RUNNING ON WATER- How can a skimmer—the little rove beetles which glide effortlessly over a water pond—run across the surface of the water?

It is now known that they are pulled by the surface tension of the water ahead of them. But how can this be, for is there not just as much surface tension in the water behind them? No, there is not. These little skimmers can only travel as fast as they do-because they lower the surface tension at the rear of their bodies in a very special manner. There is a small gland at the back end of their abdomens. A tiny amount of fluid from that gland is placed on the water as they run along. This fluid lowers the water's surface tension! But the surface tension ahead of them remains high-and it is an obscure law of physics that this difference tends to pull them forward!

Seriously now: What self-respecting beetle would be able to figure out the complex chemical formula for that fluid, much less planning how to restructure its body in order to manufacture it in the gland it is produced in? How would he know enough about physics to understand, in the first place, what he was trying to do?

Or could you, with your large brain, restructure your body? There is hardly a boy in the land who would not like to have the muscles and endurance of the tiger, but he cannot do it.

If we cannot change our bodies, why should anyone imagine that animals can do it?

MORE ABOUT CLOWNFISH-In chapter 24, we discuss the astonishing activities of the clownfish, which lives amid the stinging tentacles of the anemones without ever being injured by them. Scientists have puzzled over this for years. It has recently been discovered that the answer is that other fish have a certain chemical in the mucus covering their bodies which, when touched by the arm of an anemone, causes its stings to discharge. Clownfish lack this chemical, and are thus able to live amid those tentacles, and let the anemone defend them.

In addition, in the reefs off Australia and New Guinea, the clownfish protects the anemone. The butterfly fish is in that region, and-also lacking that chemical-it is able to bite off parts of the anemone. But when it swims near, the little clownfish comes out and attacks it, driving it away. In this way, the clownfish protects the anemone which protects it.

FISH THAT BUILD NESTS-Some fish are born in nests. The labyrinth family (which include the Siamese fighting fish) are air-breathing fish. They build nests in vegetation near the surface. Sticky bubbles are blown by the male, who places the eggs in the nest and watches over them until they are born, and thereafter for a time.

The stickleback fish also builds nests. The male collects pieces of aquatic plants, and glues them together with a cement secreted from its kidneys. Placing the plant mass in a small pit in the sand, it then makes a burrow or tunnel inside, where the eggs are then laid.

Other fish form depressions in the sand and remain there to care for their young after they hatch. But no other nesting material is used.

Nesting, whether done by birds or fish, is actually a very complicated pattern. It is not something that a weak-minded bird or fish could ever have thought up by itself. Yet most birds and some fish regularly do it.

It is of interest that, even if a solitary bird had actually stumbled upon the idea of making a nest, that bird would not have taught it to its babies. So the pattern would have stopped right there. Just as there is no way that the pattern could be started, there is no way it could be passed on to the next generation. "Oh," someone will reply, "the information simply passed into the genes." Not so, any good scientist will tell you that there is no such thing as inheritance of acquired characteristics.

STICK-BEATING BIRD-No, this isn't a stick beating a bird, but a bird beating with a stick. The huge black palm cockatoo of northern Australia enjoys screeching high notes and whistling low ones to its neighbors. It wants everyone to know it is there. Yet even this is not enough to satisfy it. To insure that no rival cockatoos enter their territory, breeding pairs signal their ownership of a territory by breaking off a small stick with their claws and beating it against a hollow tree.

HEAD-DOOR FROGS-Some Mexican tree frogs use their heads to survive. Called helmet frogs, they have bony crests on top of their skulls. When drought begins, these little frogs climb into tree trunks or into holes in bromeliads (plants of the pineapple family) that grow high in trees.

Once inside, they use the tops of their heads to seal off the entrance! Then they just sit there till rain falls again. Little water is lost through their head, and it makes an excellent camouflage at the doorway to their home.

MILKY WAY CAVES- The fungus-gnat of New Zealand lives in dark caves. You can find them there by the millions. Each of these little insects first makes a horizontal maze, which looks something like a spider web. Then it drips down several dozen mucus threads, which hang downward from its nest. Each of these threads has globs of glue at several points on the thread-and those threads glow in the dark.

Entering one of these caves and gazing upward, you will see the steady, unblinking light of millions of stars overhead. Some seem slightly closer, and some farther away. Everywhere you look above you, the stars shine.

SKIN BREATHERS-Most amphibians breathe with gills when they are larvae in the water, and later with lungs when they become adults and live on land. But there are also land-living, cavedwelling, tree-climbing, and water-living species that do not breathe through lungs or gills. Instead, they breathe through their skin!

An example of this would be the frogs of the genus Telmatobius. These little frogs live underwater in lakes in the high Andes. That water is cold! Yet these frogs, having no gills or lungs, are able to absorb oxygen from the water through their skin.

EGG PRODUCERS-Some people wish each hen in their chicken yard would produce at least one egg a day. But some creatures can do better than that. A single female cod can produce six million eggs in one spawning. A female fruit fly is far too small to do as well as the codfish but, even she can lay 200 eggs in a season in batches of a hundred at a time.

Yet there are creatures which can produce far more eggs than that. These include the corals, jellyfish, sea urchins and mollusks. The champion is the giant clam. Once each year, for 30 or 40 years, it will shoot one thousand million eggs out into the water. This is 1,000,000,000, or a full billion.

The largest litter produced by any placental mammal is that of the Microtus, a tiny meadow mouse living in North America. This little creature can give birth to 9 babies at a time, and produce 17 litters in a breeding season. Thus

it is capable of producing 150 young each year.

MOST EXTENSIVE MINER-The Russian mole rat is a champion burrower. In its search for underground bulbs, roots, and tubers, it excavates long tunnels that include resting chambers, food storage rooms, and nesting areas. Scientists excavated one tunnel system in the former Soviet Union and found it was 1 ,180 feet in length. They calculated that it took about two months to construct.

The Russian mole rat is blind and digs with its teeth, not with its claws. It rams its head into the soil to loosen it as it chews out new tunnels. Every so often, it comes to the surface and makes a mound of earth from the tunnel. The longest tunnel had 114 interconnected mounds. If that little rat can do that, just think what you can accomplish!

CHILDREN'S CHILDREN-The greenfly is a live-bearer insect, which means it does not lay eggs but brings forth its babies live, as mammals do.

But the greenfly does it a little differently. During the summer months, when there are lots of food plants in leaf, she produces eggs within herself which are self-fertile; that is they were never fertilized by a male. In addition, all her eggs will hatch into females. But there is more: Each of her daughters will automatically be fertile, so that daughter will, in turn, be able to lay fertile eggs.

MORE ON THE KANGAROO-In chapter 32, we discuss the kangaroo. But here is more information:

After being born, the baby kangaroo journeys to its mother's pouch and begins nursing. After about 9 months it will begin climbing out of its mother's pouch and begin feeding. But, at times, it will jump back in and continue taking milk. Then, at 10 months it no longer jumps in, but remains with its mother and reaches in from time to time to take more milk, until it is 18 months old.

There are two striking facts about this: (1) The mother frequently has already given birth to another tiny baby which is also in the pouch nursing, so she will have a baby and an adolescent nursing at the same time. (2) The teat giving milk to the infant produces different milk than the one which the older one drinks from! It matters not which teat it is; the older one will always receive a different composition of milk than the baby kangaroo is given. The tiny infant has very different nutritional needs. But the question is how can the mother vary the type of milk which is given, at the same time, to both an adolescent and an infant kangaroo?

An example of this is the red kangaroo, which provides milk both to a tiny joey attached in the pouch to a teat, and also to a large joey which has left the pouch. The older one is given milk with a 33 percent higher proportion of protein and a 400 percent higher proportion of fat.

IDENTICAL QUADRUPLETS EVERY TIME The female nine-banded armadillo is a common armadillo, which ranges from the southern United States to northern Brazil. It only bears identical quadruplets. This means that all four babies in each litter come from one egg, which split after fertilization. So each litter is always the same sex.

FRIGHTENING THE ENEMY-Evolutionists tell us that creatures in the wild think through the best ways to avoid being attacked, and then develop those features. But, of course, this cannot be true. There is no way an animal can change its features, or through "inheritance of acquired characteristics," give them to its offspring. But the myth is adhered to, because the obvious explanation is unwanted. The truth is that a Master Designer provided the little creature with what it needed.

The Australian frilled lizard is about 3 feet long. When an enemy draws near, this lizard raises a frill which normally is flat along the back. This frill stands out in a circular disk which can be 2 feet across. How did that frill get there? Did the lizard "will it" into existence? Did it tinker with its own DNA? How does it know to use it to frighten enemies?

The lizard adds to this immense, apparent increase in size by opening its mouth, which is bright yellow inside. By now, the situation is surely looking worse, as far as the predator is concerned. Then, to settle the matter once and for all, the lizard gives a terrible hissing sound and slowly moves toward the enemy. By that time, the troublemaker generally decides to leave.

BABY NURSERY-The eider duck sets devotedly on her eggs without eating anything. When they hatch, she leads them down to the pond. Entering it with her newborn there are often many other ducklings already there that are supervised by one or two adult females, some of which are not mothers. She leaves her brood with them, and departs to find food. Because some of the food is in deeper waters, she may be gone for several days. Upon her return, she, at times, will help take care of the nursery while other mothers leave.

The French word for "nursery" is crèche (pronounced kresh). When animals care for their babies in nurseries, scientists call it a "crèche." Some eider duck crèches have been counted at over 500. If marauding gulls appear, the adult females sound an alarm, and the young gather close about them. If the gull tries to catch one, the adult will try to grab him by the legs and pull him down into the water. As for the chicks, they only need protection from these adult nursery attendants, for they are well-able to find food for themselves.

In South America, the Patagonian cavy (which is somewhat similar to the guinea pig) is also initially cared for in a crèche of babies hidden in a tunnel by the rocks. One of the fathers cares for the group till the mothers return from feeding. Upon her arrival, she gives a call and out come about a dozen cavies. She sniffs among them, until she finds her two, and then leads them away. More babies are dropped off, and more mothers return for theirs. The babies remain in the nursery tunnel, guarded by an adult above. Adults never use the tunnel, although they initially dig it for the nursery.

When bats return to their caves after feeding, they must find their own within a nursery of a million or more baby bats! Each mother flies in and lands close to her own. Then she calls for several seconds and her baby gives an answering squeak. Formerly it was believed that they merely nursed whatever baby they landed near. But genetic tests established that it was their own. How they find their own child in such an immense nursery is astounding. After nursing her own, she flies off to another section of the large cave, hangs from the ceiling, and sleeps for a time. Then she flies off to obtain more food to feed her only baby.

VISION SKIN-DEEP-Some insects can see light through their skin, even when their eyes are covered. Experiments were done on moth and butterfly caterpillars, when their eyes were covered. There are other insects which also have this ability.

In addition, they often have eyes in very unusual places, as we discuss in chapter 16.

SUNGLASSES TOO- Yes, even sunglasses existed in nature before man began using them. Seabirds, such as gulls, terns, and skuas have built-in sunglasses. All day long they have to search for food, as they glide above the ocean's surface. Staring down into the waves for fish, the glint of sunlight on the waves reflects up into the eyes. The solution is sunglasses, which they have.

The retinas of these birds contain minute droplets of reddish oil. This has a filtering effect on light entering the eye, and screens out much of the sun's blue light. This cuts down on the glare, without lessening their ability to see the fish near the surface.

FLICKER'S LONG TONGUE-In chapter 28, we discuss the woodpecker. Here is additional information on his amazing tongue, and that of the flicker:

Woodpeckers like to eat beetle grubs. Cocking their heads to one side and then another, they carefully listen for them. When the grub is heard chewing its way through the wood-which it does most of the time,-the bird swiftly bangs on the tree with its sharp bill, drilling a hole as it proceeds.

Then it reaches out its enormously long tongue. How can a tongue be four times as long as the beak, when the beak itself is very, very long? It took special designing; accidents could never have produced the tongue of the woodpecker.

This tongue is attached to a slender bony rod housed in a sheath which extends back into its head, circles around the back of its skull and then extends over its top to the front of the face. In some woodpecker species, it also coils around the right eye socket.

Then there is the American flicker. This woodpecker-like bird is equally amazing. The tongue is so long that, after reaching around the back of the skull, it extends beyond the eye-socket and into the upper beak. Here it enters the right nostril so that the bird can only breathe through the left one. Flickers use this tongue to extract ants and termites after drilling for them.

But a tongue is not enough. The flicker must put something on the tongue to deal with those ants. Its saliva, wetting the tongue, does two things: First, it makes it sticky, so the ants will adhere to it; and, second, the saliva is alkaline, to counteract the formic acid of ant stings.

The evolutionists will tell us that all this came about by slow, laborious chance. But, obviously, such complicated structures and functions could not develop by accident even once in millions of years. -Yet in the world we find six others, totally different creatures which use this long, sticky tongue method to catch ants: the numbat, a marsupial in Australia (which is something like a small antelope); the aardvark in Africa; the pangolins in Asia and Africa (which are covered with horny plates, so they resemble giant moving fir-cones); and three very different anteaters of South America: the gazelle-sized giant of the savannahs, the squirrel-sized pygmy which lives in the tops of forests, and the monkey-sized tamandua which lives in the mid-tree levels.

As usual, the evolutionists have no answer. To make matters worse, paleontologists tell us that they can find no fossil evidence of any antiquity to explain these matters to us. In other words, there is no evidence that the woodpecker, flicker, anteater, and the others evolved from anything else.

JOURNEY TO THE UNKNOWN-In chapter 28, we consider the marvel of bird migration. Here is yet another example:

The bronze cuckoo of New Zealand abandons its young and flies to its off-season feeding grounds, located far away. After the babies hatch, they become strong enough to fly. But they have never seen their parents and have no

adult bird to guide them. Added to this is the fact that, when their parents left New Zealand, they flew to a place where no other bird in New Zealand flies to. So, as soon as these babies are strong enough for vigorous flight, what do they do? Why, they fly after their parents-and take exactly the same route. Here is the story:

The young set out each March on a 4,000-mile migration from their parents' breeding grounds in New Zealand. They fly west to the ocean's edge and keep going. How would you like to do that? The Pacific is an incredibly big ocean.

With no bird to instruct or guide them, these young birds accurately follow the path of the parent flock over a route of 1,250 miles of open sea. Arriving in northern Australia, they turn north, fly to the ocean's edge-and start off again. Arriving in Papua New Guinea, they head off again. This time they fly the gruelling distance to the Bismarck Archipelago.

Just one slight error in direction, and they would die. Why? Because not one of the birds can swim.

AMAZING HOUSE OF THE TERMITE

Termites build their homes of mud. Their homes are amazing structures, as we will learn below. Yet those large, complicated buildings are made by creatures which are blind. They have no instructors to teach them, and they spend their lives laboring in the dark. Nevertheless, they accomplish a lot.

Termites, of which there are over 2,000 species, only feed on dead plants and animals, and have very soft bodies which need the protection of strong homes. And the houses of some species are among the strongest in the world.

It all starts with two termites-a king and Queen. They burrow into the earth and lay eggs. For the rest of her life, the Queen will continue to lay eggs. Gradually, an immense colony of termites comes into being. Working together, they construct an immense turret of hardened mud that reaches high above ground. In northern Australia, in order to keep the termite tower cool, each of these tall spires is made in the form of a long, upright, rectangular wedge. Each side may be 10 feet across and 15 feet high, while only a couple feet thick at the bottom and Quite thin at the top. So the wedge points upward. The narrow part of the termite tower lies north and south; the broad side is toward the east and west.

The colony is Quite cold by sunrise, but their home Quickly warms up because the morning light shines on its broad east face. Then comes the hot, midday sun. But now the narrow edge of the nest faces its burning rays. In late afternoon, as everything cools, extra sunlight falls on the termite's home to help keep it warm through the night.

The lesson here is that it is well, in hot areas, to build one's house with the long side facing east and west.

But how can a blind termite, working inside the darkness of mud cavities, know which direction to face the tower towards? Would you know if you were as small, and weak, and blind as the termite?

Scientists have decided that the termites use two things to aid them in orienting their homes: (1) They use the warmth of the sunlight. But it takes more than the sun circling overhead; intelligent thought about how to place the slab tower in relation to that moving orb of light is also needed. Frankly, the termite is not smart enough to figure it out.

(2) The termite builds in relation to magnetic north. Experiments have been carried out, in which powerful magnets were placed around a termite nest. The termites inside were still able to face their towers in the correct direction, but they no longer placed their nests inside in the right places. So they use solar heat to orient the direction of the tower, but magnetic north to tell them where, within the darkness of the tower, to place the nests of their young.

Termite homes, located in tropical areas, have different problems. There is too much rain and the little creatures could be drowned out, and their homes ruined by the downpours. If you were a blind termite, how would you solve that puzzle? The termites do it by constructing circular towers with conical roofs, to better shed the water as it fails. One might consider that a simple solution. But if you were as blind as a termite, with a brain as big as one, how would you know how to build circular towers or conical roofs? Moreover, the eves of those conical towers project outward, so the rain cascading off of them falls away from the base of the tower. That takes far more thinking than a termite is able to give to the project.

When these termites enlarge their homes, they go up through the roof and add new sections; each section with its own new conical roof protruding out from the side. The tower ultimately looks like a Chinese pagoda.

The bellicose termites in Africa are warlike, hence their name. In Nigeria, they build an underground nest containing a room with a huge circular ceiling, large enough for a man to crawl into. It is 10-12 feet in diameter and about 2 feet high. It is filled with vertical shafts down to the water table. Termites go down there to gather moist dirt to be used in enlarging their castle. "Castle?" yes, it looks like a castle. Rising above the termite-made underground cavern is a cluster of towers and minarets grouped around a central spire that may rise 20 feet into the air. In this tower is to be found floor after floor of nursery sections, fungus gardens, food storerooms, and other areas, including the royal chambers where the king and Queen live.

The entire structure is so large that-if termites were the size of people-their residential/office building/factory

complex would be a mile high. Could mankind devise a structure so immense, so complicated? Yes, modern man, with his computers, written records, architects, and engineers could make such an immense building. But how can tiny, blind creatures-the size and intellect of worms-manage a proportionally-sized process, much less devise it?

Before concluding this section, let us view the air conditioning system used in this colossal structure. If you have difficulty understanding the following description, please know that, generation after generation, blind termites build this complicated way-and the result is a high-quality air conditioning system:

In the center of the cavernous below-ground floor is a massive clay pillar. This supports a thick earthen plate which forms the ceiling of the cellar, and supports the immense weight of the central core of the structures built in the tower.

Down in this basement cellar, the tiny-brained termites build the cooling unit of their Central Air Conditioning System Processor. This consists of a spiral of rings of thin vertical vanes, up to 6 inches deep, centered around the pillar, spiralling outward and covering the ceiling of the cavernous basement. The coils of each row of the spiral are only an inch or so apart. The lower edge of the vanes have holes, to increase the flow of air around and through them. The sides of these vanes are encrusted with salt.

These delicate and complicated vanes, made of hardened mud, absorbs moisture through the ceiling from the tower above. This decidedly cools the incoming air, making the cellar the coldest place in the entire building: The evaporating moisture leaves the white salts on the vanes.

Heat, generated by the termites and their fungus gardens in the tower, causes air from the cellar to rise through the passageways and chambers linking the entire structure. But, as any college-trained civil engineer would know, the cooling system is not yet complete. A network of flues must be installed to take the hot air down to the cooling unit in the cellar. Yes, the ignorant, blind termites also provided those flues! From high up in the tower, a number of these ventilation shafts run downward. As they go, they collect air from the entire tower and send it down, past the floor plate, into the cool cellar. As heat is produced in the various apartments of the tower, the air flows downward through the flues, drawn by the coolness of the cellar beneath.

The heat exchange problem has been solved, but there is yet another one: gaseous exchange. .

Air may be flowing throughout the cellar/tower, nicely cooling it, but carbon dioxide must be eliminated. The problem here is that no casual openings to the outside are permitted. The termites have only a few tiny entrances to the outside world, and carefully guard each one against their many enemies. Yet they must somehow refresh their air. Ask an engineering student to solve that one. He has enough equations, calculators, and material specifications that he ought to be able to provide you with a workable answer.

But those blind termites, the size of very small worms, were applying the solution before your engineer was born, the first college was built, and the first books were invented.

The flues are built into the outer walls of the tower. The lining of the flues, facing the outside of the structure, are built of specially porous earthen material. During construction, the termites dig small areas-or galleries-out from the flues toward the outer surface of the outside walls. These galleries end very close to the outer surface so gases can easily diffuse through the earth. As the stale air travels slowly through the flues, the carbon dioxide flows out and oxygen flows in. By the time the air has arrived at the cellar, it has been oxygenated and refreshed. In the cellar it is cooled and then sent back up into the tower! Any thinking human being could, without advance training, use the above guidelines to work out an excellent air-conditioning system for a house. The only basic requirement is moist heat in the upper part of the building. Engineers today call their modified versions "passive air conditioning," but the termites have used it ever since they came into existence.

With this system operational, the termites are able to keep their fungus beds permanently between 30°C and 31°C, exactly the temperature the fungus need to grow and digest the food the termites give them.

At this point, you might wonder why those termites cultivate such fungus beds. While many other termites go out and eat wood, which microbes in their stomachs digest for them, the bellicose termites only eat fungus (they lack those stomach microbes). So they cultivate gardens of manure in which fungus grows. The fungus grows best within a very precise temperature range of 30-31°C. However, the processes of decay in the gardens produces a lot of heat (for it operates somewhat like a compost heap). If you think about that awhile, you will realize that this frail termite, which cannot live outside his termite house, needs his fungus gardens, and yet, without complicated air-conditioning, cannot maintain those beds. The termite colony needs everything just right to begin with.

