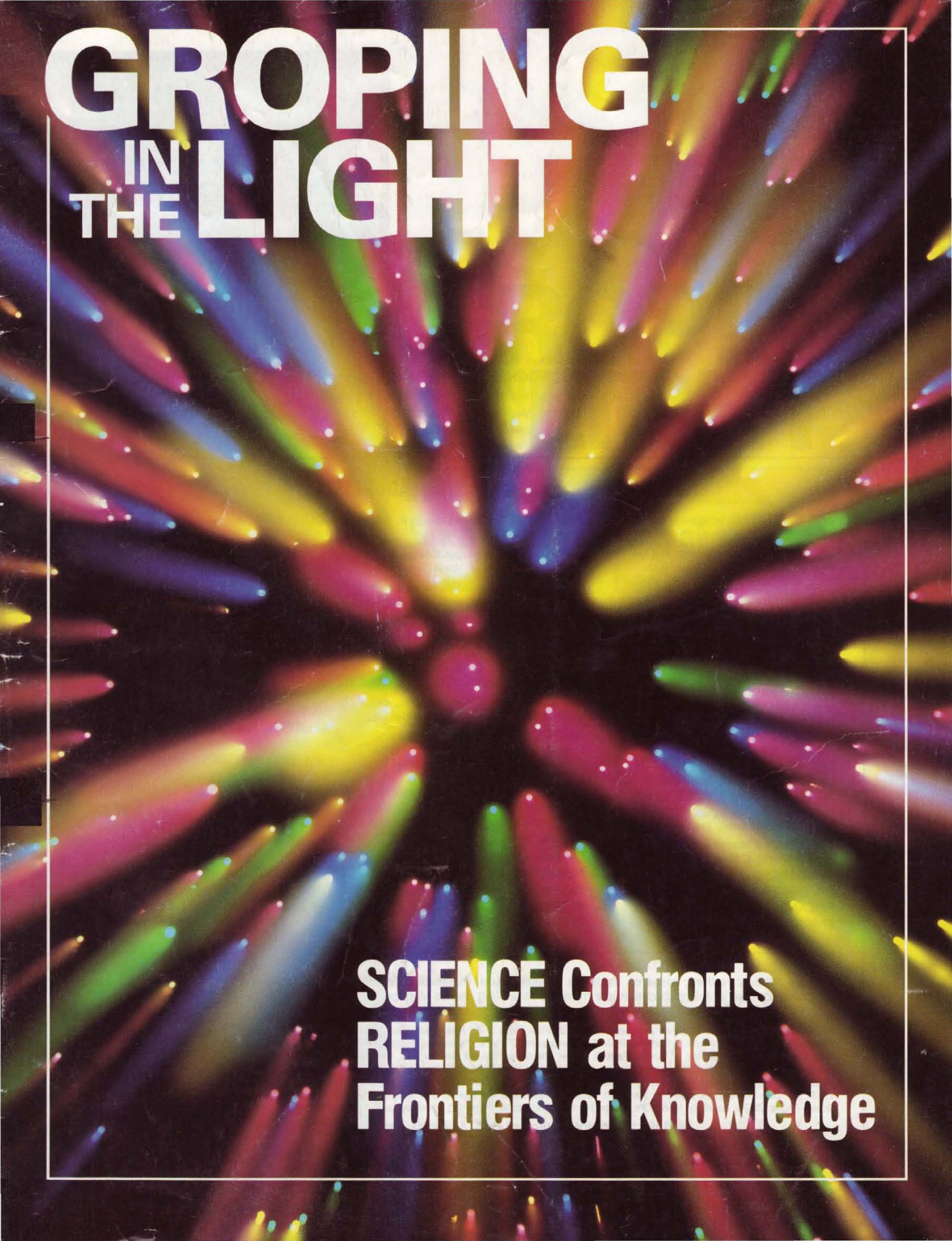
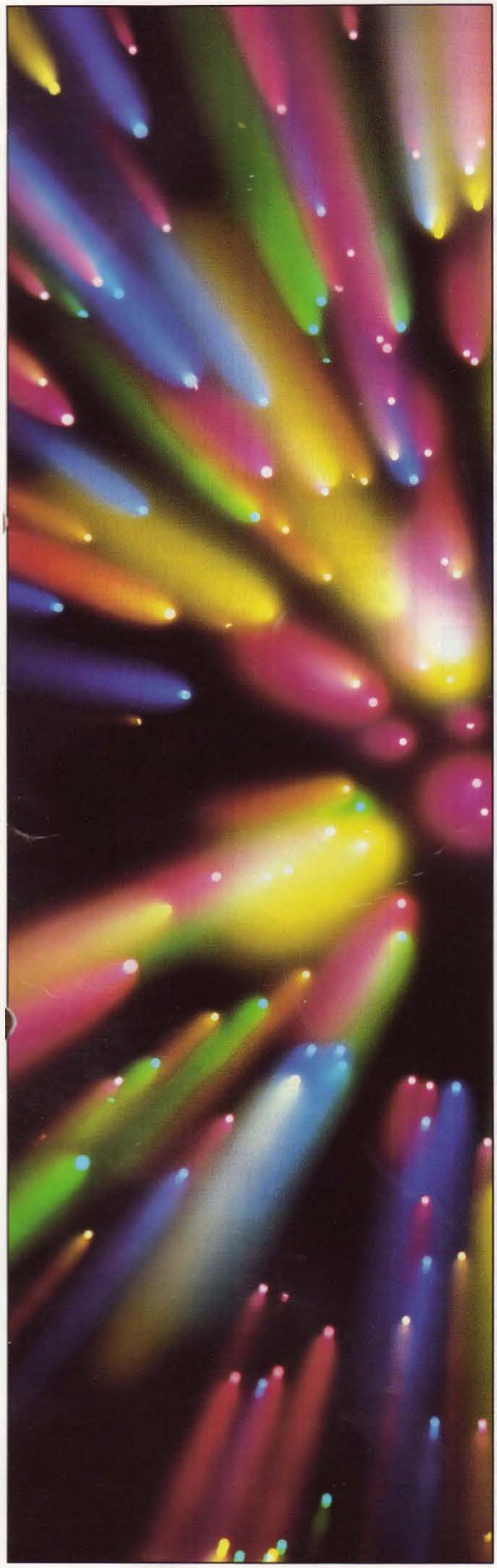
GROPING IN THE LIGHT