We have here another "chicken-and-the-egg" puzzle. The world is full of them; they are all solved by the great truth that God is the Creator. Nothing else can explain those puzzles.

More Wonders of Design - # 2

EAR MUSCLES OF THE BAT-We mention the bat in chapter 28, but here is more information about this incredible creature:

Although they have good eyesight, it is well-known that bats fly by sonar. They emit high frequency sounds which the human ear cannot hear. The returning echo of those sounds places "sound-print" pictures in their minds. Using this technique, a bat can "see" and catch a tiny, fast flying insect.

But there are more wonders here than we would otherwise have imagined: A bat can vary the pitch of that sound. The higher it is, the smaller the surface its echo can reveal. Some sounds are so high that they can enable the little bat to detect the presence of a wire no thicker than a human hair stretched across its pathway.

Then there is the intensity of that sound. The louder it is, the more distant the object that can be detected. So these calls are generally loud; so loud, in fact, that they would strike our ears as though they came from air-hammers, except that, by design, they are so high-pitched that we cannot hear them. God designed these noises, as loud as a pneumatic drill, to be in a range which would be soundless to us.

But wait! If it is necessary for a bat to make such a loud sound, in order to have it echo back from a distant object,-how can the bat possibly hear the echo with its ears, in the midst of all the racket it is making with its mouth?

This is a good question, for it would, indeed, be a very real problem. The ear of the bat was designed to be extremely sensitive, so that it can hear very faint sounds. Yet just a few of its screams would quickly deafen it! The Designer solved this problem also: There is a special muscle in the middle ear of the bat. It is attached to one of three tiny bones which transmits the vibrations of the eardrum to the tubular organ in the skull that converts them into nerve signals sent to the brain. Just as each scream is on the verge of being emitted, this muscle instantly pulls back that bone, so that it does not transmit sound from the outer ear to the inner ear. The eardrum is momentarily disconnected! Then, after the scream is ended, that muscle relaxes-and the bone moves back into place, and faint sounds can be heard. This back-and-forth motion of that bone occurs more than a hundred times a second! And it always occurs in perfect alignment with the sending of the super-short screams.

But there is still more: The faster these sounds are emitted, the more up-to-date information the bat will receive. Fast reception of information is especially needed when the little fellow is flying around the curves inside the cave, or is flying among the branches of a forest. Some bats can send out 200 quick screams a second. Each sound lasts only a thousandth of a second, and each is spaced just the right distance from the other so that each echo is clearly heard.

Talk about the amazing honeybee; who designed the bat! This creature is astounding. Frequently in this set of books, it is stated that Creation is a proven fact, not a possible alternative theory as some suggest. It is the laws of nature and the things of nature which prove Creationism; no other possibility could suffice. God made us. Accept the fact, for it is true. Not to accept it is to lie to yourself, and soon you are enmeshed in a habit of believing fanciful, foolish theories which, in reality, are obviously wrong.

GREENHOUSE PLANT-The fenestraria is not a plant in a greenhouse, but a plant which makes its own greenhouse.

Located in the southern African deserts, the fenestraria grows underground and only a small transparent window is exposed above the surface. This window is made of translucent cells and has two layers. Scientists were amazed to discover that the outer layer blocks the most damaging ultraviolet rays of the sun, and the inner layer reduces and diffuses the light to a safe level for the green photosynthetic tissue of the buried plant. How could the plant know how to do all that? Frankly, it couldn't.

Do you want to design a better greenhouse? Go study the fenestraria. Someone may eventually do it, and produce far more efficient greenhouses than we have today.

THE HOMING ANT -In the Sahara Desert there are great areas of trackless sand. How could you travel on it and know where you were going? If you were less than an inch tall, how could you do it and find your way home again? Well, the little *Cataglyphis* does it every day. This is a tiny ant which lives in that great desert. Making its home in a little nest below ground, where it is safe from sand lizards and birds, the tiny ant remains there till afternoon.

By that time, all its enemies have fled to shade rocks or burrows to escape from the burning heat, and the little ant ventures out to find its lunch. At about the same time, hundreds of these little ants crawl out of tiny tunnels and scurry off in search of dead insects. For an hour or so, they run here and there, zigzagging across the hot sand dunes. What they do must be done quickly-before they are overcome with heat.

As each ant travels, it pauses every few seconds, raises its head and moves it around. Then it dashes off in a new direction. Eventually, meal hunting time is over and the little fellow must return to its nest with the collected food.

But where is the nest? How can the little creature possibly know where it is located? Yet, without a pause, the tiny ant sets off in a certain direction-and runs straight for a distance of up to 150 yards exactly to its nest hole!

After making careful observations, researchers concluded that it was during that moment of head lifting and turning that the ant oriented itself. The scientists rigged mirrors which gave a false impression of where the sun was located-and, at the end of the food-gathering trip, the ant was not able to find its way back to the nests. Obviously, this means that the little ant, with a brain smaller than a grain of sand, was constantly memorizing directional locations as, every few seconds, it looked up and then started off in a new direction. And it was able to use the angle of an ever-moving sun as the norm for making those decisions.

BIGGEST SEEDS IN THE WRONG PLACE - The largest seed in the world is not, according to scientists, where it is supposed to be. The double coconut (coco-de-mer), *Lodoicea maldivica, is* a palm tree, the seeds of which require up to 10 years to develop before they are ready to grow into **a new palm tree.** They look like two coconuts joined together, and weigh up to 45 pounds.

In the wild they grow on hilltops in the remote Seychelles Islands. But researchers are baffled by their location on hilltops. How did they get there? Did the 45-pound coconuts roll uphill? The wind surely did not blow them up there. One would *expect* them to keep traveling farther and farther downhill, with each new generation. No known native animal or bird would be capable of carrying them up there. To add to the mystery, these coconuts sink in the water, so how did they get to the Seychelles Islands in the first place?

DOZING MOTHS-The bogong moth lives in Australia. In the springtime the little caterpillars feed on the grassy pastures of southern Queensland and New South Wales. Soon they pupate and become little greyish-black moths. But by now it is summertime and hot. What is a poor little moth to do in a place like that? I am not sure I would know, but the little moth does.

Instead of waiting around long enough to die in the heat, the little moths begin a long journey. Northward they travel to the Australian mountains. Each year they take exactly the same route that their ancestors took in previous years. Yet, just like their ancestors, they themselves have never before taken that trip-for they were born the same year they took it. Arriving at the foot of the mountains, they begin flying up and up the slopes, until they arrive at nearly 4,000-foot elevations. Some go on up to 4,500-foot locations.

The moths have arrived at piles of immense granite boulders near the summits. They alight on the boulders-and crawl into shady cracks. Packing close together, they look like tiles on a rooftop. In this high, cold place they go into a state of suspended animation, and remain there until the fall when they will return to lower elevations and lay their eggs next spring in the sand. Then they will die, and a new generation of moths will emerge in early summer-and soon thereafter wing their flight to the high northern mountains.

LIVING WITHOUT WATER-In chapter 12, we mention a plant in Israel which can live without water. Another is to be found in America. It is called the bird's-nest club moss. This little plant can survive for several months without moisture of any kind. In a drought it rolls into a tight ball to minimize the area exposed to drying winds and sun. As the water leaves the cells, it turns pale. When the plant is dampened, it unfurls and becomes green within 15 minutes.

PRAIRIE DOGS' VENTILATION SYSTEM- Prairie dogs are small, rabbit-sized rodents with short legs and small ears. They live together in very large social communities on the grasslands of the American West.

Working together, they build underground houses which are 90 feet long, with many side rooms. It is all something of a complicated apartment house. But the ventilation is crucial; how are they going to get the air moving through it? How would you do it? Admit it; using only natural materials found on a prairie, neither you nor I would probably not know.

But the prairie dog does it anyway-and quite successfully. Each tunnel has two openings, one at each end. But they are not constructed the same way. One opens flat on the surface of the prairie. The other rises up through a foot-tall chimney of mud and stones. Why does the prairie dog arrange the openings that way? He does not know why; he just does it. The Master Programmer coded it into his DNA to build his house that way; just as He coded his fur to keep him warm, eyes to see with, and ears to listen to what goes on around him.

A marvelous design factor is in that foot-tall chimney. Wind moves faster a little above ground than it does at ground level. With one chimney, the air inside the apartment house is sucked out, and fresh air is drawn in through the lower entrance. But with no chimneys-or with two, the air inside would remain stagnant.

MAKING BIRD NESTS-It is not easy to place sticks together and get them to "stick together." Try it sometime. Watch a bird do it, and you will note that the little creature works at the placement of every twig-until thoroughly satisfied. Yet how can a bird know, just by looking at it, when the location of a stick is satisfactory?

The larger nesting birds tend to make rough stick nests. But many of the smaller ones make delicate cup nests. Inside a twig cup, a lining of softer material is placed. This might be dried grass, or something similar. Thrushes use mud, the bearded tit prefers flower petals. The house wren values pieces of sloughed snake skins. The honey guide

of Australia plucks hair from the back of horses. Some birds grow special soft feathers on their chest, which they pluck off to line their nests. This has the double advantage of permitting their bare chests, which will be above the eggs, to keep those eggs warmer.

Hummingbirds use spider's silk. They build their nests while hovering over them, since the nest is too delicate for them to alight on till it is completed.

The swifts have a special problem. Although very fast fliers, their feet are poor and they rarely land on a branch-or anything else other than their nest. How then can they build their nests? How would you do it if you had to remain in the air all the time?

First, the swift collects twigs by flying at a branch and breaking off a piece in flight. Then it flies to a wall and attaches it, using saliva. The swift has been given amazingly sticky saliva! Outside the body, it acts like a fast-drying glue. More sticks are brought, and soon the nest is made. That is how the Asian chimney swift does it. The American palm swift uses-not twigs-but cotton, plant fibers, hair, and feathers. The African palm swift only uses saliva throughout the operation.

These are called "palm swifts," because they attach their nests to the underside of palm leaves. But what keeps the egg from falling out of the palm leaf when the wind blows? No problem; the bird glues the egg into the nest!

The cave swiftlets of Southeast Asia also build with saliva-but they make much larger saliva nests. These nests are deep within dark caves, and may be attached to horizontal ledges, the vertical sides of the caves-or even to the overhead roof!

How can a bird make a nest out of saliva? How would he know how to form it in the right shape as he prepares it? "Easy," you say. Well, try dripping saliva onto a dinner plate-and make a bird nest out of it! Here is how the bird does it:

First he flies to the side of a cliff and repeatedly dabs saliva onto the wall in a half-moon shape of what the wall-side part of the nest will look like. Then he dabs more and more, and slowly builds it larger and larger. Gradually, he moves the sides inward-and produces a perfectly formed nest with a cup-like top! One nest takes several days to make; and when completed, it has the inside of the cup just the right size to hold two eggs. And that is exactly how many the swiftlet always puts into the nest.

20-MINUTE PLANT-The Stinkhorn fungus Of tropical Brazil is one of the fastest -growing organisms in the world. When the fungus is ready to begin growing, chemical changes in its cells permit them to absorb water rapidly.

It pushes out of the ground at the rate of an inch every 5 minutes, and grows to full size in 20 minutes. This growth is so fast that a crackling sound can be heard as the water swells and stretches its tissues.

As soon as full size is achieved, it begins decomposing at the top. Flies are attracted and, crawling over the surface, collect spores on their feet which they carry elsewhere.

MITES IN THE EAR -What is as Small as a mite? These creatures are so tiny that one of the places they live is inside the ear of the moth. Entire colonies of mites will live inside a moth's ear. Separate parts of the ear are used for egg laying, stacking their refuse, and feeding.

But there is a problem: These little creatures so fill the moth's ear that he can no longer hear properly with it. But he needs his ears, and with mites in both of them, he wanders around erratically, and would be caught by bats.

The solution is simple enough: The mites only live in one ear! In this way the moth can hear well enough to go about his business-with less chance of being eaten. Thus the mites keep themselves from being eaten by bats.

But, who told the mites to do that? Surety no mite could be smart enough to figure that out. The brain of a mite would be smaller than the smallest speck you have ever seen.

MADE FOR EACH OTHER- It is an intriguing fact-and one evolutionists would prefer to ignore-that living things are often designed with one another in mind. Without the one, the other cannot survive. How then could they originate in the first place, if they had to begin together? What outside Power did the designing? The plants and animals themselves surely did not confer together before they existed and figure it out.

Stanley Temple, an American biologist working in the Indian Ocean island of Mauritius, noticed in 1970 that the seeds of the Calvaria major tree, although fertile, had not germinated for 300 years (the age of the youngest specimens still growing). Noting that the large, wingless bird, the dodo, became extinct about that time, Temple brought in some turkeys-in the hope that they could do what the Dodo probably had done: swallow the seeds, thereby removing their hard outer coat and enabling them to germinate.

He fed some of the seeds to domestic turkeys, collected the seeds when they had passed through the birds' digestive system, and planted them. For the first time in three centuries, Calvaria major germinated, producing healthy new plants.

DUET BIRD SINGERS-Did you know that some birds prefer to sing together? The bou-bou shrike lives throughout tropical Africa in thick forests, where they can only see a few feet at the most. A pair may not be far apart, but they cannot see one another.

The song of this bird is exquisite. It is clear, flute-like, with a long melodic pattern. Yet, the truth is that it is two birds singing, not one. One bird starts the song and then, it will suddenly pause and the other will add a note or phrase, and then the first bird will instantly take up the song again. Back and forth it will go-and yet it sounds as if only one bird is singing! There is not the slightest hesitation or pause anywhere in the song.

The two birds are a mated pair. Scientists tried to study this in detail with tape recorders and sonograms to analyze the sounds-and then made the discovery that there are many other duet-singing birds in the wild. In a square mile of South American rain forest there may be as many as a dozen different species of birds singing duets. This is how they keep track of the location of each other in those dense jungles.

Yet it is obvious that the birds did not devise this. The intellectual requirements for such a procedure are too great. It would be with the greatest of difficulty that you and I could sing such a duet together, even if we were the best singers in the world. The cue and mental requirements for such instant stopping and switching over from one bird to the other, at random points here and there in **the song are astounding.** It **has been** discovered that each bird in the pair knows the complete, complicated song and, if solitary, can sing it alone. But that cannot explain how they can know to instantly stop-so the other can sing part of it-and then return to the other.

In the darkness of night in the forests of Europe, the tawny owl also sings in duet. Its famous *towhit to whoo* call has been heard by millions of Europeans. Yet few realize that it is two birds uttering the call! One owl sings the *to-whit,* and then, the other owl instantly gives the *to-whoo.* It all sounds as if it is coming from one bird, but the call is being made, alternately, by a pair of owls.

COLD LIGHT- Most of the energy used to light a light bulb is wasted, since it is changed to heat. It takes energy to produce light, scientists cannot fathom how lights in nature operate so efficiently. The man who ever solves this problem will be a millionaire overnight, but, so far, no one has been able to do so-even though fireflies and other creatures do it all the time.

For example, the tropical firefly, Photinus, makes light with 90 percent of the energy used for that purpose. By contrast, only 5.5 percent of the energy used to power an incandescent bulb emerges as light; the rest is wasted as heat. The glow of a firefly contains only 1/80,000 of the heat that would be produced by a candle flame of equal brilliance.

If an ignorant speck-brained firefly can do that, why cannot man do it? If a thinking man cannot do it, then what reason do we have to think that an "accident" did it for the firefly? The firefly is enabled to do it because of the advance planning of an Intelligence far greater than that of mankind.

WATER ON FIRE -In the clear waters of the San Blas Islands, located in the Gulf of Mexico near Panama, you will find that the ocean sometimes sparkles with fire.

What you see are tiny fire-fleas. Each is a small crustacean about the size of a land flea, but with shrimp-like bodies. The sudden spurt of light in the dark water so startles a predatory fish that, even if it has already snapped up the fire-flea, it may swiftly disgorge it in fright. These little creatures also use their light to locate and attract one another, much as fireflies on land do.

One type of firefly makes equally-spaced spots of light as it swims. Another only flashes as it swims vertically to the surface, ever flashing faster as it nears the water line. Yet another flashes synchronistically as the males, several feet apart, move through the water flashing together in precise unison.

FISH THAT FLIES-Everyone has heard of the flying fish, but it is still a very unusual creature. Flying fish do not actually fly; they glide. First, they leap into the air at speeds up to 20 m.p.h. Then, using their wide pectoral fins as wings, they begin their glide. Because they usually remain close to the water's surface, they flick their tails occasionally to produce extra thrust and keep them going longer.

Flying fish have been known to soar as high as 20 feet and travel as far as 1,300 feet in one glide through the air.

OCEAN SOUNDS-There is more noise in the ocean than merely the lap of waves. You can dive down into the sea and not hear these sounds. This is because the small plug of air in your outer ear blocks them out. But, upon lowering a hydrophone (an underwater microphone) into the ocean, you discover that the ocean is full of sound.

Triggerfish grate their teeth together, sea horses rub their heads against their back spines, and pistol shrimps dislocate their claws when enemies draw near-and the resulting noise sounds like gunshots. When a conger eel prepares to atack a spiny lobster, the lobster rubs its stony antennae along a toothed spike that is on its head between its eyes. A rasping noise is made, and all the spiny lobsters in the area quickly jump into their holes.

PORPOISE TALK-Porpoises (also called dolphins) seem to talk more than anyone else living in the ocean. Which is quite a thought.

Scientists have studied them in aquaria and in special shallow-water locations off the coast of the Bahamas. Porpoises have a vocabulary of about 30 different vocalizations, but they can also change the significance of each by the body position at the time the sound is made. A certain sound made while nodding the head will have a different meaning than when not nodding it.

Each porpoise has a "signature whistle," which' is his unique call identifying himself. Another porpoise only uses that call to catch the attention of the owner of that special whistle.

All of these sounds are totally different than the sounds they make when they send out sonar (underwater radar). That system is discussed in chapter 32 and is used to locate distant objects.

A third way in which porpoises communicate is by ultrasonic sounds which people cannot hear, but which certain electronic equipment can receive and record. A fourth way is by touching (nudging, stroking, and smacking) one another.

SONGS OF THE HUMPBACK-The porpoises click and make high-pitched sounds. But the whales sing. Would you like to hear a whale sing? Recordings of these sounds can be purchased from wildlife organizations.

The humpback whale is the greatest singer of them all. Its songs consist of vast roars and groans, interspersed with sighs, chirps, and squawks. That description may not sound very exciting, but their songs are interesting to listen to. And they go on for quite some time. Each song can last 10 minutes or so. Once completed, the whale will repeat it again-and again-for hours. Each year the songs change somewhat, as the whales experiment with changes in the tunes. We have learned a lot about these songs, but no one yet knows why these whales sing.

BLASTS FROM THE BLUE WHALE-The largest creature in the world is the blue whale. Some have been measured at 100 feet in length. It has the largest lungs and vocal cords in the world and makes the most noise. Blasts of 188 decibels have been reported. This would be equivalent to the, Saturn five rockets which launch the space shuttle. But these sounds are extremely low in range. Scientists believe that the calls of blue whales can be heard by other whales a thousand miles away.

GROWING DOWN- Most creatures grow up, but there is a frog which does the opposite. The paradoxical frog (pseudis paraobxa) becomes smaller as it "grows up." Living in the South American tropics, the tadpoles grow to as much as 10 inches in length. But, when this particular tadpole turns into a frog, it shrinks drastically.

During this process-as do other frogs-the tail is absorbed into the body. But when the change is completed, the paradoxical frog is only 3 inches in length.

Why should this frog be so different than the others? Evolution could have no answer. The difference is one of design, and only design. Any student of DNA well-knows that hundreds of interrelated genes, located in different chromosomes, would be involved. Chance could not change them, without producing a monster which would be dead at birth.

WASPS TO THE RESCUE-Several species Of birds in South America (caciques and oropendolas, for example) and weaverbirds in Africa like an especially protected location in which to build their nests. So they first go searching for the homes of the dreaded wasp. No one wants to live near them! It will surely be well-protected from all their enemies,-but what about the wasps?

Once found, these birds build their nests close to the wasps' nests. Yet, oddly enough, the wasps do not at all mind having these birds nesting in the trees just above their own nests. But let another bird even get near, and the ferocious wasps buzz toward them threateningly.

When the nests are constructed, the birds settle down to raise a family. Then an enemy draws near to raid the nest, and instantly the wasps fly out and go after him. The wasps have decided to protect not only their own nests but those of the nearby birds also.

Scientists are still trying to figure out why wasps attack other birds but protect these certain ones.

JUMPING FROGS IN MANY COUNTRIES-

Mark Twain once wrote about a jumping frog. There are frogs all over the world, and all of them surely can jump! Pick up a frog and look closely at it. These little creatures are excellently designed for jumping. Yet they could never work out the design themselves. It had to be done for them. The back legs, folded into three sections, provide the leap; the front legs are the shock absorbers when they land.

The small North American frog, Acris gryllus, can jump up to 6 feet, which is 36 times its own 2 inch length. Many other frogs can jump somewhat shorter distances. For a man to do this, the world's champion human jump would be about 215 feet.

EGG TIMERS- Mallee fowl of Australia lay eggs at random times throughout the summer since, when each hatches, it is a fully-formed small adult; well-able to fly off and take care of itself.

But many birds which nest on the ground cannot do this. Their chicks are born very feeble and must be given much care and a lot of food. It would be very difficult if the eggs hatched and matured at different times. For example, the female quail does not begin to incubate her clutch of a dozen or so eggs until the entire number have been laid-which may require two weeks. Then she begins setting on the entire lot at the same time.