SCIENCE Confronts RELIGION at the Frontiers of Knowledge



GROPING IN THE LIGHT

Since the beginning of this century, scientists have been exploring an entirely new way of looking at the world and the universe. Their discoveries have raised challenging new questions for those who do not believe in God—and especially for those who do.

CHAPTER ONE

TWILIGHT OF FAITH

Millions of species share this planet. But only man has developed science and religion. Only man has tried to understand the world around him, and looked for purpose in his life. Only man asks who, why, what, when, where and how.

What sets us apart from all other species on earth is the awesome power of our minds. It drives us to want to know and to understand. That is why we build cathedrals, temples and churches. That is also why we peer through microscopes, build particle accelerators and send space probes to the farthest reaches of the solar system and beyond.

From the earliest of times, mankind recognized a basic symmetry and consistency in heaven and earth. The sun came up every morning. The moon waxed and waned. The stars and planets followed their courses through the heavens. Leaves changed color every autumn. New growth burst forth in the spring.

People saw this as evidence that they and their world were in the hands of God—or the gods—and all was well.

OUT OF THE SHADOWS

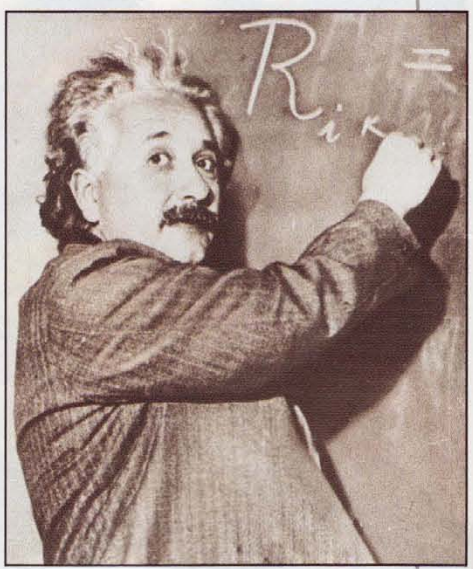
Most people lived fairly simple, predictable lives. They planted their crops, or worked at the trade they had been taught by their fathers and that they in turn would teach their sons. The average person could not read or write, and knew little of the world outside the immediate community. Everyone had a place in society—the rich, the poor, even the servant or slave. That was the way it had always been, and the way they thought it would always be.

If they had questions, they could ask the priest, or the shaman or the witch doctor, who knew what was necessary about life, death and the purpose of existence. Religion, and what eventually became the church in the Western world, was assumed to have the answers to the really important questions.

But a few have always thought more deeply and asked probing questions. Why is it this way? How does the universe work? What is the meaning of the creation—and of life itself?

For most of recorded history, the scientist was viewed as a rather eccentric figure on the fringes of normal society. He seemed to spend his time looking for the elixir of life, or trying to turn lead into gold, or doing unfathomable things with astronomical charts. Science, or what passed for science, didn't have much to do with the average person.

In general, however, the early scientist-philosophers of the Western world were bound by a deep respect for tradition, especially sacred tradition. They went about their work in the spirit of investigating their Creator's handiwork. Their humble efforts could only supplement—and certainly never challenge—the majestic revealed truths of the Bible, as interpreted by the authorities of the church.



Two of the world's greatest scientists, Galileo Galilei (left) and Albert Einstein (right) helped pioneer new ways of thinking about the universe and our place in it.

Gradually, however, a gulf opened between science and religion in the West. About 300 years ago, scientists began to move out of the shadows and onto center stage. The influence of religion

> "I want to know [God's] thoughts; the rest are details."
>
> ALBERT EINSTEIN, PHYSICIST

slowly, but decisively, decreased. Technology began to change the way we lived, but more significantly it changed the way we *thought* about ourselves. Man could now master the environment. No longer were we nature's pawn, and the dogmatic, often simplistic explanations of religion no longer satisfied.

The theologian gradually became the rather incongruous figure on the edge of society. His well-meaning efforts to help seemed less and less relevant with every passing decade of progress. Everything really important could apparently be explained without him. After centuries of groping in the dark, it was the scientists, not the theologians, who emerged with answers. *They* gave us new insights. *They* performed the miracles. *They* lightened our burdens, and brought us new truths. There was less need to rely on the concept of God to explain the existence and functioning of the universe.

The thinking developed that everything could be studied and explained by science. Physicists, chemists, biologists, geologists confidently gave answers while theologians seemed to become more and more out of touch with the needs of the real world.

A STRANGE NEW WORLD

But then, about the end of the 19th century, scientists who were studying the deepest mysteries of matter and energy were confronted with a whole new way of looking at the world. As physicists probed the vastness of space and the heart of the atom, what they discovered was so different, so fantastic and utterly unexpected that it seemed to defy all common sense, all logic and all reason.

Most of us still see ourselves as living in a predictable three-dimensional world, surrounded by familiar, solid objects. Up is up, down is down, and we usually know what time it is. But the "new physics" is telling us that this may not be the way it is at all. Our everyday world may be, at the fundamental level, a very peculiar place. The most common object—a pen, a wooden spoon, or this booklet—may be in reality a pulsating, shimmering field of energy, held in check by mighty forces that prevent it from coming apart.

Today, those who work with high-energy physics, probing the beginning of time and the ultimate building blocks of the universe, are finding that they may be hitting barriers where practical experiments can go no further.

It is an interesting state of affairs. After several decades of astounding discoveries, physicists in the high-energy field admit they may be reaching the end of their experimental rope. Research at the leading edge must be carried out in the laboratory of the mind, where the tools are those of the intellect (reinforced by horrendously complicated mathematics). But this has led some scientists into territory that has typically been the preserve of the philosopher and theologian, whose jobs have traditionally been to explain what cannot be adequately understood by experiment and observation.

Religion, however, seems to have lost its moorings at this point in human development. Today, it is rife with factions, divided into sects, cults and denominations, its clergy often unsure of themselves and their mission. And tragically, the Bible, once acknowledged as a reliable source of knowledge for mankind from its Creator, has been criticized, doubted and downgraded. This has been done not only by skeptics and agnostics, but by those presumed to understand it best.

It is tragic that the Scriptures have been so badly represented. When properly understood, the Bible adds a vital dimension to the questions being raised by those who are pushing the frontiers of knowledge. We need to look at the Bible and see if its ancient light can illuminate the remarkable mysteries we are pondering today.

But first, let's take a brief look at the history of religion and science, and understand why a gulf opened up between them.

> "As we acquire more knowledge, things do not become more comprehensible but more mysterious."
>
> ALBERT SCHWEITZER, PHILOSOPHER

CHAPTER TWO

GROPING IN THE DARK

Astronomy was among the first of the sciences to be developed in the West. The early civilizations of Egypt and Mesopotamia made a diligent and careful study of the heavens. The people were essentially practical, so their investigations were centered around the problems of everyday life. They saw in the sun, moon and stars the manifestation of the gods who influenced every aspect of their lives. What would the weather be like for the harvest? When would the river flood? What would be the sex of the next child? Consequently, their understanding became mixed with deep superstition.

The ancient Greeks were the first people to approach scientific inquiry with a desire to learn for learning's sake. Theirs was a remarkable civilization—considered one of the most productive learning periods in history.

The Greeks were a deeply religious people. They strove for perfection in mind and body, and saw evidence of it in the harmony of nature and the symmetry of the heavens. Thus they became intensely curious about everything around them. They plotted the courses of the stars and planets. They collected fossils. They sorted birds and beetles into categories. They studied anatomy, art and architecture. They developed innovative theories of politics and government.

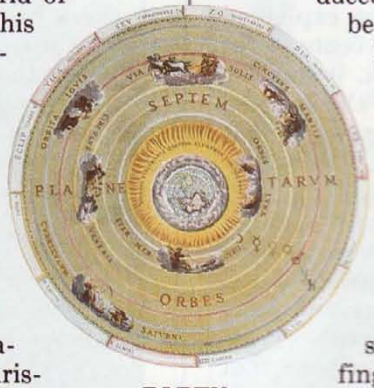
The most scholarly and systematic of the Greek philosophers was Aristotle (384-322 B.C.). He organized and classified vast amounts of information about the world of his time. Many of his concepts in the areas of astronomy, anatomy and physics greatly influenced scientific thought for centuries.

This was a mixed blessing. Because he relied solely on observation and reason, Aristotle had remarkable insight in some areas. But in other areas he was at best inadequate and, at worst, hopelessly wrong.

Reason and observation are effective if one argues from a true premise. If the basis of an argument is false, anything deduced from it may also be false. It is rather like typing with your fingers not properly placed over the home keys. As any typist knows, the home keys are where you place your fingers before you start. With your fingers properly orientated, you can type quickly and accurately. If you don't start on the home keys, the result will be confusion.

The Greek philosophers, when

ARISTOTLE
(384-322 B.C.)



EARTH-CENTERED THEORY

LIBRARY OF ALEXANDRIA

500 B.C.

- Greek philosophers Leucippus and Democritus develop concept of the atom (440s-420s B.C.)
- Aristotle classifies 500 known animal species (340s B.C.)
- Ptolemy refines Aristotle's geocentric (earth-centered) theory of the universe (A.D. 140s)
- Library of Alexandria, which flourished for centuries, is destroyed (A.D. 389)
- Decline of science in Europe (A.D. 530-1000)

A.I

DEMOCRITUS

THOMAS AQUINAS
(A.D. 1225-1274)

they based their arguments on incorrect assumptions, made some now-obvious mistakes. In Aristotle's case, he reasoned that the earth was the center of the universe, and that the sun and planets went around it. His earth-centered theory of the universe, further developed by the astronomer Ptolemy in the second century A.D., was the standard explanation until modern scientific methods proved their superiority. Aristotle's methods and conclusions were accepted until the 16th century.

By the time the Greek civilization became dominated by the Romans, the Greeks had made a useful start on the systematic compilation of knowledge. They had asked a significant number of the right questions and diligently pursued the answers. Their great libraries became vast storehouses of information. In its heyday, the library at Alexandria alone may have held more than half a million documents. Unfortunately, Greek civilization declined and their treasure houses of information were eventually destroyed.

The Romans, like the Egyptians and Babylonians, were an essentially practical people. Brilliant architects, builders and engineers, they were mainly concerned with putting knowledge to work. The Romans built roads, bridges, aqueducts and amphitheaters, some still in use today, but they did little to advance the course of theoretical science.

THE LIGHTS GO OUT

After the Roman Empire fell in the fifth century A.D., scientific progress virtually came to a standstill in the West. The Christian church, by this time the state religion of the Roman Empire, believed that Jesus Christ would return at the last judgment and the world would end. The church's priority, therefore, was to prepare the faithful for that event. Anything—including scientific discovery—that challenged the established order was regarded as a threat.