Who told the mother quail to do this? Her parents surely didn't. Yet quail regularly do not set on the eggs until the entire clutch has been laid.

But that is not the end of the matter. The little quail sets on so many eggs that the ones on the outer part of the nest do not receive as much warmth. Also she has to regularly turn the eggs, or the membranes within them may adhere to the shell. So many factors are involved that, as hatching time draws near, some eggs are not as well-developed as others.

How can this problem be solved, so that all the chicks will come out of their shells at about the same time? Another miracle; listen to this:

Scientists have discovered that, as hatching time nears, the unborn chicks begin to signal to one another. If you put a doctor's stethoscope to an egg at this time, you may hear clicks coming from within. The neighboring eggs can also hear them. If they have not yet reached the clicking stage, the sound of neighboring clicks stimulates them to speed up their development! Researchers played recordings of the clicks to batches of eggs-and thus induced them to hatch well before others from the same clutch, which had been kept alone and in silence.

BIRD BONES-In chapter 28, we discuss the amazing structure of birds. Here is more information on its bones:

Evolutionary biologists tell us that birds have evolved their bones until they are now very lightweight. But birds cannot change their bones any more than you or I can. Also, if birds cannot fly with heavy bones; how did they survive before they invented lightweight bones for themselves?

Those bones are truly unusual: They are so lightweight that a bird's feathers weigh more than its entire skeleton! That is quite a thought, considering how lightweight a feather is.

The bones are very nearly hollow, with internal struts and honeycombed air sacs to provide them with unusual lightweight strength. Modern airplanes are built in a similar manner, but only after very careful planning by intelligent men.

During flight, air flows into the sacs in the bones-and then to the lungs. This enables the bird to have a much larger supply of fresh oxygen as it flies. Even the beak is modified to save weight, and is constructed of lightweight horn with no teeth.

A golden eagle is a large bird; yet, although having a wingspan of nearly 8 feet, it weighs a total of less than 9 pounds.

DEVELOPMENTAL AGES AT BIRTH- Each animal is born in just the best way. Some creatures, like baby mice, will have a longer time to grow-since they are born in a cosy, hidden nest. So they come forth blind, hairless, and unable to walk.

But other creatures are born into a harsh environment, and must be able to travel as soon as they arrive in this world. The guinea pig and agouti has no nest, but lives on the surface of the ground. So their babies are fully formed, fully haired, and can run as soon as they are born.

Calves of the wildebeest, in east Africa, are born while the herd is migrating, and can stand up and trot after their mother within five minutes of dropping to the ground.

SMALLEST MAMMALS-The Creator can make things in miniature. The smallest mammals are the 3-inch Etruscan shrew, which only weighs about 0.09 ounce, and the 6-inch Craseonycteris *thonglongyai bat*, which weighs even less: about 0.06 ounce. How can all the dozens of specialized organs, found in every mammal, be included in these tiny creatures? It is, indeed, a great marvel of wisdom and craftsmanship.

BABY DISCOVERS ITS NOSE- Females live together in groups and cooperate in caring for the baby elephants, while the males spend their time alone, wandering about. The little elephants are cared for by all the adults in the group. If anything happened to the mother, the others would raise her little one. In the care of so many protective adults, the youngsters happily romp about and play.

Researchers who watch elephant herds, have found that when an elephant is only a month or two old, it begins shaking its trunk, wondering what this strange thing is. It will shake its head and notice how the curious object flaps back and forth. Sometimes the baby trips over it. When the baby goes down to the watering hole, it awkwardly kneels down and tries to sip with its mouth. At about the age of 4-5 months, it discovers that water can be sniffed up

into its trunk, and then can be blown out into its mouth. That discovery not only enables it to get a drink faster but can lead to more fun: Baby finds it can blow water on the other elephants.

Why is the learning process so slow for an elephant, when some other creatures are immediately prepared at birth for life's crises? This is no failure in design. The baby elephant has many protectors and a long childhood before it will becomes an adult. There is an abundance of time for it to learn as it grows, so this factor was wisely provided for in the design blueprint.

PROLIFIC BUNNY RABBITS—Female rabbits can breed when 4 months old, and every 30 days produce up to nine babies. During the spring and summer, one can bear six litters. In three years time, if there were no losses, one pair of rabbits could produce 33 million! Many young children would probably be happy if that happened. There would be enough bunnies for all of them!

BIGGEST CONVENTION OF THEM ALL-The largest gathering of mammals, held anywhere in the world, convenes every summer on the Pribilofs, an island group in the Bering Sea off Alaska. Each year 1.5 million Alaskan fur seals assemble, and produce half-a-million pups.

But it was a planned gathering. Seals on land are relatively defenseless, so they gather together in order to have better protection from their enemies.

WHEN ENEMIES CALL A TRUCE- The Rufous woodpecker of India and southeast Asia likes to eat ants. Those stinging tree ants, in turn, occupy themselves with vigorously attacking every intruder that comes near their nest.

But, surprisingly enough, when it comes time for the rufous woodpecker to build a nest, it temporarily makes peace with the ants.

The awesome fact is that this woodpecker flies to the football-size nest of stinging tree ants, tunnels in, lays its eggs there, and then settles down and incubates them-all the while with stinging ants all about it!

The utterly impossible occurs. No one can figure it out, including the scientists. The thought of a woodpecker setting on its eggs in a nest of stinging tree ants-has the experts stumped. Or treed, should we say.

When the little birds hatch, the dutiful parent feeds them till they are able to fly away. Throughout that time, it has not eaten one of the ants in that nest, nor have they disturbed it during its nesting season (although they attack anything else that comes near their nest at that time, as well as at any other time).

And then what do you think the woodpecker does? It flies off-and again does as it did earlier-eating ants in their ant nests.

SPIDER SILK-There is much more information on spiders in chapter 16, but here is more about spider silk:

Most spiders are such tiny things. Yet every one of them can produce a variety of different silk. Some of it is thin, some of it thick. Some is designed for temporary scaffolding, and Mme is stronger than steel of comparable weight and is heavy-duty building material. It is the strongest of all known natural fibers.

How can a little spider make this silk? It is a marvel. Yet each spider can and does make different kinds of silk! It can automatically turn off one spigot flow of this strange liquid (which, on contact with air, instantly changes into an elastic solid) and turn on a different type of liquid. At any given time, every spider can produce several different types of silk. The type it produces will be exactly the right kind for the job it is immediately working on. Watch an orb (circular) spiderweb in the making. The little spider begins with one type of silk for the initial construction, and then switches to another for the circular, sticky part.

This silk is actually a liquid protein that is squeezed from little nozzles at the rear of the abdomen. It hardens upon meeting the air. Spiders use silk for all kinds of purposes: egg-sac cases, the lining of nests, woven tents for their babies, safety lines when they jump, circular webs, trapdoor wrappings and hinges, non-circular webs, and airplane lines which carry them to distant areas-and across oceans.

GUARDING A SHRIMP-Some people have guard dogs, but there is a shrimp which has a guardfish. The goby *(Cryptocentrus coeruleopunc*tatus) is a 6-inch fish which lives in the ocean. It acts as a sentry for a tiny shrimp, called the snapping shrimp, with which it shares a burrow on the seabed.

The shrimp makes the burrow, and keeps it clean. The fish, in turn, has the better eyes of the two and guards the shrimp when they are outside the burrow.

When the entrance to their burrow becomes clogged with rubble, the shrimp comes out to clean the entrance and the area around it. It uses its claws like a mechanical digger. While it is working, the goby is on guard duty. It is nearby watching for enemies. Yet it remains close enough that one of its antennae touches the shrimp at all times. The moment the goby senses any danger, it wriggles its body. Instantly the shrimp jumps back into the burrow, and the goby immediately follows. Who told the shrimp and goby to work together like that?

MAGNETIC PIGEONS-Of course, we have all heard about the phenomenal homing abilities of pigeons. Ancient Roman emperors would use them to send messages across long distances. These birds tend to stay at home, not traveling more than a few miles from it at a time. Yet, if taken to a distance of several hundred miles, they will be able to find their way back home-and do it within a few hours.

Careful experiments have shown that homing pigeons take note of geographical features below them; and, when leaving their home, they initially circle overhead to get their bearings, and then head *off* to feeding locations not far away. So visual observation is a factor. But birds carried hundreds of miles away cannot see the ground from the air, and will soon travel over terrain they have never before seen. So how do they find their way home?

Birds were fitted with glasses which prevented them from seeing the ground, and yet they found their way home anyway. Obviously, sighting the land below them was not the key. There is good evidence that the birds check the angle of the sun as they fly. Yet, on overcast days, they still find their way home.

Then researchers took birds to a distant location on overcast days, tied tiny magnets to their heads, and turned them loose. They could not find their way home. So the answer is a combination of all three: visual observations of the ground, the angle of the sun, and mental readings of the location of the magnetic north pole. But, of the three, the magnetic readings are the most important for distance flying. This is a feature which does not change.

The small magnets on their heads were strong enough to keep them from sensing earth's magnetic pole. But how are they able to sense earth's magnetism? This is not known, but it has been discovered that birds are born with a tiny piece of magnetic rock in their heads! This is a little magnet in their brains. Where did that particle of rock come from? How did it get inside their heads?

Everything in nature about us is filled with mysteries, which can only be explained by the presence of a Creator who made everything.

More Wonders of Design #3

LATERAL LINE OF FISH-As fish speed through the water, not only must they see ahead, they must also be able to watch what is coming toward them from the side. It is the lateral line which is their sideways "eyes." In fact, it is equivalent to a whole row of eyes! And it operates something .like radar. But, instead of sending something out to bounce back, the lateral line constantly senses pressure waves. This line was mentioned in chapter 24, but here is more information on this natural wonder:

Many fish have a horizontal row of cells midway on their sides. This line of cells is frequently a slightly different color, so you can often see it on fish that you view in an aquarium. These special cells sense pressure differences in the water. The lateral line senses the presence of a fish coming from the side, and sends messages to the fish's brain. A map is "seen" in its tiny brain. Scientists, testing the power of this line, have discovered that a fish can even tell whether the oncoming creature is a friend, enemy, or a prey to be caught.

PATTERN FOR A PALACE-Earlier in life, Sir Joseph Paxton was the head gardener to the duke of Devonshire at Chatsworth. Paxton was the first person in Europe to successfully transplant and grow the giant South American water lily, Victoria amazonica. The leaves of this plant are up to 7 feet across, and Paxton was astounded by the fact that a child could walk on them. How could this be?

Carefully studying the plant, Paxton found that it was the arrangement of the ribs beneath the leaf's surface which gave it such immense structural strength. Years later, in preparation for the Great Exhibition of 1851, Paxton stepped forward and declared he could design a durable glass house of mammoth size; and he did it. Applying the principles revealed in the supports of that water lily leaf, he built the Crystal Palace-a vast structure of glass and iron-in Hyde Park, London to house the complete exhibition. The ribs and struts of the roof of that immense building were copied from the water lily. (Moved after the exhibition to south London, the structure withstood the elements for nearly a century, but was destroyed by fire in 1936.)

BIG SEEDS AND LITTLE-All the genetic information needed to produce an entire plant or tree is to be found inside its seeds. It is a miniaturized marvel. Of the regular plants, the orchid has the smallest seeds in the world. They are about 0.01 inch long and so light that a million of them weigh only 0.01 ounce. Each orchid seed capsule holds up to a 20,000 seeds. .

The giant double coconut of the Seychelles is the largest seed, and weighs up to 45 pounds.

EUROPEAN EEL RETURNS HOME- The Sargasso Sea is an immense patch of water in the tropical Atlantic, which is filled with a variety of seaweed and small creatures. It lies between Bermuda and the West Indies.

Among those who journey here are small eels. Upon arrival, they seem to know exactly what to do. Going to a depth of about 1 ,300 to 2,500 feet, they lay their eggs and then leave. The parent eels do not see their young and never give them any training. Soon after, the parents die.

In this deep, 20°C cold, the eggs hatch into slender, transparent eels that look different than their parents. Even their fins are located in different places. Because of where the eggs were laid, the young are gradually carried eastward at a depth of 700 feet into the Gulf Stream. Northward it takes them, and on and on they are carried.

Scientists have dropped labeled logs into the ocean where the eggs are laid, and ten months later they arrive off the coast of Europe. The little eels make the same trip but, for some unexplained reason, do it in a year-and-a-half. But these little creatures are not logs! When the wood reaches Europe, it just keeps sailing on past down the coast. But when the eels reach that large continent, they know to go up just certain rivers, into certain tributaries, and thence into certain lakes the very ones their parents used to live in. Arriving in those lakes, the young will know to depart through certain streams, and finally go back to the same brooks where their parents lived for several years!

But let us return the time they arrive off the coast of Europe. When they reach the edge of the continental shelf, which may be several hundred miles from land, their bodies begin changing. Until now, they have not needed complicated swimming gear, for they were carried along by the Gulf current. But now, at just the right time, their bodies change. But why are their bodies triggered to do it just then?

Their leaf-shaped body narrows, they shrink a little in length, and grow pectoral fins. Soon they look like their parents, but are a little smaller and still transparent. With this change completed, something inside tells them they must invade Europe. They also know that they have so much work ahead of them for awhile, they must stop eating.

Some go into Britain, others into the Baltic, still others up the rivers of France, and others go through the Straits of Gibraltar into the Mediterranean. Some go all the way to the Black Sea. Arriving at their appointed place by the coast, they know that they must now enter fresh water-and keep going. Swimming up the rivers, they remain within a yard of the bank, thus avoiding the rapid current out in the middle. Because they are transparent, they are unnoticed by most predators. Stubbornly persistent, they avoid waterfalls by wriggling through the sodden vegetation on the banks. When they enter lakes, their sensitivity tells them which feeder river to journey up.

After they have been in fresh water several months, they begin eating again. Now they grow to their full adult size and opaque appearance, with yellow backs and sides. They remain in these streams for several years, moving to lower, warmer streams in the winters and higher again in the summers.

Scientists have caught eels in a Scandinavian estuary, tagged and released them in another over a hundred miles away. Within weeks they had returned to their original feeding grounds. Others have been caught and taken several hundred yards away arid placed on the ground. They always know which direction to wriggle-in order to again return to the stream. This they do even when a rise in the ground obstructs their view and they have to wriggle upward to get over it.

After the males have been in the rivers for three years, and the females for eight or nine, they again change-this time from yellow to black.

Very soon they will need to be as dark as possible in order to remain hidden. Their eyes enlarge-because, to do what is ahead of them, they will need much sharper vision.

And now, something tells them that the time has come.

Down they go-from stream to lake, and from lake to river; downward, onward-until they reach the sea. When placed in a pond at this time, they will wriggle out of it and cross dew-drenched fields in order to reach rivers that will take them to the ocean. They know they must return to the sea. But there the track was lost; what happened to them then? Recently, scientists embedded tiny radio transmitters beneath their skin. We now know that, arriving at the ocean, they swim away from the European coast in a north-westerly direction at a depth of about 200 feet until they reach the continental shelf. The seafloor then drops to 3,000 feet, and they quickly dive to about 1 ,400 feet. Then they swim away to the southwest.

A map of the Atlantic Ocean reveals that such a course will take them back to the Sargasso Sea where they were born so many years before. Six months later, their tiny radios shows them reappearing in the Sargasso Sea-3,500 miles from their little river streams.

But how did they know where to go? Even if they did know, how could they find their way to that location through oceans-which to them are uncharted. "Uncharted," I say, for people may have charts; but the wildlife does not. How then can they know where to go and how to get there? , Regarding the second question, researchers tried a number of experiments-and found that the eels may be guided by the stars in their initial ocean travels, as they swim near the surface till they reach the continental shelf. But what is their means of guidance after that? Try diving down to 1,400 feet into the ocean, and then figure out where to go. It is pitch black in those depths, and you could not see a compass even if you had one in your hand. Do they detect very low frequency vibrations from the waves overhead? Yet passing storm fronts bring continual confusion to wave motion on the surface.

So, arriving in the Sargasso Sea, they have now laid their eggs. Their young, when hatched, will never be taught by them the journey they must make, for no adult eel has ever traveled from the Sargasso Sea to Europe, or, arriving there, initially swam up its rivers. It is a trip that only their babies will make.

After so many years absence, the parents have returned to their birthplace. They have spawned and now they swim away and die. They have come to the end of their journey.

THE FIRST BALLOONS-Scientists tried to figure out how a pine tree in Scotland could be pollinated by another in Norway, on the other side of the North Sea. But experiments revealed that this was being done.

Analyzing pine pollen, they discovered that pine pollen can travel these immense distances on the wind because of a very unusual structural feature: Each pollen grain is buoyed up by two microscopic-sized balloons. Who decided to put those balloons on the pine seeds? Did the pines get together and vote that they would all change their pollen? If the pines did not do it, then who did? DNA studies reveal it could not have been a random change; it had to be planned by Someone, who then structured the DNA to make pollen that way.

TAILOR AND WEAVERBIRDS- The Indian tailor bird uses spider silk to sew the nest together! How could it possibly learn how to do that? After making a cup of living leaves, still on their stems, the bird holds some spider silk in its bill, pierces the leaf, and draws the silk through it. It finishes by tying a knot at the end of the silk. Can you tie a knot in a thread from a spider web? You can't do it? Then how can a little bird do it? Repeating the operation many times, the nest gradually takes shape as the two leaves are sewn together. Both the weaverbirds of Africa and the icterids of Latin America go a step further-and actually weave their nests. They make a fabric of grasses as they interlace the weft spears in and out of the parallel warp blades. The result is grass cloth! The fibers used are long creepers, thin rootlets, grasses, reeds, or strips torn from broad leaves, such as the banana.

In order to weave their nests, these birds need to know two complicated skills: weaving and knotting. Without a knot, the initial woven part will immediately come undone. If you were a bird, how would you tie a knot in a stem? Here is how the bird does it: First it flies with a long piece to a tree branch where it wants to make its nest. Then it holds part of it down on the branch with one foot. Next, with its beak it passes the end around the branch, threading it through the other, and pulls it tight. A series of half hitches are then tied at the end of this knotted end. By now, are you becoming confused? The bird isn't.

The bird then begins threading one strip beneath another that runs across it diagonally or at right angles. This is not easy work, but the bird persists. It never gives up. After each threading, the strip is pulled tight. If the strip is long enough, the bird will reverse direction of weaving and loop the strip back and interweave it parallel with itself. This looping-back procedure adds to the strength of the nest.

The result is woven nests which dangle from the tips of branches. These nests are not only single rental units, but also apartment complexes! Many of them have separate rooms in them-all carefully woven together.

"It's really nothing at all; just a product of random evolution," someone will say. Well, then, try making an apartment house out of woven grass! If you cannot do it, how do you think that tiny bird ever figure out the process, especially considering two facts:

(1) No one on earth ever taught it how to do such a process. Scientists took weaverbirds and raised them from incubator hatchings. Then they turned them loose in aviaries with trees and grasses. The birds knew how to make their woven nests.

(2) The brain of that bird is as small as the tip of your little finger, and could not grasp the instruction anyway. If you take exception to that conclusion, go out and catch a bird and teach it how to make knots and make interwoven nests. Many of these nests have waterproof roofs. How would you waterproof the roof of a woven grass circular bird nest? The bird does it by using wide strips of leaves on the top, and then carefully overlaying them so the water will run off.

When all that is done, there must be a way to keep out snakes. How would you accomplish that? Some species add entrance passages, which are long, woven, curved tubes. Seeing them, snakes give up and depart without trying to steal the eggs.

If, after constructing a nest, a weaverbird decides that it is not well-made, what does the little bird do? By that time our little craftsman must laboriously unravel it all and start over because there is not enough raw material around since other weaverbirds have taken their share. Carefully taking its nest apart, the little fellow puts it all back together again!

MOVING SLIME- The slime mold is an unusual life-form. Separate mold cells live on rotting wood. When the time comes for reproduction to occur, the cells push together and form a single organism. Where there were millions of separate creatures, now suddenly there is one. Scientists are trying to decide the trigger mechanism that tells the cells when to push together. Thousands of neighboring mold cells form a single unit about 2 inches across.

This strange new creature-which was not there before-looks something like a jellied slug. But, to add to the mystery, it can now move even though the separate cells could not. In the few hours that it exists, it moves about 12 inches toward the light.

Arriving at a new location, which will be more favorable for the growth of the stalk, it sprouts up, forms spores, and the wind carries them away. When they land, they form separate stationary cells.

As soon as the spores depart, the parent organism dies.

AFRICAN HONEY GUIDE- This bird is the size of a robin and lives in east Africa. Although it eats all kinds of insects, it is especially fond of honeybee grubs. But getting them is not so easy. The wild bees of Africa are dangerous, and live in secluded areas. Although the honey guide has a way of finding them, it does not dare enter the hive

unaided. Even if it could drive off the bees, its slender, delicate bill could not penetrate their nests, which are in hollow trees or clefts of rocks. So it gets a friend to help with the task.

In northern Kenya, for example, men from the Boran tribe make money selling honey. A tribesman goes out into the countryside and claps his hands, whistles in a certain way, or blows across a snail shell or through a seed with a hole in it. If a honey guide is not far off, it will generally appear very quickly and sing a special chattering call which it never otherwise uses. When sure that the man's attention has been caught, it flies off with a low swooping flight which is easy to follow. As it flies, its tail feathers are spread wide, so that the white outer feathers are clearly displayed. The man follows, whistling and shouting to let the bird know he is coming.

Then the bird disappears for a few minutes, and then returns, perches, and calls for the man to come. As the two travel together, the bird gradually lands on lower and lower branches until, after about 15 minutes, its song changes to a low, less agitated one. It repeats it two or three times, becomes quiet, and flies over to a perch where it sits quietly. As the man approaches, he can see that the bird is sitting very close to the entrance of a bees' nest.