But as the lights dimmed in the realm of Christendom, they went on in the Arab world. If the early Middle Ages were the Dark Ages in Europe, they became the golden age of Islamic science. The Arab peoples, unified in faith and language, continued to develop science. They preserved Greek learning and carefully translated works that might otherwise have been lost.

As their influence and their empire expanded, Islamic scholars had the opportunity to compare the learning of both East and West. From India, they learned the use of the zero in calculation. They also further developed a new numbering system that was much simpler than the cumbersome Roman method of assigning a numerical value to various letters of the alphabet.

In the eighth century, the Arabs learned from Chinese captives the technique of papermaking. With a steady supply of paper, books became more com-

• Al-Mamun founds a "House of Wisdom," where important Greek treatises, including Ptolemy's astronomy, are translated (832)

.740

ARAB CLASSROOM

1360

• Islamic science flourishes (700-1300)

mon. In the 10th century, the great library at Cordoba, in Islamic Spain, probably had around half a million volumes. At that time there were probably no more than several thousand books in all of Europe.

But the tide of history ebbs and flows. In the 12th century, knowledge of the Greek philosophers eventually began to filter slowly back into Europe, and with it came a reawakening of scientific curiosity.

Science began a difficult and painful rebirth. Difficult and painful because the church had become the supreme authority and was still suspicious of the influx of knowledge that challenged its traditional position.

Thomas Aquinas (1225-1274), the leading scholar of medieval theology, considered human reason an adequate instrument for attaining truth about the physical world. Thus, he generally accepted Aristotle's ideas of physical phenomena as a foundation for physical science. If God could be known through his creation, that creation could be known by Aristotle. If Aristotle had reasoned that the earth was the center of the universe, that would also be the church's official view. Scientific discovery that conflicted with Aristotle was suppressed.

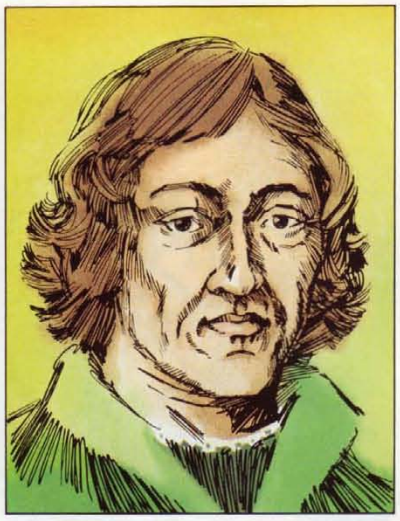
Medieval theologians regarded man's salvation as the very reason why the earth and the heavens existed. So obviously, the earth was the center of the universe and the physical focus of God's creation.

Any other concept of the universe did not sit well at all with the church. Did this not diminish the central role of Christ, and his sacrifice, and thus strike deep at the foundations of the Christian faith? It was dangerous thinking that the church did its best to squelch.

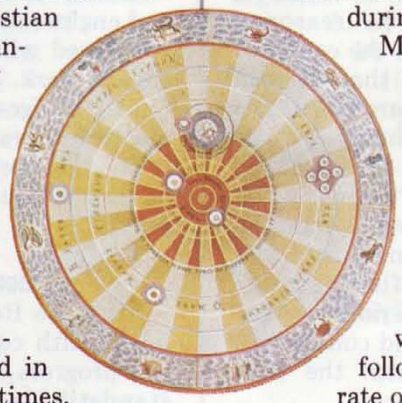
Today, this resistance to scientific progress seems stubborn, shortsighted and foolish. But if viewed in the context of the times, it is easier to see the church's point of view. Church authorities thought they were preserving truth, not suppressing it.

In many ways, the 15th century was not any more advanced than the fifth. Most work was done by hand, during daylight hours. Machinery was rudimentary and inefficient. If people traveled—and most never did—they were limited to the speed of a galloping horse, while their goods followed behind at the rate of a plodding ox.

Sailors cautiously edged their ships along the coasts, trying not to lose sight of land. A few brave mariners groped their way across the oceans at the mercy of the wind



NICOLAUS COPERNICUS
(1473-1543)



SUN-CENTERED THEORY

1360

- Copernicus' heliocentric (sun-centered) theory is published (1543)

- Galileo builds his first telescope (1609)

- Galileo sees Jupiter's moons and Saturn's rings (1610)
- Galileo is asked by Catholic Church to abjure Copernican doctrine (1633)
- Robert Hooke describes cells for the first time (1665)

16

GALILEO

"All men
by nature desire
to know."
ARISTOTLE, PHILOSOPHER

GALILEO GALILEI
(1564-1642)

and the currents, trusting their imperfect knowledge of the stars and their crude instruments.

THROUGH A GLASS DARKLY

No amount of fear and repression can forever stop people from thinking. After many years of meticulous calculation, Nicolaus Copernicus (1473-1543) rejected the cosmology of Aristotle and Ptolemy, and showed that the earth was a planet revolving around the sun. But he was a prudent man, not letting his work be published until just before his death.

Galileo Galilei (1564-1642) used the newly invented telescope to confirm the findings of Copernicus. He begged the church authorities to consider changing the official views. How could honest people be asked to believe what was demonstrably untrue?

Some theologians may have agreed with Galileo, but the traditional view prevailed. Mathematical tricks and fuzzy images in primitive telescopes had nothing to do with the truth. It was an insult to God. It was sorcery and an unpardonable invasion of the heavenly domain. Copernicus' works were labeled as heresy and banned, and Galileo was ordered to keep his ideas to himself.

Besides, at this time, the established church was having enough trouble with the Protestant reformers. This was no time for mischievous scientists to make a nuisance of themselves. (Not that the Protestant reformers were any more enlightened. Martin Luther called Copernicus a fool intent on reversing the whole science of astronomy.)