A stream of bees is moving in and out of the nest, and the man carefully draws closer and sets a small fire just upwind from the nest. This stupifies the bees and he opens the nest and extracts the combs, dripping with rich deep-brown honey. He hangs up part of the honeycomb for the bird. The bird flies to the remains of the nest and eats the fat, white beegrubs, and also some of the honeycomb wax. The honey guide is one of the only animals which can digest beeswax.

Scientists have spent months observing the honey guide in action. Disguised in animal skins, so it will not see

them, they have found that this little bird knows the location of every beehive in its territory-and frequently checks to see their condition. On cold days, it hops up to them and peers in. On hot days, it notes the general amount of activity, as the bees go in and out. When the bird begins to guide the man, and then disappears for 15 minutes, it has flown off to be sure it is leading the man to a good, active hive. Then, after leading the man to the nest, if he does not immediately set to work to open it, the honey guide gives its special call and sets out to lead the man to another nest.

Who taught the honey guide to lead people to bees nests? Who taught it the procedure to follow? Who gave it that low, swooping flight and the white signal feathers in the tail? Who told the bird to be quiet when it comes close to the nest-so the bees will not sting it to death? Who gave the bird the ability to digest beeswax?

The honey guide also leads animals to bees nests. The ratel is a badger-sized animal that is actually an African skunk. Also called the honey badger, it has black underparts and white on top, and likes honey. The honey guide behaves in the same manner with the ratel that it does with a human. Arriving at the nest, the ratel sprays the area beneath the nest with a fluid which stupifies the bees, and then the rateI sets to work. It is both a powerful digger with strong forelegs, and narrow enough that it can squeeze into small openings. Soon it has the nest torn open, and it takes its share and leaves some for the waiting bird.

FALLING LEAVES-Why do broad-leaf trees in colder areas shed their leaves in the fall? They do it in order to survive the winter. Much of the water in the ground will, at times, become frozen, so the tree would not be able to draw it up the trunk. Since the leaves need-and lose-more water than other parts of a tree, their absence in winter allows the tree to conserve moisture. Trees covering an area of 100 square feet need more than 20 tons of water a day to thrive. The same number of non leaved trees need only a fraction of that amount.

But coniferous evergreen trees, such as the pine and fir, can survive the winter without shedding their greenery because their narrow needles are so very small and lose very little water through evaporation. Those needles often have a glassy layer that helps reduce loss through evaporation.

The broad-leaf trees shed their leaves in the fall and the leaves cover the ground, protecting it from winter's ravages. The ground does not freeze as hard beneath those leaves. The conifer sheds its needles also; but, since they rot more slowly, they also protect the ground.

FLASHING TREES OF MALAYSIA-In Malaysia and Borneo at dusk, the fireflies come out for several hours. You can journey out in the evening into the mangrove swamps, and you will see a remarkable sight. Scattered flashes begin to blink among the trees. Arcs of light appear as fireflies move across one's line of vision. Minute by minute, their numbers increase. Gradually the lights gather on the limbs and branches of a certain tree, and soon the entire tree sparkles and flickers. Then, as you watch, the confusion of flashes begins to resolve itself into a steady onoff pattern of light-as thousands of fireflies coordinate their light show and blink on and off together.

Not all the mangrove trees are used by the fireflies for this purpose. Some have tree ants which eat insects which land on them. The fireflies know to avoid such dangers, and only go to safe locations to perform their displays.

Researchers have decided that the pulse rate of flashes is so rapid that the fireflies could not possibly coordinate it visually. Instead, they must have some kind of internal metronome which beats so accurately that, once they are locked in together, they can continue on in perfect unison.

To add to the problem, their pulse rate of flashing varies slightly with the temperature (the colder the evening, the slower the rhythm), yet each firefly, in his little body computer, duplicates this factor also. By coordinating their flashing, the light from these creatures can be seen a quarter mile away.

A WORLD OF INSECTS- Biologists tell us that, without insects, we could not survive on this planet. The great majority of insects help, rather than harm, both us and our food supply. And there surely are a lot of insects out there!

An acre of average pastureland contains an estimated 360 million insects. There are about 1 million different types of insects. At least three-quarters of the known animal species in the world today are insects. There are more than a million insects for every man, woman, and child. The world's insect population weighs about 12 times as much as the total human population.

We are told that if the spiders were to disappear, the people would be gone within five years. One reason is that spiders are outstanding insect hunters.

TIMING THE FIRE-The fungus Mycaena luxcoeli, which grows on the Japanese island of Hachijo, can be seen in the dark from 50 feet away, gleaming like little lanterns.

There is a bay near Parguera, Puerto Rico called Phosphorescent Bay, which has the glow of millions of tiny marine plants called Pyrodinium. Another puzzle is this: Why do all these glowing plants-as well as the glowing insects and fish too-only glow or sparkle at night? Obviously, the glow is only useful in the dark, but how can the Pyrodinium, which is a type of plankton can be smart enough to only glow at night? (Plankton consists of the smallest plants and animals in the ocean; it is that which makes ocean water greenish.)

A Designer is doing the thinking, and the glowing plants, insects, and fish only do what they are instructed to do.

FISH: BIG AND LITTLE-The Great Designer was not limited when He planned for fish. The largest is the whale shark at more than 60 feet in length. The whale shark is a placid creature, feeding on plankton.

The smallest fish in the world is the dwarf pygmy goby, a freshwater fish found in the Philippines. It can be less than 0.3 inch long when fully grown, is about 5 billion times smaller than the whale shark. Yet it has all the vital organs that the whale shark has. (Whales are larger still, but since they are mammals, they are not classified as fish.)

PROTECTING THE NEST-The Mexican fly, Ufulodes, lays a batch of eggs in clumps on the underside of a twig, then moves farther down the twig and lays another clump. But this second batch has no eggs in it. It is a brown fluid with smaller, club-shaped kernels. This fluid neither hardens nor evaporates, but remains liquid for the three or four weeks till the eggs farther up the twig hatch. Along comes an ant, searching for food, and runs into the brown liquid. Touching it, the ant jumps back, cleans itself frantically and leaves.

The blacksmith plover lays its eggs in the hot savannahs of east Africa, where there is little vegetation to shade them. In the heat of the day, the plover does not set on the eggs, but instead stands with outstretched wings to shade them from the sun.

In Australia, a jabiru stork gathers food in the morning and late afternoon. During the hot midday hours it occupies itself flying to a pond, filling its beak with water and then spraying the water on its eggs to cool them off.

NATURE'S WATER TANK- In chapter 19, we discuss frogs which apparently have been in rocks for a very long time. Frogs can survive a long time in suspended animation, if they have water and are in a watertight place.

In central Australia, there is a little frog which lives in non-watertight locations for 5 or 6 years without water. The water-holding frog (Cyclorana platycephalus) comes out of its underground den when it rains. Immediately it eats and then drinks water. Rather quickly it absorbs a lot of water as much as 50 percent of its own weight. During this time it feeds and mates. The eggs, laid in pools, hatch quickly, and the tadpoles grow rapidly. Within a few weeks-faster than most species of frog-they too are frogs. Then all the frogs burrow into dens in the sand beneath this desert country .

No more rain will fall for years. The frogs then wait, without moving. Five or six years later the rain may return, and out they come again.

RICH NOURISHMENT-The milk given to a baby elephant seal pup is one of the richest, most nourishing milks to be found anywhere. It is 12 times as rich in fat and 4 times as rich in protein as the best Jersey cow's milk.

Why is the milk so rich? The answer is that the pup will only receive milk for three weeks. Once again, we see evidence of careful advance planning.

As soon as the pup is born, it begins guzzling milk. At birth it weighed about 40 kilos. Within a week, it puts on another 9 kilos. After 3 weeks, it has tripled or quadrupled its weight. Much of the increase in weight was added blubber. But now, suddenly its food supply is cut off.

The mother has not eaten for those three weeks, and must return to the sea for food. Unlike the whale, she is not able to nurse her baby in the ocean where her own food is to be found, and so the pup henceforth will be on its own.

After the departure of its mother, the little seal will stay on the beach for another 6-8 weeks, eating nothing, developing organs,-all the while living off the blubber made by that three-week milk supply.

If it is a male, when the little seal grows up, it will be the biggest of all seals: 14 feet long and weighing 2.5 tons!

LOOKING YOUNG- The axolotl salamander of Mexico can for years look like an adolescent; that is, if it stays in water. It keeps its feathery external gills and a larval, tadpole-like shape. But it can also breed, as though it were an adult.

But if the year comes that the water in the pond dries out, then the axolotl will very quickly grow up. It will change into a salamander and its gills will disappear. In their place it will have lungs.

OUTWITTING THE MILKWEED-Most everyone leaves the milkweed alone. This is because, when damaged, it immediately exudes a milky sap which has a bitter taste and clogs the stomach. Even cows, deer, and horses avoid it. But certain creatures, which could not possibly figure out such devices by themselves, know how to outwit the milkweed.

Certain beetles, landing on a leaf, immediately bite through the midrib. The latex, flowing from the wound, drips to the ground. Beyond it, the beetle eats the tender leaf.

Some caterpillar species not only sever the midrib veins, but also gouge out a circular trench on the underside of the leaf, with only a few bridges holding it together. Then they feed inside this area.

The caterpillars of the monarch butterfly feed on the milkweed without taking any of these precautions. They have a genetic immunity to the poison of the milkweed. More than this, as they eat it, some of the poison is stored in their tissues. This poison remains, even after they change into butterflies. If a bird tries to eat them, the taste is so bad that it never again bothers a monarch.

BIG-MOUTHED PIGEON-The green imperial pigeon can unhitch its lower beak and expand its mouth not only vertically but horizontally. Having done this, it can then swallow a nutmeg that is slightly larger than its own head! The seeds remain in its gizzard for a long time while the rind is dissolved off and the insides digested.

RUNNY-NOSED BIRDS- That is what seabirds are always like: runny-nosed. This is because they have special salt-processing glands in their heads. The glands discharge a highly concentrated salt solution into the nostrils, from where it drips back into the sea. With such a built-in desalination plant, seabirds never need to drink fresh water. They extract all they need from seawater.

Without such a system, no bird could live in the oceans and seas. Large doses of salt are poisonous, leading to dehydration, overloaded kidneys, and a painful death.

But wait! If birds have such a simple, highly successful system for eliminating salt from drinking water,-why do we not copy it? The problem of extracting salt from seawater is one of the leading challenges of mankind. Fresh water is urgently needed all over the world. Transporting it is less of a problem than extracting the sea salts from it. The problem is the high cost of the desalination plant. Yet, not only is the system used by birds a proven success, but it is also extremely miniaturized, and costs the bird nothing. It requires no fuel oil, high-voltage electricity, coal, or propane.

If a bird can do it, surely we can make equipment that do it also. Any competent evolutionist will tell you that the bird did it totally by accident. Then, by careful thought, we ought to be able to do it just as efficiently and inexpensively.

CHOPSTICK FINGERS-The aye-aye is a rare lemur that lives on the island of Madagascar. The middle fingers on its front paws are so thin and elongated that they resemble chopsticks. The aye-aye uses them to eat with-by dipping them one at a time into the pulp of fruit, and then lifting the finger to its mouth and sucking off the juice. It drinks water the same way. Its other food is wood-boring insects. The aye-aye chews through the wood till it reaches the insect, which it then pulls out with one of those long fingers.

RADAR JAMMING AND STEALTH PLANES As the little bat flies through the darkness, its sonar squeaks giving its brain a picture of what is ahead as it searches for flying insects.

But the moth (apparently, all moths) can hear its high-pitched squeak from 100 feet away. This is an advantage, since the bat can only receive echoes from 20 feet. Intercepting the bat signals, which tell it that the bat is drawing near, the moth knows that it must suddenly go into a free fall. Why does it know that a bat squeak means imminent death? Once a moth is swallowed by a bat, it cannot warn its offspring. Until it is swallowed, it cannot know the danger is there.

But now the little moth is falling for its life, and its only hope of safety is to suddenly drop to the ground. But the bat may catch the falling moth in its sonar. Going after the moth, the bat comes closer. But the moth resorts to aerobatics, and flits this way and that. It only has a few feet to go before reaching the protective ground.

Some tiger moth species have a sonar jamming device. This is an ultrasonic sound that throws the bats off course. Using some of the techniques employed by the millions-of-dollars stealth plane, the tiger moth makes it to safety—as the bat heads off toward where he thought the return echo was coming from.

Can the U.S. military use a cheaper stealth bomber? (It is presently the most expensive plane in the world!) Go to the tiger moth and ask him . how he does it. He never paid a dollar for his equipment. He didn't think it up either; it was given to him.

IMPRINTING-Imprinting was first named and described by the Austrian naturalist, Konrad Lorenz. Certain animals will go to the first fair-sized, moving creature they see after being born. It is usually their mother, but it could be another animal or even a human being.

Because of this trait, ducklings automatically follow their mother to the pond and swim after her. They followed the first large moving thing they saw after being hatched. Among mallard young, imprinting occurs precisely between 13 and 16 hours after coming out of their shells. People who have raised waterfowl have discovered that, if the ducklings first see their green rubber boots, they will thereafter follow those boots until they grow into adult ducks.

The imprinting cue can be a sound instead of a sight. In chapter 28, we mention the fact that the mother wood duck speaks to her young while they are still in their shells. Then when they hatch, she jumps out of the hollow tree, high above the ground, where the nest is located-and calls to them from the ground. In response, the tiny things jump out of the hole, fall to the ground and follow her into the pond. This is also the result of imprinting. Earlier, back in the hole, it was too dark for them to know what she looked like, but they knew her voice.

Greylag geese, rails, coots, and domestic chickens respond with visual imprinting cues.

In Africa, the female ostrich lays the eggs and the male sets on them. When they hatch, the young imprint to the father. As he travels across the fields, they all follow him. When other orphaned young see him, they hurry over and follow him also. Observers have seen male ostriches with as many as 60 young; by their age differences, they show that they are from at least 3 or 4 different broods.

Then there are baby shrews. They are born in litters of 6 or so. After imprinting to their mother, they remain

close by her side. When danger threatens, she sounds an alarm and begins running. Instantly, one seizes the fur at the base of its mother's tail, gripping it firmly in its jaws. Just as quickly, another baby does the same, and within a few seconds, the wild train of shrews is running away at full speed-all connected. It looks like a furry snake gliding fast through the grass and brush. As they go, they keep in perfect step. Even if you were to pick up the mother (which you will be wise not to do without very thick gloves), the babies would continue to hang on. Arriving at a place of safety, the mother signals again and the train uncouples and they return to foraging for food.

In South Africa's giant Kruger National Park, there is an elephant that thinks it is a buffalo. In the early 1970s five baby elephants, raised by a veterinarian, were released in the park close to a herd of buffalo.,

Game rangers later reported that one of those young elephants had imprinted upon the buffalo.

It had Joined the herd and was adopting buffalo habits. Traveling in a herd of 20 buffalo, the elephant has been seen drinking with them at a waterhole. A herd of elephants draws near and the elephant runs off with the buffalo. It has also been seen trumpeting and bellowing in an effort to drive lions away from a waterhole where its family of buffalo are watering.

MORE ON THE HUMMER-Elsewhere we have a lengthy section on the marvels of the hummingbird. In it, we tell about the twice-a-year migration of the ruby-throated hummingbird, each of which is a nonstop 500-mile flight between North America across the Gulf of Mexico to South America.

But it has recently been discovered that the ruby-throated hummingbird is not able to make that trip. It is just not possible, scientists have concluded. We know they must be right, for they used the latest equipment, metabolic studies, and computer analysis. The ruby-throated hummingbird is only 0.1 ounce in weight, and the conclusion of the experts is that it cannot possibly store the amount of nourishment required for the trip. Metabolic tests reveal the bird is simply too small to carry enough fuel.

Of course, the little bird does not concern itself with the announcement that the scientific world has declared it cannot cross the Gulf of Mexico. It just keeps doing it anyway-twice each year. Fortunately, the scientists have not yet applied their metabolic tests to migrating butterflies. It is probably best that they not do it. The news might frighten the poor creatures into no longer migrating. Using their own wing power, many species of butterflies can travel up to 600 miles without a refueling stop. Some have even been known to fly 'right across the Atlantic Ocean from North America to Europe, backed by the driving force of prevailing westerly winds.

THE NOSE HAS IT -The dog has an amazing sense of smell. This makes up for their poor eyesight. A dachshund, for example, has about 125 million smell-detecting cells in its nose. A human being has only 5 million. A German shepherd dog has 230 million, making its sense of smell more than a million times more sensitive than a human's. A bloodhound has a sense of smell which is equal to that of the German shepherd. There must be genetic factors in the odors we produce. George Romanes, in 1885, showed that skilled tracker dogs could differentiate between anything, except identical twins. To the dog, the twins smelled exactly the same.

By the way, dogs also have good hearing. They can hear high-pitched sound frequencies of up to 40,000 vibrations a second. A human being can not go beyond 20,000 vibrations per second.

EARS ON ITS FEET -In chapter 16, we discuss the amazing ichneumon fly, which walks on the bark of trees-and somehow knows just where to

begin drilling for wood wasp larvae inside the tree. We noted with amazement the mystery of how this tiny creature is able to know where to begin drilling, and then is able to actually do it-using what appears to be a delicate, long antennae to do it. But now we know how it locates the larvae; the ichneumon can hear and smell through its feet. Yet that solution only leaves us with more mysteries. How can this creature hear or smell a creature so far below it in solid wood? For you to do it would be equivalent to walking on the ground and hearing/smelling a gopher digging nine feet below you!

MELON OF THE PORPOISE-The porpoise also has a sonar system. He is discussed in chapter 32. Here is more information on that system:

A porpoise needs to be able to make special sounds, but how can he make them underwater? We cannot talk underwater, so how could a porpoise do it? He doesn't; instead, he produces soar clicks by forcing air through special passages and sinuses in his head. These are focused into a beam of sound which flows out in front of him. The oval, fat-packed organ-called the melon-which forms a bulge on his forehead, does the focusing. Without the carefully-shaped melon, the porpoise could not use sonar.

As many as 700 clicks a second are made by the melon, which is a sound lens producing a sonic "searchlight," with which the porpoise scans the oncoming water path. Using these sounds, the porpoise is able to tell the distance to an object, its shape, texture, and movement. Scientists have found that a porpoise can tell the difference between a tin can full of water and one that is empty, and also between rock in the distance and flesh.

CIRCULAR FLIGHT OF THE PUFFIN-They may fly in circles, but they are not confused. Puffins spend most of their time fishing in the open seas of the north Atlantic, but each spring they nest. Within a space of two or three days, a million and a half puffins arrive at the island of St. Kilda in the Scottish Hebrides. No one can explain

how these little birds-vast numbers of them scattered all over the ocean-know to arrive together at the same time to this small island. How can the bird even find its way across trackless oceans to this one tiny spot in the seas?

But, at the same time, the greater black-backed gulls arrive also. They also come to nest, and eat puffins.

The little puffin-which is a very colorful bird nests in holes on the steep grassy cliffs of the island. They are safe until they flyaway from the entrances to their holes.

But they must fly in order to feed while setting, and later when the chicks hatch. At this time of year, there is an abundance of fish in the ocean about them, but getting safely to it and back is the problem. Once they arrive out in the open sea, they not easy to catch, for they are swift in the air, turn quickly, and have strong wings. Even if a gull outmaneuvers them, they can escape by diving below the surface of the water where the gulls cannot follow.

But during the trip to the ocean they are vulnerable, and on the way back, laden with fish for their young, they are also easier to catch. So the black-backed gulls wait for them in the air above the cliffs. Their goal is to catch a solitary puffin. If you were a small-brained puffin, how would you solve the problem? Frankly, you are a very intelligent human being-and you probably have no answer either.

Could some highly-trained design engineers come up with a plan as good as this one:

Scientists have discovered that, when animals are in herds and fish in schools, it is difficult for predators to catch them. The large numbers of moving objects tend to confuse the eye, and render it difficult to focus on one and catch it. The puffins apply this principle in a mind-boggling solution which no puffin-alone or in committee with others-would ever be able to devise.

It is time for the little puffin to leave its nest, fly into the air and go out to sea to catch fish. Up into the air it goes-and overhead quickly flies into a gigantic living wheel!

Above this immense cliff, where all the puffins in the Atlantic breed each spring, is a huge aerial ring, half a mile across, filled with tens of thousands of puffins. All day long they fly in this circle above the cliff. Upon departing from its hole, a puffin immediately flies up into this circle and begins flying the giant wheel. At a random point out over the ocean, with a quick sideways dive, it leaves the wheel and quickly drops to the ocean's surface. Now it begins feeding, and here it is safe from the gulls. For its return flight, it cruises along the ocean's surface until it nears the cliff, then quickly flies up again into the wheel, and flies the great circle route back to a point above its nest, and then rapidly drops to the entrance hole of its nest.

What astounding planning! Scientists have observed that gulls rarely catch puffins circling in the wheel, and mainly catch those who are too slow in getting into it. The number and density of those flying in the wheel make it too difficult to catch one. Of course, the whole arrangement requires that the puffins all arrive and leave that island at about the same time. The entire pattern all works together, and took careful advance planning. That planning was done before gulls started catching puffins, otherwise there would be no puffins today. If this sounds like a farfetched story, go to the St. Kilda Island and watch the puffins flying in the wheel-and see for yourself how well this remarkable arrangement works.

SOMETHING TO THINK ABOUT

Within these three volumes, we have provided you with thousands of details pointing to the existence and workmanship of the Creator. Evolutionary theory falls dead before such a wealth of information. But there are also facts about the living of our lives which also point to the existence of God, His guidance, and intervention in the affairs of men.