It is important to understand that men like Copernicus and Galileo were not questioning the authority of the Bible. They maintained a deep respect for the Scriptures, believing that scientific observation was a confirmation of revealed truth. But the church authorities remained adamant in their opposition to experimental science.

Men of genius like Leonardo da Vinci (1452-1519) and Michelangelo (1475-1564) were continuing to experiment in less controversial areas, such as engineering, art and architecture. They were ahead of their time, but their flashes of brilliance could not hide the fact that there still did not exist a systematic understanding of scientific principles. Knowledge was fragmented and disorganized, like a book without a table of contents, chapter headings or an index.

Someone was needed to tie the fragments of information into an overall framework of understanding.

THE BREAKTHROUGH!

That person was Sir Isaac Newton (1642-1727), one of the world's greatest scientific geniuses. He is best known for formulating the theory of gravity. Newton, of course, was not the first person to notice gravity. The story of the apple falling on his head as he sat under a tree is probably a legend. But he was the first to recognize that the various ef-

STEAM LOCOMOTIVE

fects of nature are governed by universal laws. The force that made an apple fall was the same force that governed the motion of the earth around the sun.

In 1687, Newton published his remarkable book *Philosophiae Naturalis Principia Mathematica,* showing how the previously unfathomable secrets of nature could be expressed in formulas and equations. Newton showed that although the creation looks complicated, its basic workings are quite simple. It is like a watch, which at first glance seems like a jumble of springs, sprockets and gears, but on closer examination is seen to operate on basic mechanical principles. Newton discovered a far-reaching principle: *Laws govern physical phenomena.*

Newton's laws of mechanics, gravitation and motion, along with the invention of calculus, gave scientists tools to understand the world and even the universe as never before. The creation was seen to behave like a giant clock that, having been wound up, ticked steadily and predictably along.

Newton was aware that his methods only explained how the universe worked—not why. It is interesting to note that he maintained a deep interest in theology and spent his last years in a study of biblical prophecy. But ironically, his theories and laws opened even wider the gap developing between religion and science. The more natural phenomena could be explained, the more the grip of superstition and dogma loosened.

The medieval concept of God in heaven, and puny man here below, continued to change. Now man began to see that he could become the revelator of nature's secrets.

The scientists now had their hands on the home keys. They could learn from the mistakes of the past, and apply the new scientific techniques to explore and experiment in ways never possible before. The forces that made the world work had become definable, and what is even more important, they began to be harnessed. It was the breakthrough needed, and the pace of invention quickened.

In 1851, Britain, the first industrial nation, staged the Great Exhibition in London's Hyde Park. The centerpiece was the Crystal Palace, a monumental structure of iron and glass, a suitable temple to man's newfound industrial genius. Beneath its soaring roof, the wonderful inventions of the industrial nations were arrayed for the world to admire.

Eight years later, Charles Darwin published *The Origin of Species,* in which he explained his theories of the evolution of life. At first even Darwin was reluctant to suggest the possibility of such a complex creation as man without a Creator. But his theory led him to an inevitable conclusion: Man was not a unique creation. He was rather the most capable, efficient and intelligent creature to have evolved through the process of natural selection. The human race was the magnificent end product of millions of years of evolution. As Darwin explained it, only the fittest survived.

For a people becoming infatuated with their own ingenuity, this was the right idea at the right time. The Western world was transforming itself into an industrial society, ready to exploit the earth's resources as never before. Competition, it was claimed, was the first law of nature, and man had won. Might was right, and

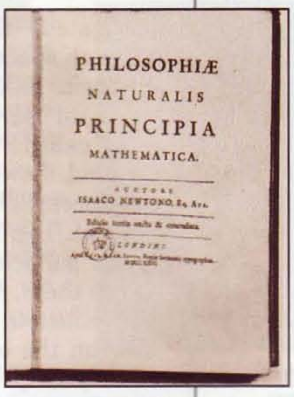
1830

- Leon Foucault uses pendulum suspended in church to demonstrate earth's rotation (1851)
- Dmitri Mendeleev and Julius Lothar Meyer publish versions of the periodic table of elements (1869-1870)
- James Clerk Maxwell's *Electricity and Magnetism* contains the basic laws of electromagnetism (1873) • Heinrich Hertz uses Maxwell's theory to produce long waves, now known as radio waves (1888) • Marchese Guglielmo Marconi invents wireless telegraphy (1895)
- Wilhelm K. Roentgen of Germany discovers X-rays (1895)
- Marie and Pierre Curie discover that thorium gives off "uranium rays," which Marie renames radioactivity (1898)

MARIE & PIERRE CURIE

19

ISAAC NEWTON
(1642-1727)



Newton's Principia Mathematica, *published in 1687, is considered one of the greatest scientific books ever written. In it, Newton explained his laws of motion and theory of universal gravitation.*

thus man had the right to dominate the planet.

So dominate he did.

THE TRIUMPH OF TECHNOLOGY

Marvelous inventions transformed the way the Western world lived. No longer did it amble along to the rhythm of nature. A network of canals, roads and railroads joined the new industrial cities. Steam was harnessed and obediently pushed the pistons that drove mighty locomotives at unprecedented speeds, or spun giant paddle wheels that propelled great ships across the oceans, independent of wind and tide.

The invention of the internal combustion engine made possible the automobile, and with it a new freedom of movement.

Thomas Edison's persistent experiments with electric light turned night into day. Messages sped along telegraph wires strung across the continents and through cables under the ocean. What used to take days or even months could now be accomplished in seconds.

In 1895, Marchese Guglielmo Marconi transmitted messages without wires, and even the airwaves began dancing to the new tune.

What a world it was—with great machines clanking and puffing, their boilers hissing, motors whirring, wires humming and sparks flying—all obedient to predictable, definable laws, and all under human control.

Even the depths of the universe became mankind's territory. Using Newton's laws, scientists predicted, plotted and found previously unknown planets on the fringes of the solar system.

And at the other end of creation, the smallest pieces of matter were giving up their secrets. Physicists had long accepted that matter was made up of indivisible particles called atoms. Now they began to pry them open, discovering electrons and the protons and neutrons that made up the nuclei.

About a hundred years ago a young German student, Max Planck, asked his teacher for some advice on his future career. He had two options. He could become a physicist, or he could study to be a concert pianist. Be a pianist, he was advised. "Physics is finished.... It's a dead-end street." But young Max Planck chose to walk down the "dead-end street" and helped turn the world of science upside down.

• Joseph John Thomson of England discovers the electron (1897)

J.J. THOMSON

1900

2000

• Albert Einstein publishes his general theory of relativity, which changes the world's perception of the universe (1916)
• Edwin Hubble announces his findings that the more distant a galaxy is, the faster it is moving away from the earth (1929) • First electron microscope built (1933)
• Discovery of the transistor (1948) • Laser technology conceived (1957)
• Quark theory proposed (1964) • Introduction of the microprocessor, now known as the chip (1971) • Concept of the universe being 10 or more dimensions (1976)

CHAPTER THREE

GROPING IN THE LIGHT

Perhaps we should not blame Max Planck's teacher for telling him physics was a dead-end street. It did seem, at the end of the 19th century, that all the major theories were established and the classical physicist's work was done.

There were still many problems, but it was felt that at least science was now on the right track. The universe seemed like a great machine, still largely unknown, but thanks to Isaac Newton, at least explainable. Whatever was out there could be relied on to work predictably and coherently, obedient to the laws of gravity and motion that ruled the behavior of all moving objects.

But scientists began to notice that Newton's laws did not give an adequate explanation of all observable phenomena. There were still some awkward paradoxes.

At the turn of the century, Max Planck focused his attention on one of these paradoxes—why heated objects radiated light of different colors as they became hotter. Most of us don't give this a second thought, but physicists realized this seemed to contradict a basic law of physics.

In 1900, Max Planck advanced a revolutionary explanation: Energy was not radiated in a steady continuous stream, but in precise, discrete units or "packages," which he called "quanta." His idea helped explain the enigma of radiated light—but it also opened a door to a whole new way of looking at the universe.

Although quantum theory is now nearly a century old, most people are still unfamiliar with it. Even fewer understand it. However, the expression "quantum leap" has entered our language to describe a sudden change in levels of activity or understanding.

For example, we could say that we hope this booklet will be a quantum leap in understanding for you. We'll soon be looking at some very peculiar ideas. If it gets a bit bewildering, don't worry. You're in good company. One of the pioneers of quantum mechanics, physicist Niels Bohr, said, "Anyone who is not shocked by quantum theory has not understood it."

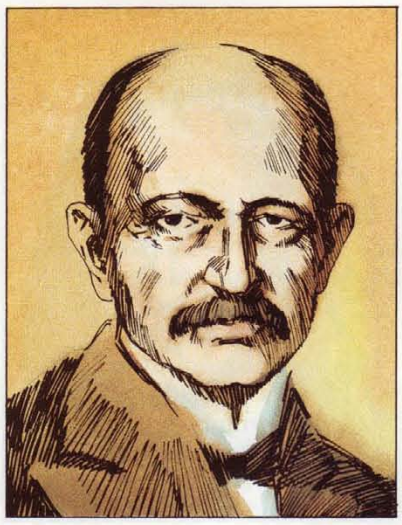
Understandable or not, quantum theory opened the door to the equally bewildering theory of relativity.

EINSTEIN'S LIGHT FANTASTIC

About the time that Planck was advancing quantum theory, a shy young man named Albert Einstein was employed as an examiner at the Swiss patent office in Bern. His job as a patent examiner allowed him much free time, which he spent in scientific investigation.

In 1905, Einstein published a paper on the nature of light. Until the 19th century, light had been thought of as a wave that traveled through "ether," a mysterious substance that flooded the universe, like the water of a cosmic ocean. But experiments in the 19th century had failed to detect this ether. So, reasoned Einstein, if there was no ether, light could not be a wave, because there was nothing for it to "wave" through.

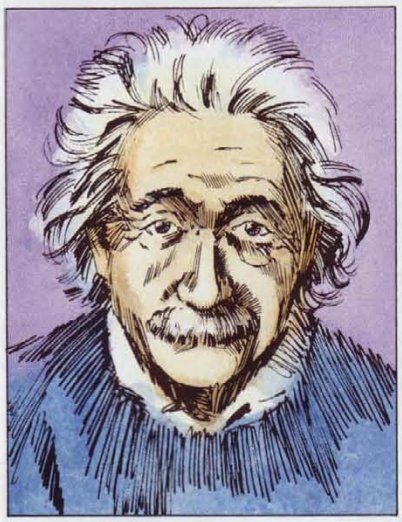
Given what Max Planck had suggested—that light traveled through space in little packets—Einstein thought light must be made of particles, which were later called "photons." He discovered, however, that in some instances, light also behaved like a wave. Light was both a wave and a particle—a "wavicle." Between them, Max Planck and Albert Einstein had opened a window on the extraordinary world of relativity and quantum mechanics.