Scientists tell us they cannot measure data indicating relationships with the Creator. Yet there is a lot of it available, and it clearly points in one direction. For example, which group of people are the most interested in preserving the life of the unborn? It is the Christians. Other groups, in general, are far less concerned about whether abortions are carried out. Which group generally has happier lives? It is the Christians, and it matters not whether theirs is a life of poverty or wealth. Which group has the greatest peace of heart? It is the Christians. Which group commits the fewest felonies and major crimes? It is the Christians.

Everyone knows that adultery, crime, or murder by a Christian pastor is far more likely to be given space in the media than if committed by an atheist. Why? It is the rarity of the event which makes it so newsworthy. As usual, it is not the dog biting the man which is published, but the man biting the dog. A genuine Christian does not do improper acts as often as the average person.

So the facts can, indeed, be quantified. They are there. It is the believers in and worshipers of the Creator God which consistently have contented, happier, more caring lives. Problems enter the lives of all, but it is the Creationists who are the most peaceful, the most obedient to right principles, and the most stalwart in their defense.

For a few minutes, let us gather together some data on how men face oncoming death. With an open mind, consider the facts for yourself. Except for unusual divine intervention, we will all die. That includes you; within a few

years you will be dead. The way a man faces death is but a reflection of his entire way of life and all his past experiences. A man living for himself is terrorized by the approach of death, but a man who has personally experienced the presence of God realizes that death is not an enemy to be feared.

We are not here discussing something imaginary. The facts consistently bear out the fact that it is the leading atheists, the most blatant haters of God-who are the most terrorized as death approaches. In contrast, as we will see below, those who have loved and served the God of heaven have an amazingly peaceful certainty that the future will be far better than their present life.

Experience after experience can be collected and quantified. The results of such research, revealed throughout these three books, indeed confirm these facts of nature that we have found: There is a God; He created the earth, sea, and sky. He also made us. We can only be happy as we love Him and obey His laws. In doing so, we become ennobled with better principles, live far happier lives, and are ready when death nears.

Yet, although we rarely mention it to others, this is exactly what we want to know: how to face *death.*

A group of American soldiers were gathered for the last time for entertainment in England. The next morning they were to ship out. One man stood to thank their British hosts, and then, as an afterthought, said to them: "Tomorrow morning we will cross the channel to France. There we will go to the trenches, and very possibly, of course, to death. - Can any of our friends here tell us how to die?" There was silence in the room.

When it comes, death frequently comes suddenly and unexpectedly. It is today that we must prepare for what will come as a certainty for tomorrow. The preparation can indeed be made.

The following pages may be among the most important you will ever read.

On a dark afternoon in September 1583, in a stormy sea near the Azores, the *Golden Hind,* commanded by Sir Walter Raleigh, sailed close to the *Squirrel,* a smaller vessel commanded by Sir Humphrey Gilbert. The captain of the *Golden Hind* cried out to Gilbert, who was sitting in the stern of his vessel with a book open in his hand, and urged him, for his safety; to come aboard the larger vessel. This Gilbert refused to do, saying he would not leave his companions in the *Squirrel.* Then Raleigh heard him call out over the waves, "Heaven is as near by sea as by land."

Conditions rapidly worsened; and, at midnight that night, those on the *Golden Hind* saw the lights on the smaller vessel suddenly go out. And, in that moment, Gilbert and his ship were swallowed up by the dark, raging sea.

Death can come suddenly for every one of us. But how many are ready when death draws near?

On her deathbed, *Queen Victoria* told those around her that she loved God and was His little child, so she was ready to die. Then she called for the hymn to be sung:

"Rock of Ages, cleft for me. "Let me hide myself in Thee."

For decades she had ruled the British Empire, but when death approached, all she had was God.

And that is the consistent pattern with those who have made peace with their Creator and love and serve Him. Here is how Christians die, as revealed in their dying words:

***Brownlow North* (1875),** a profligate nobleman who became a preacher: " 'The blood of Jesus Christ His Son cleanseth us from all sin.' That is the verse on which I am now dying. One wants no more."

***John Nelson Darby* (1882):** "Beyond the grave comes heaven. Well, it will be strange to find myself in Heaven, but it won't be a strange Christ--One I've known these many years. I am glad He knows me. I have a deep peace, which you know."

Charles Wesley, author of over 4,000 published hymns: "I shall be satisfied with Thy likeness. Satisfied!"

***Charles Dickens* (1870)**, the famous author: "I commit my soul to the mercy of God, through our Lord and Saviour Jesus Christ."

John Quincy Adams: "This is the last of earth. I am content!"

Benjamin Parsons: "My head is resting very sweetly on three pillows: infinite power, infinite wisdom, and infinite love."

***Henry Moorhouse* (1880)**: "If it were God's will to raise me up [from this sickbed], I should like to preach from the text, John 3:16. Praise be to the Lord."

***Earl Cairns* (1885),** lord high chancellor of England: "God loves me and cares for me. He has pardoned all my sins for Christ's sake, and I look forward to the future with no dread."

Bishop Joseph Lightfoot, after having several Scriptures read to him, he was asked what he had in mind. In utter calmness of spirit, he replied: "I am feeding on a few great thoughts."

***Sidney Cooper* (1902),** member of the Royal Academy of Science in London: "I have full faith in Thy atonement, and I am confident of Thy help. Thy precious blood 1 fully rely on. Thou art the source of my comfort. I have no other. I want no other."

***Lord V.C. Roberts* (1914)**, who died in France while telling those gathered by him of the importance of their studying the Bible: "I ask you to put your trust in God. You will find in this Book guidance when you are in health, comfort when you are in sickness, and strength when you are in adversity."

***Catherine Booth,* wife of the founder of the Salvation Army: "**The waters are rising, but so am I. I am not going under, but over. Do not be concerned about dying; go on living well, the dying will be right."

***William Pitt* (1778),** Earl of Chatham, statesmen, orator, and prime minister: "I throw myself on the mercy of God through the merits of Christ."

Edward Perronet, pastor and author: "Glory to God in the heights of His divinity! Glory to God in the depths of His humanity! Glory to God in His all-sufficiency! Into His hands I commend my spirit."

***Augustus Toplady* (1778),** preacher and author of the hymn, *"Rock of* Ages": "The consolations of God to such an unworthy wretch are so abundant that He leaves me nothing to pray for but a continuance of them. I enjoy heaven already in my soul."

Sir Walter Raleigh, English admiral, before his beheading: "It matters little how the head lies if the heart be right. Why doest thou not strike?"

***Countess of Huntingdon* (1791):** "I have the hope which inspired the dying malefactor. And now my work is done; I have nothing to do but go to the grave and thence to my Father."

***Robert Burns,* the Scottish poet:** "I have but a moment to speak to you, my dear. Be a good man; be virtuous; be religious. Nothing else will give you any comfort when you come to be here."

***John Wesley* (1791):** "The best of all: God is with us!"

Lady Glenorchy: "If this is dying, it is the pleasantest thing imaginable."

***John Bacon* (1799),** eminent English sculptor, whose monument of Lord Chatham stands in Westminster Abbey: "What I was as an artist seemed to be of some importance while I lived; but what I really was as a believer in the Lord Jesus Christ is the only thing of importance to me now."

Francis Ridley Havergal, songwriter. After requesting a friend to read to her Isaiah 42, she uttered these nine words after verse 6-and died: ("I the Lord have called thee in righteousness, and will hold thine hand, and will keep thee."): called-held-kept! I can go home on that!"

***George Washington (1799*)**, an earnest Christian and the first president of the United States: "Doctor, I am dying, but I am not afraid to die."

John Huss, Bohemian reformer and martyr, asked at the last moment by the Duke of Bavaria to recant: "What I taught with my lips, I seal with my blood."

***Lady Powerscourt* (1800):** "One needs a great many Scriptures to live by, but the only Scripture that a person needs to die by is 1 John 1:7, and that verse never was sweeter to me than at this moment." ("But if we walk in the light, as He is in the light we have fellowship with one another, and the blood of Jesus Christ His Son cleanseth us from all sin.")

***Sir Walter Scott* (1832)**, the famous author was talking with his son-in-law: "What shall I read?" said Lockhart. "Can you ask?" The dying man replied, "there is only one Book."

John Pawson, minister: "I know I am dying, but my deathbed is a bed of roses. I have no thorns planted upon my dying pillow. In Christ, heaven is already begun!"

***William Wilberforce* (1833)**, member of Parliament who helped eliminate slavery in England: "My affections are so much in heaven that I can leave you all without a regret; yet I do not love you less, but God more."

Adoniram Judson: American missionary to Burma: "I go with the gladness of a boy bounding away from school. I feel so strong in Christ."

***Captain Hedley Vicars* (1855):** "The Lord has kept me in perfect peace and made me glad with the light of His countenance. In the Lord Jesus I find all I want of happiness and enjoyment."

***Sir Henry Havelock* (1857),** when felled by an attack of malignant cholera and told that he could not survive, calmly replied: "I have prepared for this for forty years," and then he added to those around him: "Prepare to meet thy God!"

***The Apostle Paul* (A.D. 66):** "I have fought a good fight, I have finished my course, I have kept the faith; henceforth there is laid up for me a crown of righteousness." (2 Timothy 4:7-8).

Longfellow., "For the Christian, the grave itself is but a covered bridge leading from light to light, through a brief darkness."

***Polycarp* (A.D. 155),** disciple of the Apostle John, at his own martyrdom: "Eighty and six years have I served Him, and He has done me nothing but good. How could I curse Him, My Lord and Saviour?"

David Brainard, pioneer missionary to the American Indians: "I do not go to heaven to be advanced, but to give honour to God. It is no matter where I shall be stationed in heaven, whether I have a high or low seat there, but to live and please and glorify God . . My heaven is to please God and glorify Him, and give all to Him and to be wholly devoted to His glory."

Susanna Wesley, mother of John and Charles Wesley: "Children, when I am gone, sing a song of praise to God."

George Whitefield, English evangelist: "Lord Jesus, I am weary in Thy work, but not of Thy work. If I have not yet finished my course, let me go and speak for Thee once more in the fields, seal the truth, and come home to die."

***Philip Melanchthon* (1560),** after several passages of Scripture were read to him by his son-in-law, he was asked if he would have anything else: "Nothing else but heaven!"

***Preston*:** "Blessed by God! Though I change my place, I shall not change my company."

***Samuel Rutherford* (1615)**: "Mine eyes shall see my Redeemer. He has pardoned, loved, and washed me, and given me joy unspeakable and full of glory. I feed on manna. Glory, glory, glory to my Creator and Redeemer forever!"

***Francis Bacon,* lord chancellor of England:** "The sweetest life in this world is piety, virtue, and honesty."

***John Bunyan* (1688),** author of Pilgrim's Progress: "Weep not for me, but for yourselves. The Father of our Lord Jesus Christ, who, through the mediation of His blessed Son, receives me, though a sinner. We shall meet to sing the new song, and remain everlastingly happy."

***Baxter,* the English martyr:** "I have pain; but I have peace, I have peace!"

***David Brainard* (1747)**, well-known missionary in the American Colonies: "I am going into eternity; and it is sweet to me to think of eternity; the endlessness of it makes it sweet. But oh! What shall I say of the future of the wicked! The thought is too dreadful!"

Ann Hasseltine Judson, missionary to Burma and wife of Adoniram Judson: "Oh, the happy day will soon come when we shall meet all our friends who are now scattered--meet to part no more in our heavenly Father's house."

Abbott: "Glory to God! After the grave heaven will open before me!"

John Knox. "Live in Christ, and the flesh need not fear death."

Everett. "Glory, glory, glory!" (This expression was repeated for 25 minutes and only ceased with life itself.)

John A. Lyth: "Can this be death? Why, it is better than living! Tell them I die happy in Jesus!"

Martin Luther: "Our God is the God from whom cometh salvation. God is the Lord by whom we escape death! Into Thy hands I commit my spirit; God of truth, Thou hast redeemed me!"

Margaret Prior: "Eternity rolls before me like a sea of glory!"

Goodwin: "Ah! is this dying? How have I dreaded as an enemy this smiling friend!"

***Martha McCrackin**:* "How bright the room! How full of angels!"

Mary Frances: "Oh, that I could tell you what joy I possess! The Lord doth shine with such power upon my soul!"

Sir David Brewster, scientist and inventor of the kaleidoscope: "I will see Jesus; I shall see Him as He is! I have had the light for many years. Oh how bright it is! I feel so safe and satisfied!"

***Michael Faraday* (1867)**, chemist, electrical engineer, and leading British scientist, as he neared death, replied to a scientist who asked him what he would do in heaven: " 'Eye hath not seen, nor ear heard, neither have entered into the heart of man, the things that God hath prepared for them that love Him.' I shall be with Christ, and that is enough." When a journalist interjected and questioned him as to his speculations about a life after death, he said, "Speculations! I know nothing about speculations. I'm resting on certainties. **`I know that my Redeemer liveth,' and because He lives, I shall live also."**

Daniel Webster (1852), the well-known orator and legislator, had William Cowper's hymn read to him:

> ***"There is a fountain filled with blood,***
>
> ***"Drawn from Immanuel's veins."***

Then he read the last stanza:

"Then in a nobler, sweeter song,

"I'll sing Thy power to save.

"When this poor lisping, stammering tongue

"Lies silent in the grave."

At this, Webster, one of the most powerful speakers in American history, replied, "Amen! Amen! Amen!"

Owen, the Puritan, lay on his deathbed, and his secretary was writing a letter, in his name, to a friend: "I am still in the land of the living," he wrote and read what he had written to Owen.

"No, please do not write that," Owen said. "I am yet in the land of the dying, but later I will be in the land of the living!"

On November 20, 1847, in Nice, France, ***Henry Frances Lyte,*** a retired pastor of the Church of England died. He had spent his life working in the slums of London helping people. After his death, his family found a paper he had written during those last days. It is now a hymn sung around the world:

"Abide with me: fast falls the eventide.

"The darkness deepens; Lord, with me abide!

"When other helpers fail, and comforts flee,

"Help of the helpless, 0 abide with me."

The epitaph on the grave in Canterbury, England, of Henry Alford, the hymn writer is this: *"The inn of a pilgrim journeying to Jerusalem."*

A 22-year-old Dutch patriot wrote the following letter to his parents before he was executed by a Nazi firing squad for the crime of trying to escape with his three companions to England:

"In a little while at five o'clock it is going to happen, and that is not so terrible . . On the contrary, it is beautiful to be in God's strength. God has told us that He will not forsake us if only we pray to Him for support. I feel so strongly my nearness to God, I am fully prepared to die . . I have confessed all my sins to Him and have become very quiet. Therefore do not mourn but trust in God and pray for strength . . Give me a firm handshake. God's will be done.. we are courageous. Be the same. They can only take our bodies. Our souls are in God's hands . . May God bless you all. Have no hate. I die without hatred. God rules everything."

Pilgrim's Progress is generally considered one of the greatest books every written by a follower of Christ. In it, the two pilgrims, Christian and Hopeful, finally received their summons and came down to the river. But, when they saw how deep, wide, swift, and dark were its waters, they were stunned.

Then they were told, "You must go through, or you cannot come at the gate." Then they asked if the waters were all of a depth, and the answer was given: "You shall find it deeper or shallower as you believe in the King of the place."

Then they went into the water, and Christian began to sink, and said: "I sink in deep waters; the billows go over my head; all His waves go over me."

But Hopeful answered, "Be of good cheer, my brother: I feel the bottom, and it is good."

And with that Christian broke out with a loud voice, "Oh, I see him again; and he tells me, "When thou passest through the waters, I will be with thee; and through the rivers, they shall not overflow thee."

Then they both took courage, and the enemy was after that as still as a stone until they were gone over.

They had passed through the grave to the glorious resurrection day beyond.

Little Kenneth was very sick. He felt that he was not going to get well. Turning toward his mother, who sat by his bedside, he asked, "Mother, what is it like to die?"

Mother was filled with grief, and she knew not how to answer him. She replied, "Kenneth, I must go to the kitchen. I'll be right back." Hurrying there, she prayed, "Lord, show me how to answer Kenneth's question." Immediately, she knew how to express it.

Returning to Kenneth, Mother said, "Kenneth, you know how you have often played hard and gotten very tired in the evening? Then you have come into my room and climbed upon my bed and gone to sleep. Later your father carried you in his arms and put you in your own bed. In the morning you have awakened and found yourself in your own room, without knowing how you got there."

Kenneth said, "Yes, Mother, I know that."

"Well, Kenneth," Mother continued, "death is something like that for God's children. Jesus spoke of death as sleep. God's children go to sleep with they die. Later, at the resurrection, they will arise and be with Christ forever. Heaven is a wonderful place, Kenneth!"

Then the boy smiled and said, "Mother, I won't be afraid to die now. I'll just go to sleep and, later, wake up and be with Jesus forever. I know God will take care of me."

Henry Van Dyke wrote this very accurate statement: "Remember that what you possess in this world will be found at the day of your death and belong to someone else; what you are will be yours forever."

All that you own will someday be given to another, but your character--what you are--will determine your future destiny.

[And I, who am proofing this book to put on the website, wish to add my testimony. I sat by my father as he lay dying in the hospital. I repeated to him the Shepherd's psalm, especially the part about walking through the valley of the shadow of death, and fearing no evil. His face was shining with hope and joy. Again and again he said, "Praise the Lord! Praise the Lord!" I cannot weep for him. I can only pray that I will be ready to join him some day.]

But now the entire picture changes. We leave the deathbeds of the Christians and visit the deathbeds of the atheists.

We have observed how men and women who have given themselves to God--who earnestly love and obey Him--have died. They confidently declared at the portals of death, "Yea, though I walk through the valley of the shadow of death, I will fear no evil: for Thou art with me." (Psalm 23:4).

The Apostle Paul said, "To die is gain" (Philippians 1:21), and "O death, where is thy sting?" (1 Corinthians 15:55). But to so many others death is a fearsome, dreadful thing.

***Aristotle* wrote:** "Death is a dreadful thing, for it is the end!"

John Donne, the English author, wrote: "Death is a bloody conflict and no victory at last; a tempestuous sea, and no harbor at last; a slippery height and no footing; a desperate fall and no bottom!"

Rousseau cried, "No man dares to face death without fear."

The infidel, ***Robert Ingersoll,*** when standing at the grave of his brother, said, "Life is a narrow vale between the cold and barren peaks of two eternities. We strive in vain to look beyond the height. We cry aloud, and the only answer is the echo of our wailing cry. From the voiceless lips of the unreplying dead there comes no word."

After the death of Alexander the Great one of his generals, ***Ptolemy Philadelphus,*** inherited Egypt and lived a selfish life amid wealth and luxury. As he grew old, he was haunted by the fear of death, and even sought in the lore of Egyptian priests the secret of eternal life. One day, seeing a beggar lying content in the sun, Ptolemy said, "Alas, that I was not born one of these!"

We shall discover that the last words of the atheists are far different than those who love and honor their Creator. For example, when ***Phineas T. Barnum,*** the famous circus showman of yesteryear, died in his 82nd year, his last words were a question about the big show's gate receipts at their latest Madison Square Garden performance. Then he was gone!

But, for most atheists, their concerns are far more dramatic. Here are the dying words of atheists:

Voltaire, the most influential atheist of Europe in his day, cried out with his dying breath: "I am abandoned by God and man; I shall go to hell! I will give you half of what I am worth, if you will give me six months life."

Honore Mirabeau, a leading political organizer of the French Revolution: "My sufferings are intolerable: I have in me a hundred years of life, but not a moment's courage. Give me more laudanum, that I may not think of eternity! O Christ, O Jesus Christ!"

Mazarin, French cardinal and advisor to kings: "O my poor soul! what will become of thee? Wither wilt thou go?"

Severus, Roman emperor who caused the death of thousands of Christians: "I have been everything; and everything is nothing!"

Thomas Hobbes, the political philosopher and sceptic who corrupted some of England's great men: "If I had the whole world, I would give anything to live one day. I shall be glad to find a hole to creep out of the world at. I am about to take a fearful leap in the dark!"

***Caesar Borgia*:** "I have provided, in the course of my life, for everything except death; and now, alas! I am to die, although entirely unprepared!"

Sir Thomas Scott, chancellor of England: "Until this moment, I thought there was neither God nor hell; now I know and feel that there are both, and I am doomed to perdition by the just judgment of the Almighty!"

Edward Gibbon, author of "Decline and Fall of the Roman Empire": "All is dark and doubtful!"

Sir Francis Newport, the head of an English infidel club to those gathered around his deathbed: "You need not tell me there is no God for I know there is one, and that I am in His presence! You need not tell me there is no hell. I feel myself already slipping. Wretches, cease your idle talk about there being hope for me! I know I am lost forever! Oh, that fire! Oh, the insufferable pangs of hell!"

M.F. Rich: "Terrible horrors hang over my soul! I have given my immortality for gold; and its weight sinks me into a hopeless, helpless Hell!"

Thomas Paine, the leading atheistic writer in American colonies: "I would give worlds if I had them, that *The Age of Reason* had never been published. O Lord, help me! Christ, help me! . . No, don't leave; stay with me! Send even a child to stay with me; for I am on the edge of Hell here alone. If ever the Devil had an agent, I have been that one."

Napoleon Bonaparte, the French emperor who brought death to millions to satisfy his selfish plans: "I die before my time, and my body will be given back to the earth. Such is the fate of him who has been called the great Napoleon. What an abyss between my deep misery and the eternal kingdom of Christ!"

Aldamont, the infidel: "My principles have poisoned my friend; my extravagance has beggared my boy; my unkindness has murdered my wife. And is there another hell yet ahead?"

John Wilkes Booth, who assassinated Abraham Lincoln: "Useless! Useless! The terrors before me!"

Thomas Carlyle**:** "I am as good as without hope; a sad old man gazing into the final chasm."

David Strauss, leading representative of German rationalism, after spending a lifetime erasing belief in God from the minds of others: "My philosophy leaves me utterly forlorn! I feel like one caught in the merciless jaws of an automatic machine, not knowing at what time one of its great hammers may crush me!"

Tallyrand was one of the most cunning French political leaders of the Napoleonic era. On a paper found at his death were these words: "Behold eighty-three passed away! What cares! What agitation! What anxieties! What ill-will! What sad complications! And all without other results except great fatigue of mind and body, a profound sentiment of discouragement with regard to the future, and disgust with regard to the past!"

Some 15 years before his death, ***Mohandas K. Gandhi*** wrote: "I must tell you in all humility that Hinduism, as I know it, entirely satisfies my soul, fills my whole being, and I find a solace in the Bhagavad and Upanishads."

Just before his death, Gandhi wrote: "My days are numbered. I am not likely to live very long-perhaps a year or a little more. For the first time in fifty years I find myself in the slough of despond. All about me is darkness; I am praying for light."

"What did you do to our daughter?" asked a Moslem woman, whose child had died at 16 years of age. "We did nothing," answered the missionary. "Oh, yes, you did," persisted the mother. "She died smiling. Our people do not die like that." The girl had found Christ and believed on Him a few months before. Fear of death had gone. Hope and joy had taken its place.

In a *Newsweek* interview with **Svetlana Stalin, the daughter of Josef Stalin,** she told of her father's death: "My father died a difficult and terrible death . . God grants an easy death only to the just. . At what seemed the very last moment he suddenly opened his eyes and cast a glance over everyone in the room. It was a terrible glance, insane or perhaps angry. . His left hand was raised, as though he were pointing to something above and bringing down a curse on us all. The gesture was full of menace. . The next moment he was dead."

Charles IX was the French king who, urged on by his mother, gave the order for the massacre of the Huguenots, in which 15,000 souls were slaughtered in Paris alone and 100,000 in other sections of France, for no other reason than that they loved Christ. The guilty king suffered miserably for years after that event. He finally died, bathed in blood bursting from his veins. To his physicians he said in his last hours:

"Asleep or awake, I see the mangled forms of the Huguenots passing before me. They drop with blood. They point at their open wounds. Oh! that I had spared at least the little infants at the breast! What blood! I know not where I am. How will all this end? What shall I do? I am lost forever! I know it. Oh, I have done wrong."

William E. Henley, an atheist, wrote a famous poem, the last two lines of which have often been quoted:

"Out of the night that covers me,

"Black as the pit from pole to pole,

"I thank whatever gods may be.

"Beyond this place of wrath and tears

"Looms but the horror of the shade;

"And yet the menace of the years

"Finds, and shall find, me unafraid.

"It matters not how strait the gate,

"How charged with punishment the scroll,

"I am the master of my fate;

"I am the captain of my soul."

Men who have been bold in their defiance of God have lauded Henley's poem, but most of them were not aware that **William Henley later committed suicide.**

Few men in Europe have tried to eradicate the Bible and the knowledge of God from the minds of the people as did the French infidel, Voltaire. **The Christian physician who attended Voltaire during his last illness later wrote about the experience:**

> "When I compare the death of a righteous man, which is like the close of a beautiful day, with that of Voltaire, I see the difference between bright, serene weather and a black thunderstorm. It was my lot that this man should die under my hands. Often did I tell him the truth. 'Yes, my friend,' he would often say to me, 'you are the only one who has given me good advice. Had I but followed it, I should not be in the horrible condition in which I now am. I have swallowed nothing but smoke. I have intoxicated myself with the incense that turned my head. You can do nothing for me. Send me an insane doctor! Have compassion on me-! am mad!'
>
> "I cannot think of it without shuddering. As soon as he saw that all the means he had employed to increase his strength had just the opposite effect death was constantly before his eyes. From this moment, madness took possession of his soul. He expired under the torments of the furies."

Well, we have looked at the hour of death. But the rest of our life is just as revealing.

An American tourist in France went to the hotel keeper to pay his bill. The French hotel keeper said, "Don't you want a receipt? you could be charged twice." "Oh, no," replied the American, "if God Wills I will be back in a week. You can give me a receipt then."

"If God wills," smiled the hotel keeper, "do you still believe in God?" Why, yes," said the American, "don't you?" "No, said the hotel keeper, "we have given that up long ago."

"Oh," replied the American, "well, on second thought, I believe I'll take the receipt after all!"

It was over a century ago, and a man and his nephew were traveling west through the Colorado mountains. But they had lost their way, and finally came upon a cabin among the trees. The country was still wild, and they were nervous when they knocked on the door. Could they sleep for the night? they inquired.

As they prepared for bed, they heard low mumbling words in the adjoining room where the family (a husband, wife, and grown son) were. Almost in terror by now, the two men feared for their lives. They were carrying considerable money. What should they do? they only had one revolver.

After a time, they heard the chairs move, a shuffling, and more low mumbling. This must be it! A plot was afoot to kill them. With beads of sweat on his cold brow and hands, the nephew crept softly to the door and peered through the keyhole.

Coming back to the bed, his entire demeanor was changed. *"Everything is all right,"* he whispered, and explained what he saw. Immediately both fell soundly asleep and did not wake until morning.

Through the keyhole the young man had seen the family kneeling. They had read from the Bible, pushed back their chairs, and were praying.

The two men knew they had nothing to fear; they were in the home of genuine Christians.

"Have you studied Voltaire, Tom Paine, Robert Ingersol, or any of those fellows?" asked a passenger as he stood by the captain at the wheel of a steamship.

"No," replied the captain.

"Well, you should. You can't fairly turn down their argument until you have thoroughly investigated for yourself," the passenger replied.

"I've been captain of this ship a long time," said the captain. "The charts that I work with tell me the location of the deep water, so I can safely guide the ship into port. When I first became a sea captain, I decided that I would not investigate the rocks. The experience I've known other chaps to have with the rocks has been sufficient warning for me.

"Over the years I've watched the lives of men who have read the Bible everyday and loved God. Those were the men who had solid families, stayed away from drink, and helped other people in the community.

"And I've also seen the others: the drunkards, drug addicts, criminals, and all the rest. Those are the ones who have nothing to do with God and the Bible, and who never attend church.

"No, I've made my decision; *I stay away from the rocks.* My mother taught me the Bible when I was little, and I worship and serve the God of heaven who made all things. I'm not a bit interested in anything that Ingersoll, Voltaire, and Paine have to offer."

The preacher was on the street corner telling the passing crowds about Jesus Christ. A crowd had gathered and was listening intently. Then a hoarse voice spoke up from the back.

"Preacher, you've got it all wrong. Atheism is the answer to humanity's problems. People get into trouble and go crazy when they hear about Christianity. Religion is bad for minds and ruins lives. Come on now-prove to me that Christianity is real, and I'll be quiet."

Everyone was interested to see what would happen next.

The preacher held up his hand for quiet, and then said this:

"Never did I hear anyone state, 'I was undone and an outcast, but I read Thomas Paine's *Age of Reason* and now I have been saved from the power of sin.' Never did I hear of one who declared, 'I was in darkness and despair and knew not where to turn, until I read Ingersoll's *Lectures*, and then found peace of heart and solutions to my problems.'

"Never did I hear an atheist telling that his atheism had been the means by which he had been set free from the bondage of liquor. Never did I learn of anyone who conquered hard drugs by renouncing faith in God.

"But I have heard many testify that, when as hopeless and helpless sinners, they had turned in their great need to the Son of God and cast themselves upon Him for forgiveness and enabling power to overcome sin-they were given peace of heart and victory over enslaving sin!"

Then, turning to the atheist, he said:

"Who starts the orphanages, the city missions, and the work among the poor? It is the Christians. Who owns and operates the taverns, and manufactures the liquor sold in them? It is the atheists. Who risk their lives to help poor people in mission fields all over the world? It is the Christians. Who runs the abortion mills and the houses of prostitution? It is the atheists. Who are the most solid, kindly, industrious people in the nation? It is the Christians. Who operates the gambling halls and the crime syndicates? It is the atheists.

"Who are the swindlers, bank robbers, and embezzlers? It is the atheists. Who helps men put away their sins, live to bless others, and prepares men for death and eternity? It is the Christians.

"Yes, professed Christians sometimes do bad things. But it is infrequent enough to be newsworthy. If an atheist does a criminal act, it is to be expected. But if a church leader does it--it will make the headlines, because it is such a rare event.

"What leads men to throw away the bottle and stop beating their wives? It is Christianity, not atheism. What saves the wayward girls, the teenage boys, and the rest of us out of lives of sin? It is Christianity, not atheism.

"Christianity offers eternal happiness that begins now. Atheism can only offer doubt, skepticism, a miserable end, and eternal death."

Then the crowd turned to the atheist to give an answer, but he was gone. He had crept away without answering a word.

Wonders of Nature: Vol. 1 and Wonders of Nature: Vol, 2. Index

In order to simplify the task of locating nature nugget information in these two books, a single Index covers them both. But a single index would cause confusion in identifying which book each page number referred to. So the paging of Volume 2 of the set begins at page 101. This means that any listing over page 100 will be found in Volume 2. The two books, together, contain a rich mine of valuable Information about natural history.

There are two primary ways to refute the foolish errors of evolutionary theory: The first is by a discussion of scientific facts. This is done in Books 1-20 of this series. The second is by describing a few of the multitudes of design factors in nature. In the structure and function of plants, animals, and the rest is to be found profound evidence that God

is their Maker. This Design Index lists but a few of these many "nature nuggets." Even the smallest bug is amazing In planning, construction, and movement!

This Index is entirely to Volumes 21 and 22 in this series (Wonders of Nature: Vols. 1 and 2). In the index, below, certain codes are given after the description and before the page reference. Here is what they mean:

A crosshatch indicates that the Item listed is the name of an item, which includes several topics. - A dash indicates that this nugget will be one of several mentioned in a topic on that page, so it will not be labeled in full caps in the item title. No code after an entry indicates it is a major heading.

Biographies of creation scientists

Vance Ferrell

Evolutionists tell the public that creation scientists are not smart enough to do worthwhile research or make useful contributions to science. Yet the foundations of modern science were primarily laid by the research discoveries of brilliant creation scientists. These pages are filled with a few of the many biographies of creation scientists.

In reading these and other histories of scientific research, a common pattern emerges: An Individual with unusual Intelligence and determination spends years studying nature, and finds a few of its extremely technical secrets.

How could the random confusion of "natural selection" or damaging, lethal effects of mutations produce such sophisticated laws, high-level functions, and complicated organs? Only a Person with far higher Intelligence and craftsmanship could have produced what we find in nature.

AGASSIZ-(Ag'uh-see) Jean Louis Rodolphe Agassiz (May 28, 1807 - December 12, 1873). Swiss-American naturalist and glaciologist.

Agassiz was the son of a pastor, and a descendant of a French Huguenot family that fled France during religious persecutions under Louis XIV.

After obtaining a Ph.D. at Munich, he completed a medical degree in 1830. Arriving in Paris in 1832, he worked with Cuvier and then became professor of natural history at Neuchatel in Switzerland.

While there he completed a massive study on fossil fish, which was published in 5 volumes between 1833 and 1844. Europe's leading scientist, Humbolt, paid to have it published. He later received the Wollaston Prize for this achievement. Then Agassiz began studying glaciers, and became the father of glaciology. Immense boulders had been carried into the valleys of Switzerland, and Agassiz decided that glaciers were responsible. If true, this meant that glaciers at some earlier time were much larger than today, and that they moved.

In the summer of 1836 and 1837 he explored glaciers and found evidence of that movement. The sides and ends of glaciers contained piles of rock. In addition, rocks had been scoured by glacial movement. He also found similar grooved rocks where no one remembered ever having seen glaciers. Then, two years later in 1839, Agassiz found a cabin that had moved nearly a mile since being erected in 1827. Next, he drove heavy stakes into the ground in a straight line across a glacier. Two years later, in 1841, he found that the stakes had formed a U shape. This meant that the center of the glacier was moving faster than the edges.

"Charles Lyell, who led out in encouraging "Charles Darwin to write his book Origin of the Species, was not happy with Agassiz' discoveries, for they disproved his concept of uniformitarianism, which theorized that no unusual changes had ever occurred in past time.

Acclaimed as one of Europe's leading scientists, Agassiz spent the last 27 years of his life in the United States, most of it at Harvard University as a professor. He spent his spare time studying glaciation and ancient lakes in North America.

When Charles Darwin published his book, Agassiz resolutely refused to accept it. In fact, he became the most prominent biologist in America to oppose it, just as Sir Richard Owen in England was the leading biologist in Europe to resist Darwin's theory of evolution by natural selection. Evolutionists today declare that creationists never make good scientists. But men such as Louis Agassiz prove them wrong.

BABBAGE-Charles Babbage (December 26, 1792 - October 18, 1871). English mathematician.

Charles Babbage was an earnest Christian who, as a youth, taught himself mathematics. Then he applied for and received permission to study at Cambridge University. While there, he founded the Analytic Society and gathered together young mathematicians who wanted to research more deeply into mathematics than had been done since the time of Newton.

Before long, Babbage became so prominent that he was elected to the Royal Society in 1816. Vigorously, he sought to encourage British scientists to do more advance work in mathematics. Practical as well as mathematical, Babbage devised new methods of mass production in post offices and public work places, using methods strikingly similar to those Henry Ford would later employ in America.

Babbage developed the first reliable actuarial (lifespan) tables, now in use by governments and insurance companies around the world. In 1847 he invented the first ophthalmoscope, for examining the retina of the eye.

A major achievement was his development of a calculating machine. Very much aware of the mathematical errors in astronomical data and logarithm tables, he devised a machine which could automatically calculate numbers. Obtaining the backing of the British government, he worked on the, machine for several years, and then hit on something totally new: a computer.

This entirely new concept, which forms the basis of the latter 20th century computer revolution, was keyed to punched cards directing the calculating machine in its operations, and enabling the calculator to do many functions beyond that of mathematical operations. He thought out many of the basic principles which guide modern computers. However, he only had machines with which to do it, not our present electronic gadgetry.

BOYLE-Robert Boyle (January 25, 1627 - December 31, 1691). English physicist and chemist.

Born into a wealthy home, Boyle early showed great brilliance. At the age of eight he was enrolled at Eton College, and then traveled through Europe with a private tutor. While in Geneva, during a terrible thunderstorm he determined to dedicate his life to God. For the remainder of his life he was an earnest Christian.

In 1654, supported by a liberal inheritance, he made his home at Oxford, began research with other scientists, and helped found the Royal Society. Boyle was ahead of his age in that he not only had a brilliant mind, but he also believed in experimentation and not just theory.

In 1657 he devised an air pump, and the vacuum produced by it was for a time called a Boylean vacuum. He was one of the first to make use of evacuated, hermetically sealed thermometers. Galileo had earlier said that in a vacuum all objects fall at the same velocity. Using an evacuated cylinder, Boyle was the first to verify Galileo's principle. He also demonstrated that sound could not be heard across a vacuum, while an electrical attraction could still be maintained.

Then he began research on gases. He was the first chemist to collect a gas. He discovered the inverse relationship of air pressure (called Boyle's law). He concluded from this that, since air was compressible, it must be composed of discrete particles separated by a void. Compression merely squeezed the particles closer together.

Boyle was the first scientist to carefully and thoroughly write down the process and results of each experiment, so it could be repeated by others. This was a major step forward in science.

By the publication of a book, which explained that basic elements could not be changed into one another, but could be combined into compounds, Boyle changed alchemy into the science of chemistry. He appealed to scientists to determine elements experimentally, not theoretically. He is today considered to be the father of modern chemistry.

Boyle was the first to distinguish between acids, bases, and neutral substances, and he pioneered the use of acid-base indicators. He was the first to discover that water expanded as (and just before) it froze.

Before Boyle's time, discoveries were often kept secret, but Boyle insisted that they be made public as soon as possible to aid scientific research.

Robert Boyle was deeply religious, and later in life learned Hebrew and Aramaic to aid him in his Biblical studies. He wrote essays on religion and financed missionary work in the Orient. In his will, he founded the Boyle Lectures to defend Christianity against atheism.

BRAUN- Warnher Magnus Maxmillian von Braun (March 23, 1912 - June 16, 1977). German-American rocket engineer.

Von Braun was educated in Zurich, and completed his doctorate at the University of Berlin in 1934. Fascinated with rocketry, he began research into them. One went a mile high. The German government took over the project, and a rocket research center was built in Peenemunde on the Baltic, and by 1940 Von Braun was in charge of it. But Hitler did not like his views and he was briefly imprisoned in 1944, till Hitler was persuaded that the rocket program could not continue without Von Braun's brilliance.

When the war ended, Von Braun and many of his colleagues fled westward to surrender to the Americans. Now he was free to express openly his Christian beliefs. The United States government, recognizing that he was the leading rocket scientist in the world, appointed him to head up the Huntsville Research Center that placed America's first satellite (Explorer I) into orbit on January 31, 1958. In 1962, his team began construction of the Saturn 5 rocket that eventually carried men to the moon.

BREWSTER-Sir David Brewster (December 11, 1781 - February 10, 1868). Scottish physicist.

Son of a schoolteacher, Brewster was educated for the ministry but, although a fervent Christian, went into scientific research instead.

In 1815 he found that a beam of light could be split into a reflected portion and a refracted portion, at right angles to each other, and that both would then be completely polarized. Still known as Brewster's law, it earned him the

Rumford medal in 1819.

In 1816, Brewster invented the kaleidoscope. Later still, he produced the stereoscope, which produces three-dimensional pictures. He helped found the British Association for the Advancement of Science in 1831, and was knighted in 1832.

EULER-(Ol'ler) Leonhard Euler (April 15, 1707 - September 18, 1783). Swiss mathematician.

Euler was deeply religious from his youth, and considered entering the ministry as his father had done, but his mathematical brilliance led him into science instead.

Euler has been considered the most prolific mathematician of all time. He wrote extensively on every branch of the subject and was always careful to explain what he had done, and every false path he had entered in the course of his investigations. In 1766, he became blind, but this hardly slowed his work. In addition to all he had previously learned, he could remember several pages of newly-researched formulas. During his lifetime he published 800 scientific papers, many quite lengthy. At his death, he left behind so many additional papers that it took 35 years for mathematicians to process and print them.

He applied mathematics to astronomy, replaced the geometric proof methods used by GaliIeo and Newton with algebraic proofs, did advance research into lunar motions, was the first to announce that light was a wave form and that color depended on wavelength. We could fill all three of these books, plus many more with all the discoveries of this earnest creation scientist.

FARADAY-Michael Faraday (September 22, 1791 - August 25, 1867). English physicist and chemist.

Faraday was an earnest creation scientist, as well as one of the greatest scientists of all time. Without his research and discoveries, the 20th century would be far different.

He came from a poor family, and was apprenticed to a book binder. But his keen mind soon took him into scientific research.

This brilliant, self-taught scientist first devised methods for liquefying gases such as carbon dioxide, hydrogen sulfide, hydrogen bromide, and chlorine under pressure. He was the first to produce lab temperatures below O°F. In 1825 he discovered benzene, improved Davy's initial studies on electrolysis, and developed what are now called Faraday's laws of electrolysis which established the connection between chemistry and electricity, putting electrochemistry on a solid basis.

In 1821, Faraday showed that a current of electrified wire around a magnet could convert electrical and magnetic forces into continual mechanical movement. This provided the basis of modern electric motors. Later research that he did, produced open and closed circuits, electric induction, and the first transformer. Faraday was the first to discover magnetic lines of force and the magnetic field.

Interestingly enough, Faraday was the greatest scientist in history who knew no mathematics- He was entirely self-taught. Maxwell, another creation scientist, was later to devise the mathematics of electromagnetism-and in doing so arrived at the same conclusions that Faraday had. In 1831 Faraday produced the first electric generator. It is considered to be the greatest single electrical discovery in history. Later expansion of this discovery made it possible to produce large amounts of inexpensive electricity, whether it be coal-fired, hydroelectric, or nuclear-generated. Because of it we now have electrified cities, offices, factories, and homes.

FLEMING-Sir John Ambrose Fleming (November 29, 1849 - April 18, 1945). English electrical engineer.

Fleming was the brilliant son of a Congregational minister. After completing university work at Cambridge, he worked with Edison Electric for a time, and then with Marconi. After this, he set out on his own to advance the research of both scientists.

He found that the Edison effect (the passage of electricity from a hot filament to a cold plate within an evacuated bulb) to be caused by electrons boiling off the hot filament. This helped clarify certain important facts about alternating current. In 1904 he developed the rectifier. (De Forest, in America, added a grid to it, and this made electronic instruments practical.)

Fleming was knighted in 1929, and lived to be nearly 100.

GESNER-(Guess'ner) Konrad von Gesner (March 26, 1516 - December 13, 1565). Swiss naturalist and natural historian.

Gesner was the son of a furrier killed in the religious wars, and the protégé of the Protestant reformer, Ulrich Zwingli. In 1541, Gesner obtained a medical degree at the University of Basel and became a physician.

In his time, he was known as a master of erudition, for he spent his time researching and collecting a wide variety of natural materials: plants, animals, rocks, fossils, etc. He wrote extensively, and discovered over 500 species hitherto unknown.