MAX PLANCK
(1858-1947)

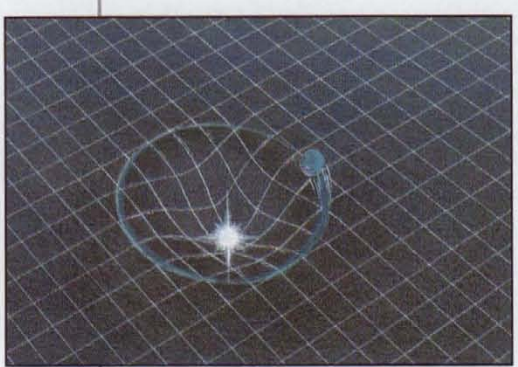
In 1905, Einstein also published a paper describing his special theory of relativity, which gave a theoretical understanding of a whole host of strange effects in nature that occurred near the speed of light. Newton's laws had shown that factors governing the speed, direction and mass of an object were constant and thus predictable. For example, if you knew an object's present location, its speed and direction, you could know for certain exactly where it would be at any given time in the future.

Einstein's special theory of relativity suggested that the very factors Newton had shown to be constant, were in fact *relative.* At very high speeds, mass would increase, time slow down and



ALBERT EINSTEIN
(1879-1955)

According to Einstein's general theory of relativity, matter warps—or curves—"space-time," causing what we experience as gravity. Diagram at right shows planet following a curved path in space-time caused by a depression made by a star's great mass.



objects actually shorten in the direction of motion.

The only fundamental constant with respect to an observer was the speed of light, always approximately 186,000 miles (300,000 kilometers) a second.

Einstein's general theory of relativity, published in 1916, proposed an even stranger idea. The characteristics of space and time were influenced by the presence of matter. Einstein suggested that the universe was in fact four-dimensional, with time being the fourth dimension. He visualized a universe as an expanse of four-dimensional "space-time," a concept that even some physicists still find difficult to grasp.

According to Einstein, matter caused depressions in space-time (think of a bowling ball resting on a mattress). The heavenly bodies followed the shortest distance along the curves of these depressions. The earth's orbit, for example, followed a curved path in space (or rather *space-time*) caused by a depression made by the great mass of the sun.

This *is* difficult to comprehend, isn't it? It gets even stranger, as we'll see.

BENT SPACE AND THE BIG BANG

Einstein explained that gravity should not be thought of so much as a force that acts on solid bodies, but as the very "fabric" of space-time. It could warp space, slow down time and even bend light.

This was very different from the rather neighborly, predictable cosmos of Isaac Newton. For those who understood the implications of Einstein's theories, the universe once more became a rather unsettling place.

The complex mathematics of the theories of relativity indicated that the universe was expanding. In 1916, there was no evidence to support this, and Einstein, in what he later said was the biggest mistake of his life, altered the equations to fit the accepted idea of a static universe.

Almost at the same time, the astronomer Vesto Slipher concluded from his observations that about a dozen galaxies were moving away from the earth at speeds up to about 2 million miles (3 million kilometers) an hour. In 1929, further observations by the astronomer Edwin Hubble verified Slipher's conclusions. Far from being a constant size, the universe was expanding by many millions of miles every day. Einstein's extraordinary ideas seemed plausible.

This raised an obvious question. If the universe was expanding, there must have been a time when everything in it was much closer together. This led modern physicists to a theory of the origin of the universe popularly known as the "big bang." It proposed that there was a time when *everything* in the universe was compressed into a single, infinitely dense point. Scientists estimate that sometime between 10 to 20 billion years ago, this incredibly dense mass "exploded" and began expanding at a tremendous rate.

Although this theory is still controversial, many scientists believe it offers an explanation of the origin of the universe.

According to the big bang theory, all that we know and see—all matter, all space, even time itself—was created at that moment. The characteristics that decided the nature of the universe were established. Obviously, nobody (nobody physical, at least) was around to know what was happening at the time, but radio telescopes have detected background radiation

BIG BANG THEORY

Time		Temperature
10^{-43} sec.	Universe is about the size of a dust grain; the fundamental forces initially exist as one "superforce," but gravity quickly separates out.	10^{31} Kelvin*
10^{-35}	Universe rapidly "inflates," doubling in size every 10^{-35} second; strong force separates out from the still-unified electromagnetic and weak forces; quarks, the building blocks of matter, now appear.	10^{27} K
10^{-11}	Electromagnetic and weak forces are now separate; laws of nature observed today have emerged.	10^{15} K
10^{-6}	Universe is a "soup" of elementary particles and quarks, which begin to bind together to form protons and neutrons.	10^{12} K
3 min.	Protons and neutrons combine to form simple atomic nuclei of hydrogen, helium and lithium; it is still too hot for atoms to form.	10^{9} K
10^{3} years	Electrons settle into orbit around atomic nuclei, forming the first hydrogen and then helium atoms.	10^{5} K
	[Zone of Uncertainty]	
10^{9}	Formation of earliest stars and galaxies; our own sun and solar system emerge several billion years later.	10 K
NOW	Universe continues to expand, with the most-distant galaxies traveling at close to the speed of light.	3 K

*273.16 K = 0 C = 32 F

THE FUNDAMENTAL FORCES

GRAVITY

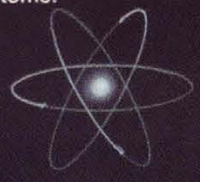
Gravity is the weakest of the four forces. It is so weak that if it were not for the fact it can act over long distances and is always an attractive force, we'd never notice it. Every particle in the universe feels the force of gravity.

ELECTRO-MAGNETIC FORCE

The second strongest of the four forces, it is the union of electricity and magnetism. This force interacts only with charged particles like electrons and quarks, and is much stronger than gravity.

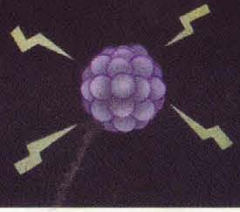
STRONG FORCE

The strongest of the four forces, with the shortest range of all. It holds the quarks together in the protons and neutrons, and holds protons and neutrons together to form the nuclei of atoms.



WEAK FORCE

The second weakest of the four forces, it has a very short range. The weak force affects all matter particles, but not force-carrying particles. It is responsible for radioactive decay in nature.