GUTENBERG-(Goo'ten-berg) Johannes Gutenberg (c. 1398 - c 1468). German Inventor. Gutenberg ranks as one of the most influential men of all history. His invention of the basics of the printing press laid the basis for all modern research, transmission of knowledge, invention, and modern life.

Gutenberg is often called the inventor of printing. What he actually did was to develop the first method of utilizing moveable type and the printing press in such a way that a large variety of written material could be printed with speed and accuracy.

For thousands of years men had used seals and signet rings, which work on the same principle of block printing. Block printing could print a book, but required a completely new set of carved blocks for each new book. Gutenberg made movable type-each letter of the alphabet was a separate block. But he also did far more. Modern printing required movable type, along with some procedure for setting it and fixing it in position. The printing press itself was needed. Special inks were required. And, last, paper was needed.

Gutenberg already had the paper available to him, and some work had earlier been done on the other aspects. But he made brilliant improvements on each of the first three-and succeeded where others before him had failed.

Gutenberg developed a metal alloy suitable for type. He made a mold for casting blocks of type precisely and accurately. He made an oil-based printing ink. He made a press suitable for printing. But Gutenberg did far more: he combined them all into a complete manufacturing process. Mass-production of books, pamphlets, and tracts was needed, and Gutenberg supplied it.

When Gutenberg lived, China and Europe were about equally advanced. But within 50 years after Gutenberg introduced high-speed printing to the West, Europe shot ahead. Gutenberg's invention was not the only reason for this, but it was a major one.

HENRY- Joseph Henry (December 17,1797 - May 13, 1878). American physicist.

Like Faraday, Henry came from a poor family, had little schooling, and had to go to work while young. Also, like Faraday, he became interested in electrical experiments. Trying to wrap additional wires about a magnet to induce a greater magnetic field, he found he could not do so because the wires touched and short-circuited. So he began producing home-made insulated wires. He was now able to make powerful electromagnets. In 1831 he developed one that could lift 750 pounds (Sturgeon had earlier lifted 9 pounds). At Yale, later that year, using an ordinary battery he lifted more than 2,000 pounds of iron. In 1832, he was accepted as a professor at Princeton.

By 1831, he was sending signals over a mile by small, insulated wires. One problem was that, according to Ohm's law, the longer the wire, the greater its resistance and the smaller the current flowing through it. So Henry invented the electrical relay in 1835. This enabled the signal to be sent much greater distances than otherwise possible.

In effect, Henry had invented the telegraph. But he did not patent any of his devices, and it was Morse, another creation scientist, who worked out the details to put the first telegraph to practical use (in 1844). Henry freely helped Morse develop it.

In England, Wheatstone, after a long conference with Henry, produced a second telegraph. In 1830, he discovered the principle of induction (an electric current in a coil can induce a current not only in another coil, but in itself). In 1831, he published a paper describing an electric motor. An electric motor is the opposite of an electric generator: In a generator, mechanical force turns a wheel and produces electricity; in a motor, electricity turns a wheel and produces mechanical energy. One creation scientist (Faraday) had invented the generator to produce the electricity; another one (Henry) described the motor to use that electricity. The two inventions together have changed all modern civilization.

By means of an ingenious experiment in 1846, Henry demonstrated that sunspots were cooler than the rest of the sun.

In 1846, he was elected first secretary of the newly-formed Smithsonian Institution, and quickly made it a clearing house for scientific information. He also helped found the National Academy of Sciences, and was one of its first presidents.

Later still, he set up a system of obtaining weather reports from all over the nation. When the U.S. Weather Bureau began, it used his system. At the funeral of this creation scientist, high government officials were in attendance, including President Hayes.

HERSCHEL-Sir William Herschel (November 15, 1738 - August 25, 1822). German-English astronomer.

In 1757, at the beginning of the Seven Years' War, Herschel's parents managed to send him to England, where he remained the rest of his life. He began his career by becoming a well-known organist and music teacher. Then he taught himself Latin and Italian. The theory of musical sounds led him to a study of optics, and a desire to see the heavens through a telescope. Not able to afford a telescope, he learned how to grind lenses, and then he made his own.

He refused to be satisfied with his first lens, until he had made 200 of them! Then he was ready to produce them perfectly. In 1772, he brought his sister Caroline over from Germany, and she proved an earnest fellow worker in lens grinding and telescope making. Eventually, the pair were producing the finest telescopes available anywhere. By 1774 they were producing the best refracting and reflecting telescopes in the world.

But that was not good enough. Herschel decided to systematically scan the heavens through his marvellous telescopes. Soon he began turning out the first of hundreds of scientific papers and articles on his findings on the mountains of the moon, variable stars, the possibility that sunspot activity could affect agriculture on earth, and more besides.

In 1781, Herschel discovered a new planet which he named Uranus. He was to become the most important and successful astronomer of his time, yet he was entirely self-taught in that occupation. He was the first to discover binary stars, and found 800 of them. He was the first to systematically report on the periods of variable stars, and the first to discover that our solar system was moving in a certain direction (toward the constellation Hercules). He catalogued 2500 cloudy objects, which he called *galactic clusters.* In 1787 he discovered two of Uranus' moons, and, after constructing a 48-inch reflector, on the first night of viewing found two new moons of Saturn. He was the first to time the rotation of Saturn and ascertain that its rings rotated also.

In 1800, he tested various portions of the sun's spectrum for heat, and found that the hottest was just off the red end; he had discovered infrared radiation. In 1816, this creation scientist was knighted.

JOULE-(Jowl or Jool) James Prescott Joule (December 24, 1818 - October 11, 1889). English physicist.

Born into wealth, Joule was frail in health and weakened by a spinal injury in childhood. His father encouraged him to rest and spend his time in study and research, which he so much enjoyed. Supplied with a home laboratory, he was largely self-educated. Above all, Joule loved to measure things. Soon he was publishing papers on heat production by electric motors, the formula for the development of heat by an electric current. Although he later had to manage his father's business, Joule still found time to continue his research. He spent ten years measuring the heat of every process he could think of. In it all, he carefully calculated the amount of work that had entered the system, and the amount of heat that came out. Consistently, a certain amount of work always produced a certain amount of heat, and the formula was called the *mechanical equivalent of heat.*

For years, Joule's discoveries and reports were snubbed by the scientific community because of his lack of formal education. Fortunately, his work eventually came to the attention of William Thomson (later known as Lord Kelvin), who helped him become accepted. The later formulation of the First Law of Thermodynamics (on the conservation of energy) was partly based on Joule's determination of the mechanical equivalent of heat. Consistently thereafter, through the work of such men as Einstein and Pauli, the First Law has been re-established more and more firmly.

Joule collaborated with Thomson in 1852 in analyzing the temperature of gas when it expands, and discovered that freely-expanding gas always falls in temperature. Knowledge of this formula, the *Joule-Thomson effect,* enabled later researchers to obtain extremely low temperatures.

Although living at a time when Darwin's theories were gaining in popularity, Joule, Kelvin, and many other scientists remained conscientious creation scientists. In 1850 Joule was elected to the Royal Society; in 1866 he received its Copely medal; in 1872 and 1887 he was made president of the British Association for the Advancement of Science; and in 1878, he received a lifetime pension from Queen Victoria.

HARVEY-William Harvey (April 1,1578-June 3, 1657). English physician.

Harvey studied medicine at two of the leading European medical schools: Cambridge and Padua. Harvey was in Italy during the time that Galileo went through his heliocentric crisis with the authorities.

Returning to England in 1602, he became a well-known physician (Francis Bacon was one of his patients), and was eventually appointed court physician to James I and Charles I.

Yet, in spite of this success, Harvey was more interested in medical research than regular practice. In the first 14 years of his medical practice (1602-1616), he had, on the side, dissected over eighty species of animals. A special interest of his was the heart and blood vessels. Other researchers had tried to figure out the purpose of the heart and blood vessels, but it was Harvey that solved the problem. His great asset was persistence and research, instead of speculation and glances at anatomy.

After years of careful examination, Harvey correctly decided that the heart was a muscle; actually a blood

pump. He was astounded at the high degree of planning and intelligence that must have gone into making it in the beginning.

Through actual dissection, he found that the valves which separated the two upper chambers (auricles) of the heart from the two lower chambers (the ventricles) were one-way valves. Blood could go from auricle to ventricle, but not back again.

Then he carefully examined the veins and found that the valves in them, which Fabricius had earlier discovered, were also one-way! This meant that blood in the veins could only travel toward the heart, not away from it. (In later years, Harvey told young Boyle, another creation scientist that it was the valves in the veins which convinced him he was on the right track in his research.)

HOOKE-Robert (July 18, 1635- March 3, 1703). English physicist.

Even in childhood Hooke was recognized as brilliant. Scarred by smallpox, he attended Oxford. In his early 20s, he teamed up with fellow creation scientist, Robert Boyle, in developing the air pump. In 1663 he became a member of the Royal Society, and later became an influential officer. He was an ingenious and capable experimenter in almost every field of science. He did theoretical research into the wave theory of light, gravitational theory, steam engines, and the atomic composition of matter. He was the second to discover a double star. He studied the action of springs and formulated what is today known as Hooke's law. His analysis of the expansion and contraction of spiral springs made possible wristwatches and ship's chronometers with "hairsprings;" no longer were bulky clocks and their pendulums required.

Hooke did outstanding work in the field of microscopy and insects. His data and illustrations were unrivaled in his time. During his discovery of the porous structure of cork, he gave the microscopic holes a new name: cells, which has became a basic word in biology.

It needs to be understood that in Harvey's day, scientists assumed that the blood just sloshed back and forth through the arteries and veins. But Harvey calculated that in one hour the human heart pumped a quantity of blood that was equal to three times the total weight of a man! Since blood could not possibly be formed that rapidly, it had to be the same blood which was being pumped out of the heart through the arteries and then flowing back in through the veins. Blood did not slosh, it circulated.

Harvey also tied off an artery and noted that only the side toward the heart bulged. When he tied off a vein, the side away from the heart bulged.

As early as 1616, he began lecturing on these principles, but it was his 72-page book, Exercitatio De Motu Cordis et Sanguinis (On the Motions of the Hearth and Blood) published in 1628, which settled the matter. Among professionals, this book was to became famous.

But not at first. Harvey received ridicule, patients stopped coming, and learned physicians wrote articles and books against him. Men of science denounced him as a quack. Interestingly enough, their scientific evidence consisted of the theories of Galen, a Greek physician who lived 1400 years earlier! This reminds us of the current controversy over evolutionary theories, which are also based on assumptions and not facts.

By the time Harvey was old, his discoveries were accepted nearly everywhere.

Interestingly enough, there was one loophole in his position: nothing was known about how the blood got from the arteries to the veins. The arteries became smaller and smaller until they could no longer be seen, and then extremely tiny veins appeared out of nowhere. Four years after Harvey's death, Malpighi, another creation scientist, applied the microscope to the wing of a bat-and discovered capillaries-the extremely tiny tubes that connect the arteries with the veins. We now know that those capillaries are so small that the blood cells pass single file through them. Harvey was also one of the first researchers to study the development of the chick within the egg. Harvey was elected president of the College of Physicians in 1654, but declined because of his age.

KELVIN-Lord Kelvin (William Thomson; June 26, 1824 - December 17, 1907). Scottish mathematician and physicist.

The son of an eminent mathematician, Kelvin was an infant prodigy who, by the age of eight, was carefully listening to his father's mathematics lectures. At eleven he entered the University of Glasgow, and finished second in his class in mathematics. After that he studied in Cambridge and then in Paris.

Kelvin collaborated with Joule, another creationist, in discovering the *Joule-Thomson effect.* After researching further into the temperature drop of gas, Kelvin announced in 1848 that the lowest possible temperature that could be achieved was -273°C. It was later discovered that this temperature *(absolute zero,* or 0°K) applied to all matter, not merely to certain gases. Scientists working with low temperatures regularly use the *Kelvin scale,* which uses the same graduation marks as the centigrade scale. The motion *(kinetic energy;* a term introduced by Kelvin), of molecules becomes virtually zero at absolute zero.

The First Law of Thermodynamics specified that energy is never actually lost. Kelvin helped in formulating that law. In 1951 Kelvin deduced from Carnot's work that all energy, even though not lost, gradually becomes unusable. This is the *Second Law of Thermodynamics.* Everything in the universe is gradually running down, or, to say it another way, is gaining *entropy.*

Kelvin invented improvements in cables and galvanometers, in order to make possible the laying of the Atlantic cable. He introduced Bell's telephone into England, and in 1866 was knighted. He improved the mariner's compass, devised new types of sounding gauges, tide predictors, and many other things. He was buried in Westminster Abbey next to Newton.

KEPLER- Johann Kepler (December 27, 1571 - November 15, 1630). German astronomer.

As a child Kepler had smallpox which damaged his body and weakened his eyes. Attending the University of Tubingen to study for the ministry, his brilliance in mathematics was soon recognized. By 1594 he was teaching science at the University of Graz in Austria.

In 1598, he went to Prague and began working with the aged Tycho Brahe. On Tycho's death, all his research papers passed to young Kepler. This represented a lifetime of careful measurements of the apparent motions of the planet Mars. Repeatedly, Kepler tried to figure out how this data could be properly interpreted by mathematics and geometry. He found that the planet moved in an ellipse, or somewhat flattened circle, about the sun. He then applied this concept to data for other planets and their moons.

Kepler also described improvements in telescope manufacture, including double convex lenses, and a compound microscope. In addition, he showed that a parabolic mirror focused parallel rays of light, thus laying the basis for optics and Newton's work.

Using the newly-developed logarithms, he completed revised **tables of planetary motions, and** produced a star map. He **also calculated the** transits of the inner planets in front of the sun. After his death, his calculations were shown to be correct.

LISTER-Baron Joseph Lister (April 5, 1827 -February 10, 1912). English surgeon.

The son of the inventor of the achromatic microscope, Lister studied medicine and became a surgeon. He was thankful he could use the newly-developed technique of anesthesia during operations and amputations. But he was concerned that so many patients died afterward from infections.

Learning of the research work of another creation scientist, Pasteur, he decided to try to kill any germs present at the time of the incision. For this purpose he used carbolic acid (phenol) in 1867, and deaths by infection stopped.

He had thus founded the science of antiseptic surgery, and later research by other scientists improved on the means of doing it.

He was the first physician to sit in the House of Lords, and in 1885 succeeded Kelvin as president of the Royal Society.

MARCELLO MALPIGHI (Mahl-pee'gee) Marcello Malplghl (March 10, 1628 - November 30, 1694). Italian physiologist.

Malpighi is known as the father of microscopy because of his pioneer research with the newly-invented microscope. A physician by training, he lectured at various Italian universities and carried on basic microscope research.

In 1660 he showed that, in the frog, the blood flowed through a complex network of vessels over the lungs. This discovery explained how, through breathing, the blood could carry oxygen throughout the body.

Malpighi's observations of a bat's wing membranes revealed the finest blood vessels, which were eventually named capillaries. These connected the smallest arteries with the smallest veins. This discovery explained the missing link in Harvey's theory of the circulation of the blood.

He studied chick embryos and the respiratory vessels in insects, and found the stomata-small openings-on the underside of leaves.

MAURY-MATTHEW FONTAINE- Maury (January 14, 1806 - February 1, 1873). American oceanographer.

In 1830, at the age of 18, Maury entered the U.S. Navy, and we never would have heard more about him if he had not been lamed in a stagecoach accident in 1839. He was retired from active duty and given an office job as superintendent of the Navy Depot of Charts and Instruments.

Frankly, nothing was expected of him, but Maury surprised everyone and did a prodigious amount of work. He studied ocean winds and currents, and distributed specially-prepared logbooks to captains of ships so he could collect further data. He studied the Gulf Stream, and called it "a river in the ocean." His research received international recognition because ocean voyages were shortened as captains were now able to work with the currents instead of fighting them.

In 1850 he developed a set of ocean depth charts of the Atlantic to aid in the laying of the transatlantic cable. Recognizing that international cooperation was needed to properly study the ocean, he convened an international conference, which was held in Brussels in 1853.

The work of Maury laid the foundation of the United States Naval Observatory, and he is considered the father of oceanography. To the consternation of many scientists, however, he refused to accept evolutionary teachings.

In later years, he invented an electric torpedo and taught physics at the Virginia Military Institute. He is honored today by Maury Hall at the Naval Academy at Annapolis. In 1930 he was elected to the Hall of Fame for Great Americans.

MAXWELL-James Clerk Maxwell (November 13, 1831 • November 5, 1879). Scottish mathematician and physicist.

Early recognized as having unusual mathematical ability, he contributed a paper on oval curves to the Royal Society of Edinburgh. It was so well done that they refused to believe that a 15-year old had produced it.

In 1857, Maxwell showed that the rings of Saturn consisted of particles, instead of being solid or liquid.

Analyzing movement of gas particles in 1860, he co-developed the *Maxwell-Boltzmann kinetic* theory of gases in relation to temperature. This showed that temperature and heat were velocity of molecules and nothing else.

Maxwell conceived a theory of color perception which was to form the basis for the later development of color photography.

Between 1864 and 1873, he placed into mathematical form the lines of force found in a magnetic field. His work verified that electricity and magnetism always exist together, so his work is usually referred to as the electromagnetic theory.

Maxwell showed that the speed of electromagnetic radiations was constant, that it was equivalent to the speed of light, and that that speed was 300,000 kilometers per second [186,000 miles per second]. (It has since been refined to 299,792.5 kps [186,282 mps].) Because the speed of light was identical to other radiations, he decided that light itself was produced by an oscillating electric charge. Later researchers found that to be correct. Maxwell also predicted that many other radiations would be found-far beyond the infrared and ultraviolet, which were yet unknown that has proven true also.

MERCATOR-(Mer-kay'ter) Gerardus Mercator (March 5, 1512 - December 2, 1594). Flemish geographer.

The great voyages of discovery had begun by the time Mercator graduated from the University of Louvain in 1532. Good maps were necessary, and so the young man founded a geographical institute at Louvain University two years later.

He began the preparation of a lengthy series of maps, using instruments that he himself designed, plus a lot of mathematical calculations. Religious persecution nearly cost him his life, so he fled to Protestant Germany in 1552 and there continued his work as cartographer to the Duke of Cleves.

In 1568, he made his great improvement in mapmaking. Drawing flat maps of spherical surfaces is difficult, but Marcator devised a way to partially do it. He made a cylindrical *projection*, today known as a Mercator *projection. This* is the shape of the world most often seen on a world map.

To understand it, take a globe of the world and place a light at the center of it. Then place a cylinder of paper around it which only touches the sphere at the equator. The light shining through the globe traces an image onto the rolled-up paper. THAT is the Mercator projection. All the meridians of longitude (north-south lines) are equidistant and parallel, and the parallels of latitude run horizontal and parallel. The result is a round world portrayed on a flat map. As one goes farther north or south the east-west distances become wider than they really are, and the latitudinal (east-west) lines gradually lengthen the closer they are to the poles. The result is that such places as Antarctica, Canada, Greenland, and the northern Soviet Union are portrayed much larger than they actually are.

But there was a decided advantage for navigators, in that, following a constant compass direction, a route appeared straight on a Mercator projection, but curved on any other.

NEWTON- Sir Isaac Newton (December 25, 1642. March 20, 1727). English scientist and mathematician.

In childhood, this frail child occupied himself constructing devices such as sundials, kites, and water clocks. In school he seemed somewhat slow. Then he was taken out of school to help on the farm, but his uncle, a college teacher thought he might have ability and urged the family to send him to Cambridge. While there he was an average student, who worked on little projects in his room.

Sent home to escape the plague, which had arrived in London, he had already in his spare time worked out the very important binomial theorem in mathematics,-a formula of great importance which no one before his time had ever thought of. On his grandmother's farm he one day watched an apple fall from a tree, and began to think through gravity. (Newton was strictly honest, and he himself said the apple story was true.)

This young man decided that "the rate of fall was proportional to the strength of the gravitational force and that this force lessened according to the square of the distance from the center of the earth." That was his famous Inverse square law. Yet Newton questioned whether he could be right, so he set that idea aside for 15 years, until he had developed an entirely new mathematical system for reanalyzing such problems.

At this same time, the 23-year-old Newton conducted experiments on the farm, which were scientific breakthroughs in the field of optics. Among other things, he discovered that white light contained all the colors, and the prism merely separated them. When his experiments became known, Newton became famous. Returning to Cambridge, he remained there for 30 years. At the age of 27, he became a professor of mathematics at the school. He was only required to give about eight lectures a year; the rest of the time he could spend in research. Elected to the Royal Society in 1672, he went on to invent calculus.

Then he developed the particle theory of light, and turned his attention to telescopes. Refractors were getting about as large as they could without producing aberrations, so he invented the reflecting telescope, which used mirrors instead of lenses.

In 1684, Christopher Wren, the well-known architect, offered a reward to anyone who could solve the problem of the laws governing the motion of heavenly bodies. Halley (the one who predicted the return of the comet bearing his name) asked Newton if he could solve it. He replied, yes, he already had-20 years before, while back on his grandmother's farm after that apple fell!

Halley then asked him how did the planets move, and Newton replied, "In ellipses." "How do you know?" "Why, I calculated it" was the reply. Urged by Halley to work out the calculations again, and this time write them down, Newton wrote a book. Eighteen months later Principia Mathematlca was published. It is generally considered the greatest scientific work ever written. Later in life, Newton wrote a large book of commentary on the Bible, which he had a deep respect for. He said that the Bible contained solid, worthwhile principles which helped people, and which had greatly helped him think more clearly and live a better life.

In 1696, a Swiss mathematician challenged Europe's scholars to solve two problems. The day after Newton saw it, he anonymously mailed him the correct answers. Upon reading them, the challenger said, "I recognized the claw of the lion." In 1716, when Newton was 75, Leibniz stated an extremely difficult mathematical problem specifically to stump Newton. Newton solved it in an afternoon.

In 1696, this highly-honored creation scientist was appointed master of the British mint-and reorganized that branch of the government. In 1703, he was elected president of the Royal Society. In 1704 he wrote Optlcks, to summarize his research in that field. In 1705 he was knighted by the queen. At his death he was buried in Westminster Abbey. The atheist, Voltaire, who was visiting London at the time, said, “England honors a mathematician as other nations honor a king."

Two famous statements by Newton are worth repeating: "If I have seen further than other men, it is because I stood on the shoulders of giants."

"I do not know what I may appear to the world; but to myself I seem to have been only like a boy playing on the seashore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me."

MORSE-Samuel Finley Breese Morse (April 27, 1791 - April 2, 1872). American artist and Inventor.

He started out as a successful artist who made little money. But then, in the 1830s, he started carrying out electrical experiments. Morse decided to build an electrical telegraph, but quickly realized he lacked the electrical knowledge to do so. By accident he met the creation scientist, Joseph Henry, who patiently over a period of time answered every question he put to him.

Morse then decided to obtain financial backing for his project, and had the bulldog determination needed to carry it through to completion. After patenting the device in 1840, he lobbied Congress into appropriating $30,000 to

construct a 40-mile telegraph from Baltimore to Washington. Completed in 1844, it worked. The first message, sent by Morse in a dot-and-dash code he had devised, was “What hath God wrought?"

NAPIER-(Nay'pee-ur) John Napier (1550 -April 4, 1617). Scottish mathematician.

Napier, who grew up amid religious warfare in Scotland, was an earnest Christian. In 1594 he devised the exponential method of expressing numbers (22 5 4; 23 5 8; etc.), and spent 20 years working out complicated formulas for obtaining exponential expressions for various numbers, including trigonometric functions needed so much in astronomical calculations.

He called these new numbers logarithms, or "proportionate numbers." In 1614, he published his tables of logarithms, which were not improved on for over a century. Scientists everywhere eagerly grasped them. Now it was possible to do complex multiplication and division, simply by adding or subtracting numbers.

Napier became famous for his logarithms, so much so that few today remember that it was Napier who also invented the decimal point-and thus gave us decimal fractions.

PASCAL-(Pas-kal') Blaise Pascal (June 19, 1623-August 19,1662). French mathematician and physicist.

Pascal was a sickly child that nearly died in infancy. But he was later seen to be a mental prodigy. By the age of 9, he was reinventing Euclid's first 32 theorems; at 16, he published a book on conic sections that was more complete than that of anyone before his time. When he was 19, he had invented a calculating machine operated by cogged wheels which could add and subtract. Pre-electronic cash registers in the 20th century were based on it.

Shortly after that, he laid the basis of the modern theory of probability. Turning to physics, Pascal studied fluids and came up with Pascal's principle, which is the basis of the hydraulic press, which Pascal then described in theory.

Turning to the atmosphere, Pascal correctly theorized the relation of atmospheric weight to altitude, and predicted that a barometer could identify altitude by sensing atmospheric weight. This was shortly afterward proven.

In 1654, Pascal decided to devote the remainder of his life to religious studies, and, after a lifetime of being chronically ill, he died at the age of 39.

PICARD-(Pee-kahr') Jean Picard (July 21,1620 - July 12, 1682). French astronomer.

Picard was a creation scientist who first became an astronomer, and later in life became a priest. In 1655 he became professor of astronomy at the College de France and was one of the charter members of the French Academy of Sciences. He helped found the Paris Observatory, and searched through Europe for capable men to work in it.

Picard was the first astronomer to use the telescope-not merely for observation-but for the accurate measurement of small angles. He also obtained the best clock mechanisms available to record time and time intervals in astronomic observations.

Picard was the first person since the Greeks to measure the earth with any accuracy. Using a star instead of the sun, Picard arrived at almost the exact measurement.

PRIESTLY-Joseph Priestly (March 13, 1733 -February 6, 1804). English chemist.

Priestly was frail, but early revealed a brilliance of mind. In his youth he studied a variety of languages, ancient and modern, but never studied science formally. Yet it was in that field that he did his outstanding work.

In 1766 he met Benjamin Franklin who was in London in a vain effort to solve the taxation problem and avert the Revolutionary War. As a result, Priestly decided to enter a career in science.

Priestley researched into electricity and was the first to discover that carbon is an electrical conductor. He then wrote an important history of electrical research in 1769, followed by another on the history of optics. He predicted that electricity would eventually become important in chemical research.

Fermenting a grain produces a certain gas. Priestly noted that this gas snuffed out flames, was heavier than air, and part of it dissolved in water. Priestly had found carbon dioxide. Priestly studied more gases and found nitrous oxide, ammonia, sulfur dioxide, and hydrogen chloride. He also isolated oxygen.

Later he investigated and named rubber from a South American tree recently brought to Europe.

PASTEUR-(Pas-teur') Louis Pasteur (December 27, 1822 - September 28, 1895). French chemist.

Pasteur was an average student in school, although showing talent in mathematics. He was interested in art and wanted to become a professor of fine arts. But then he attended a series of chemistry lectures by Jean Dumas, and was determined to succeed as a chemist. Immediately his grades in science classes improved.

Upon graduation, this creation scientist began a lifetime of top-flight research work. He received the Rumford medal from the Royal Society for his first research work (separating tartaric acid crystals into both clockwise and counterclockwise planes under polarized light). Ten years later he showed that living creatures only have left-handed amino acids. The implications of both discoveries were important, because of what they revealed about the shape of molecules.

These and similar chemical discoveries gave him a succession of professorial appointments and made him a member of the Legion of Honor. But his research discoveries in biology and medicine were to far overshadow in importance what he had accomplished in chemistry.

In 1856, a Lille industrialist asked the young chemist to solve the problem of why certain liquids (such as wine, beer, and milk) fermented, and what could be done to prevent it. Under the microscope, Pasteur found that such liquids normally contained different types of yeast cells, that fermentation did not require oxygen, and that it was lactic acid yeast which was causing the souring. The solution he offered was to gently heat the liquid to 120°F. He said that this would kill any yeast in the solution, and, if immediately stoppered, the liquid would not sour. That process is today called pasteurization.

Then Pasteur chose to step into a full-blown controversy over the origin of life. The aged Biot warned him to stay out of it, but Pasteur ignored the warning. Because this point is a subject of concern in this present three-volume set of books (especially chapter 9), we will view it here in some detail:

A century earlier, Lazzaro Spallanzani had run experiments showing that when a vessel is heated, no life afterward forms within it. But in Pasteur's day, the spontaneous generation advocates-especially Ernst Haeckel-maintained that Spallanzini had, by his experiments, destroyed vital principles in the air-and this prevented lifeless chemicals from changing into living creatures.

Pasteur was a fervent creation scientist, and he was determined to enter this controversy. He was certain that there was no evidence that life sprung spontaneously from chemicals. So he devised an experiment in which the air in the vessel was not heated.

Pasteur showed that dust in the air included spores of living organisms and that by introducing dust into nutrient broths he could cause the broth to swarm with organisms. The next step, then, was to show that if the dust was kept out, no organisms could form in the broth. In 1860, the year after Darwin's book was published, Pasteur boiled meat extract and left it exposed to air, but only by way of a long, narrow neck bent down, then up. Although unheated air could circulate throughout the tube, the dust particles would settle in the entry-way bottom curve. As a result, the meat extract did not spoil; no decay took place; no organisms developed. Haeckel could not say that "vital principles" in the air had been destroyed by heating the air.

Pasteur announced the results at a meeting of the Sorbonne on April 9, 1864. A committee of scientists, under the direction of Dumas, studied the experiments and found them conclusive. There was no doubt that Pasteur was right and that the theory of "spontaneous generation" had been disproved.

This experiment, incidentally, greatly helped scientists develop better techniques for sterilizing nutrient cultures, and thus aided the science of bacteriology.

By this time, Pasteur was considered the greatest chemist in all of France. In 1862, a disease in southern France threatened to wipe out the silkworm industry. Traveling south, Pasteur examined the silkworms with his microscope, and found a tiny parasite was infesting both the worms and the mulberry leaves that were fed to them. Pasteur ordered all infested plants and worms immediately destroyed. This was done and the silkworm industry in France was saved.

Pasteur's attention was now fully turned toward communicable disease, and he developed the germ theory of disease, which said that germs could cause disease and they could be passed from one person to another.

During the Franco-Prussian War, he urged physicians to boil their military hospital instruments and steam their bandages in order to prevent death by infection. To whatever extent this was done, outstanding success followed. So in 1873, Louis Pasteur, who had no medical degree, was made a member of the French Academy of Medicine. .

Next he studied anthrax, a fatal domestic animal disease. He determined that infected animals must be killed and buried deep, and any animal surviving it would thereafter be immune. Pasteur then developed a vaccine to inoculate the herds. Similar methods were established against chicken cholera and rabies (hydrophobia). As a result of his work, the Pasteur Institute was established in 1888.

RAMSAY-(Ram'zee) Sir William Ramsay (October 2, 1852 . July 23, 1916). Scottish chemist.

Ramsay was the son of a civil engineer, and had a strong body, and good mechanical and thinking ability. After studying chemistry, he took positions at various British colleges and universities.

Researchers had found that a mystery was connected with nitrogen, and Ramsay suspected that another gas was mixed with it. In 1894 he experimented and found spectroscope lines of what clearly was' a new gas. He named it argon.

The next year he found helium. It had earlier been named when found in spectra of sunlight. In 1898 he found the rare gases neon, krypton, and xenon. In 1903 he helped another researcher who found the last of these Inert gases, radon. Knighted in 1092, he received the Nobel Prize in 1904.

RAYLEIGH-Lord Rayleigh (John WIlliam Strutt; November 12, 1842 - June 30, 1919). English physicist. Born into wealth, he showed remarkable mathematical ability at Cambridge. Elected to the Royal Society in 1879, he succeeded Maxwell, another creation scientist, as director of the Cavendish Laboratory at Cambridge the same year. Research into wave motion became his specialty. He worked out an equation of the variation between light-scattering and wavelength of electromagnetic waves. This confirmed that it was light-scattering in the atmosphere which caused the sky to appear blue. He next developed equations for black-body, long-wave radiation wavelength distribution.

Rayleigh studied sound waves, water waves, and earthquake waves. His work, along with that of Rowland in America, established accurate determinations of absolute units in electricity and magnetism.

Turning next to chemistry, he found that the atomic weights of oxygen and hydrogen was not 16:1, but 15.882:1. This led him to the discovery that nitrogen sometimes had the wrong weight. Ramsay, another creation scientist, checked into that and found that a new gas, argon (which constitutes about 1 percent of the atmosphere), had been included in the weight of atmospheric nitrogen.

Rayleigh received the Nobel Prize in 1904, and the next year was elected president of the Royal Society. In 1908, he became the chancellor of Cambridge University.

REDI-(Ray'dee) Francesco Redi (February 18, 1626. March 1. 1697). Italian physician.

Redi received a medical degree at the University of Pisa in 1647. In the year 1668, he performed a very important scientific experiment.

For thousands of years, people thought that small creatures, such as worms, frogs, and flies, automatically came to life when manure, mud, pond water and similar non-living substances changed into these living organisms!

This theory was called spontaneous generation. Common folk and deep thinkers (including Aristotle) believed in spontaneous generation. One of the best examples, in their thinking, of this was decaying meat, which produced maggots which hatched into flies.

At about the time that Redi was born, the English physician, William Harvey, wrote a book establishing the circulation of the blood. In it, Harvey noted that it was entirely possible that spontaneous generation might not be true, and that small eggs laid by living creatures had merely hatched. Redi decided to test this idea of Harvey's.

In 1668, he put a variety of meats into eight flasks, then sealed four of them, and left the other four open to the air. Flies could enter the four that were open, and those were the only ones that bred maggots. Next, desiring air to circulate through all eight flasks, he performed the experiment again; but this time with gauze over the openings of four of them. Once again, only the four open flasks bred maggots.

Redi concluded that maggots came from fly eggs, and not from spontaneous generation. Incidentally, this was the first scientific experiment on record when controls were used.

The spontaneous generation theory did not die because of Redi's experiment, for soon Leeuwenhoek discovered microbes, and because they seemed to appear out of nothing, it was thought that they originated by spontaneous generation. The theory of spontaneous generation was believed by many scientists until the middle of the 19th century, at which time another creation scientist, Louis Pasteur, performed a special experiment which totally collapsed the possibility that the theory could be true.

Yet, ironically, that did not eliminate belief in the theory of spontaneous generation. For Charles Darwin's 1859 theory, which came to be known as evolution, required spontaneous generation. Evolution in all its forms (Darwinism, neoDarwinism, Saltation theory, etc.) absolutely requires spontaneous-generation. Yet scientific research has repeatedly disproved the possibility that spontaneous generation can occur. Redi in 1668 was the first scientist to disprove it, Spallanzani in 1768 was the second, and Pasteur in 1860 was the third. But evolutionary theory survives because its advocates consistently ignore the mountain of scientific evidence opposed to it.

RIEMANN-(Ree'mahn) Georg Friedrich Riemann (September 17, 1826 - July 20, 1866). German mathematician.

The son of a Lutheran pastor, Riemann planned to become a minister, but was so talented in mathematics that

he majored in that field at the University of Gottingen and graduated in 1851.

Although he died of tuberculosis at the young age of 39, he still accomplished much in mathematical research. His best-known contribution to science was a non-Euclidean geometry, published in 1854, that was different than any devised earlier. (His was keyed to geometry on a curved surface.) A half-century later, Einstein based his work on Riemann's non-Euclidian geometry.

SPALLANZANI- (Spahl-/ahn-tsah'nee) Lazzaro Spallanzani (Janaury 12, 1729 - February 11, 1799). Italian biologist.

Spallanzani graduated from the University of Bologna in 1754, and then became a priest to help support himself. He taught at several Italian universities, collected natural history specimens in Turkey in 1785, and visited Naples in 1788 while Vesuvius was erupting.

His primary contribution to science was an experiment done in 1768. Earlier, in 1668, Redi had established that creatures visible to the eye did not originate by spontaneous generation from non-living materials. But many scientists still believed that microscopic creatures came to life by spontaneous generation.

What Spalianzani did was simple enough: He boiled solutions for 45 minutes and then sealed the flasks. No microorganisms appeared In the solutions regardless of how long they stood. Spallanzani found that some of these organisms survived brief boiling, but that none escaped lengthy boiling.

Spallanzani concluded that microorganisms appeared In such solutions only because they were already there; either in the solution, in the air around it, or on the inside of the flask. Clearly, no spontaneous generation occurred, no matter how long the matter remained inside the flasks. In later years, Spallanzllni carried out two other pioneering experiments. In 1779, he showed that sperm cells had to make actual contact with egg cells in order for fertilization to occur.

In the 1790s, he tried to figure out how bats flew in the dark. He covered their eyes and found they navigated and avoided obstacles just fine. But when he covered their ears, they became helpless. Spallanzani was astounded. How could bats see with their ears? If he had taped shut their mouths, he might have come closer to the answer. Bats emit cries with their mouths which they hear with their ears. It was not until the 20th century that scientists discovered those ultrasonic sound vibrations and the principle of radar which bats use.

SWAMMERDAM- (Svahm'-er-dahm) Jan Swammerdam (February 12, 1637 - February 17, 1680). Dutch naturalist.

Swammerdam studied medicine at Leiden University, but afterward spent his time studying things under the microscope. He collected 3,000 species of insects, placed them under the microscope and drew excellent pictures of their anatomy. The drawings were as good as anything produced later, and he is considered the father of modern entomology-the study of insects.

He was the first to show that muscles change shape but not volume. He also found the reproductive organ of insects, which aided in disproving the spontaneous generation theory.

In 1658 he announced a special discovery: he had found the red blood corpuscle (which we now know to be that unit of the blood which carries oxygen to the cells, and carries off carbon dioxide, lactic acid, and other wastes).

STENO-(Stay'noh) Nicolaus Steno (January 11, 1638 - December 5, 1686). Danish anatomist and geologist.

Steno was raised a Lutheran and later converted to Catholicism. Obtaining his medical degree from Leiden in 1664, he eventually became court physician to the Grand Duke Ferdinand II of Tuscany.

Steno carried out many research projects in animal and human anatomy. He found the parotid gland duct (the salivary gland near the front of the back of the jaw), and the fibril nature of muscles. He discovered the pineal gland in animals. Steno was one of the first to decide that fossils were the remains of ancient animals which had died and been petrified.

He also set forth the first law of crystallography.

STOKES-Sir George Gabriel Stokes (August 13, 1819 - February 1, 1903). British mathematician and physicist.

Stokes, a pastor's son, graduated from Cambridge in 1841 with highest honors in mathematics. Within a few years, he became a Cambridge mathematics professor; secretary, and then president of the Royal Society.

He developed Stokes' law, which explains cloud motion, wave subsidence, resistance of water to ship

movements, and a variety of other things.

Stokes introduced the word, fluorescence, and did research into it, along with sound and light. He was the first to show that ultraviolet light passed through quartz, but not through ordinary glass.

In 1896 he suggested that the newly-discovered X-rays were electromagnetic radiations, akin to light rays. He received the Rumford medal of the Royal Society in 1852 and its Copely medal in 1893.

DURER-(Dyoo'-rer) Albrecht Durer (May 21, 1471 - April 6, 1528). German art geometrician.

Durer was not only a highly-talented artist, but also a skilled craftsman. An earnest Christian, he lived at the time of the 16th century reformation, and was a personal friend of Martin Luther. One of the greatest artists of history, he was also the inventor of the art of etching. He worked in oils, engraving, woodcuts, as well as etching.

Like Leonardo da Vinci, Durer's interest in art drove him into scientific research. In 1525 he published a book on geometrical constructions, using the straightedge and compass. His discoveries made possible more exact three-dimensional pictures on two-dimensional surfaces. It is considered the first surviving text on applied mathematics. Not only did he explain how to do it, he also provided careful mathematical proofs for his formulas, which included complex curves. He also devised and published mathematical formulas for body proportions.

VIRCHOW-(fihr'-khoh) Rudolph Carl Virchow (October 13, 1821 - September 5, 1902). German pathologist.

Obtaining his medical degree at the University of Berlin in 1843, he became a well-known surgeon, and later university professor. In 1845, he was the first to describe leukemia, and went on to specialize in cellular pathology (the study of how cells become diseased).

In 1860, Virchow stated what became a famous axiom: "All cells arise from cells." This statement, accepted by all scientists today, actually has more meaning than most scientists recognize.

Yes, all living cells today only come from other living cells. But so it has always been! This fact renders the self-origin of life (spontaneous generation) totally impossible. Life must come from life. It can never come from non-life.

Virchow refused to accept Pasteur's germ theory of disease. Virchow considered disease to arise from problems within the body, not from germ invasion from without. In actuality, both concepts are at times correct.

In later years, Virchow went into politics and rapidly rose to high positions in the German government. A thorough despiser of Darwin's theory, he voted in the Reichstag (the German national congress) for a law that banned the teaching of Darwin's theory in the public schools.

WATT -James Watt (January 19, 1736 - August 19, 1819). Scottish engineer.

A frail child with chronic migraines, Watt was taught at home by his mother. As a young man, he went to London and completed an apprentice as a tool and instrument maker, then joined the faculty of the University of Glasgow.

Conversations with a chemist, Joseph Black, about latent heat turned his mind toward the possibility of designing an efficient steam engine. Those in operation (Newcomen steam engines) were produced too little power for the amount of fuel they required.

After repairing a Newcomen in 1764, he set himself to the task of improving on it. He added a second chamber to hold the heated steam, so the first chamber would not have to be reheated each time. Within five years (1769), he had made a far more efficient steam engine, that did its work much more quickly.

In addition, he introduced steam from both sides. In this way the piston could be driven by air pressure in both directions. In 1774 he began manufacturing and selling them. In 1781 he devised mechanical attachments that converted back-and-forth piston movement into rotary movement of a wheel. .

Watts' steam engine rapidly replaced the Newcomen, and by 1800 five hundred of his engines were working in England. His invention quickened modern history, for it began the industrial revolution, lessened home piece-meal work and farm work, and increased cities and slums.

Watt also invented a centrifugal governor that kept the energy output of the steam engine steady, and never too large or too small.

In 1783 he tested a strong horse to see how much it could lift and the distance it could lift it in one second. He defined this amount as 550 foot-pounds per second, or, as he called it, "one horsepower. " When the metric system was later devised, the standard was called "one watt, " with one horsepower equaling 746 watts.

In 1800 Watt retired and received an honorary doctorate from Glasgow University, and election to the Royal Society.

WOODWARD-Robert Burns Woodward (April 10, 1917 - July 8, 1979). American chemist.

Even as a boy, Woodward tinkered with chemistry. Entering the Massachusetts Institute of Technology at 16, he displayed such extraordinary ability in chemistry-and such poor aptitude in some other fields-that, instead of flunking him, the faculty assigned him to a special program. Four years later at the age of 20 Woodward had, not a B.A., but a Ph.D.

He immediately accepted a position on the staff of Harvard. In 1944 Woodward, with Doering, succeeded in synthesizing quinine. This was a total synthesis from chemicals, and not from any animal or plant product. By 1951 he was synthesizing such steroids as cholesterol and cortisone. In 1954 he synthesized strychnine and lysergic acid. In 1956 he synthesized reserpine, and in 1960 chlorophyll. Many more syntheses were to follow. Woodward received a National Medal of Science Award in 1964 and the Nobel Prize for chemistry in 1965.