> "What the Universe was like at day minus one, before the big bang, one has no idea. The equations refuse to tell us, I refuse to speculate."
>
> JAMES PEEBLES, PHYSICIST

"noise" that comes from all directions in the sky and is unrelated to any earthbound or individual celestial source. Scientists think it may be a faint echo of the big bang.

One of the more challenging adventures physicists have undertaken in recent years has been to theorize what the universe was like in the first dynamic moments after the so-called big bang.

Matter would not have existed as it does now. Even individual atoms would not have yet formed. The four fundamental forces that scientists believe govern the behavior of matter—gravity, the electromagnetic force, a strong nuclear force that binds the nucleus of the atom, and a weak nuclear force that controls radioactive decay in nature—theoretically existed only as one "superforce."

Scientists today are hoping to be able to recombine these forces into a grand unified theory. A single theory has been developed for the electromagnetic, strong and weak nuclear forces, but gravity remains the odd man out. So far, scientists have been unable to "fit" it into a unified theory.

Nevertheless, it is one of the outstanding achievements of scientists today to have pushed back the frontiers of understanding and built a picture of what the universe was like 10^{-43} second after an event that scientists believe was creation. To give an idea of how short that is, *a thousandth* of a second, the limit of accuracy of most stop watches, is expressed as 10^{-3}.

Physicists are still probing, but it seems that at about 10^{-43} second, calculations and formulas break down. Some doubt that it will ever be known what happened before this time because of the limits of man's ability to theorize via experimentation. But to push past that barrier is one of the great challenges of physics today.

> "It is difficult to imagine that a handful of residents of a small planet circling an insignificant star in a small galaxy have as their aim a complete understanding of the entire universe, a small speck of creation truly believing it is capable of comprehending the whole."
>
> MURRAY GELL-MANN, PHYSICIST

THE WONDERFUL WORLD OF QUARKS

Relativity is by no means the strangest idea to come from the new understanding of physics. Even more peculiar are the theories that offer a new way of thinking about what things are made of.

We have come a long way from Aristotle's assumption that the world is made up of earth, fire, water and air. By the 19th century, scientists had learned that the everyday world was made up of combinations of 92 basic elements. Then they discovered that the elements were made up of atoms.

At the beginning of this century, the internal structure of the atom began to be understood. There was a nucleus, surrounded by electrons. Originally, electrons were thought to orbit the nucleus rather like planets in a miniature solar system. That view has been modified. The electron is now understood to be more of an energy field cloud fluctuating around a solid nucleus, or rather, a not-so-solid nucleus.

The nucleus itself seemed to be composed of two smaller constituents—protons and neutrons. But were protons and neutrons the end of the trail? Or were there still finer levels of smallness?

In 1964, physicists Murray Gell-Mann and George Zweig showed evidence, later confirmed by experiments involving particle accelerators, that protons and neutrons were indeed made up of even more elementary particles, which Gell-Mann called "quarks."

If Einstein's view of the universe seemed strange, it was even stranger to look into the miniature world of quarks. Again, "look" is not the right word. You can't see quarks, and not just because they are too small. They also do not seem to be quite "all there." They may prove to be the fundamental

PARTICLE ACCELERATORS

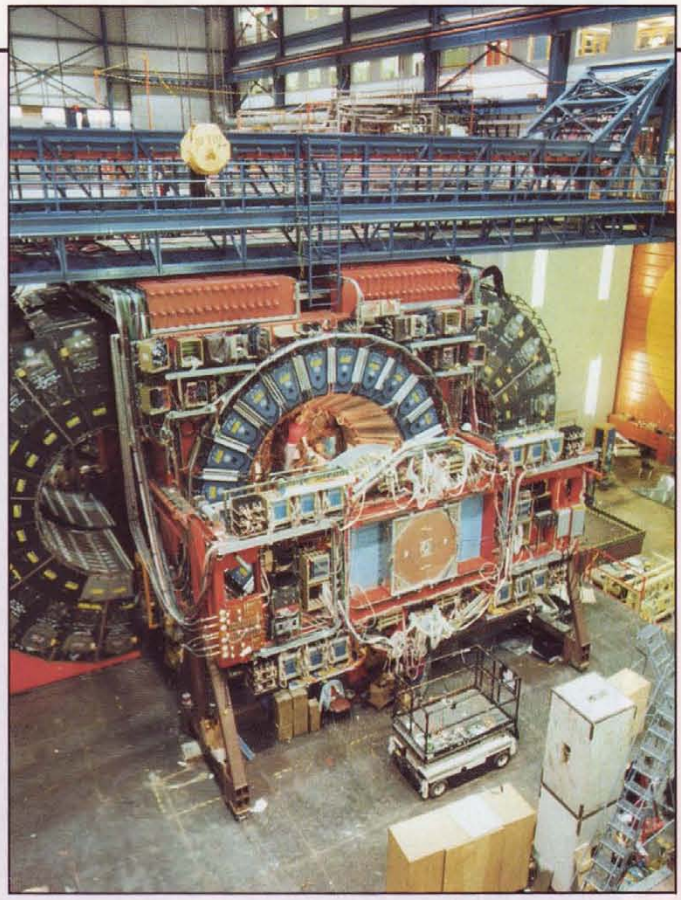
To investigate the smallest things in the universe, scientists need the largest scientific instruments ever built—particle accelerators, popularly known as atom smashers.

The most powerful of these devices accelerate beams of positively and negatively charged particles in opposite directions along a tunnel of electromagnets. As they approach the speed of light, the particle beams are diverted to collide head on. The collision produces tremendous energy, some of which is converted into new, short-lived particles of matter. (Einstein's famous equation, $E = mc^2$, shows that mass and energy are interchangeable.)

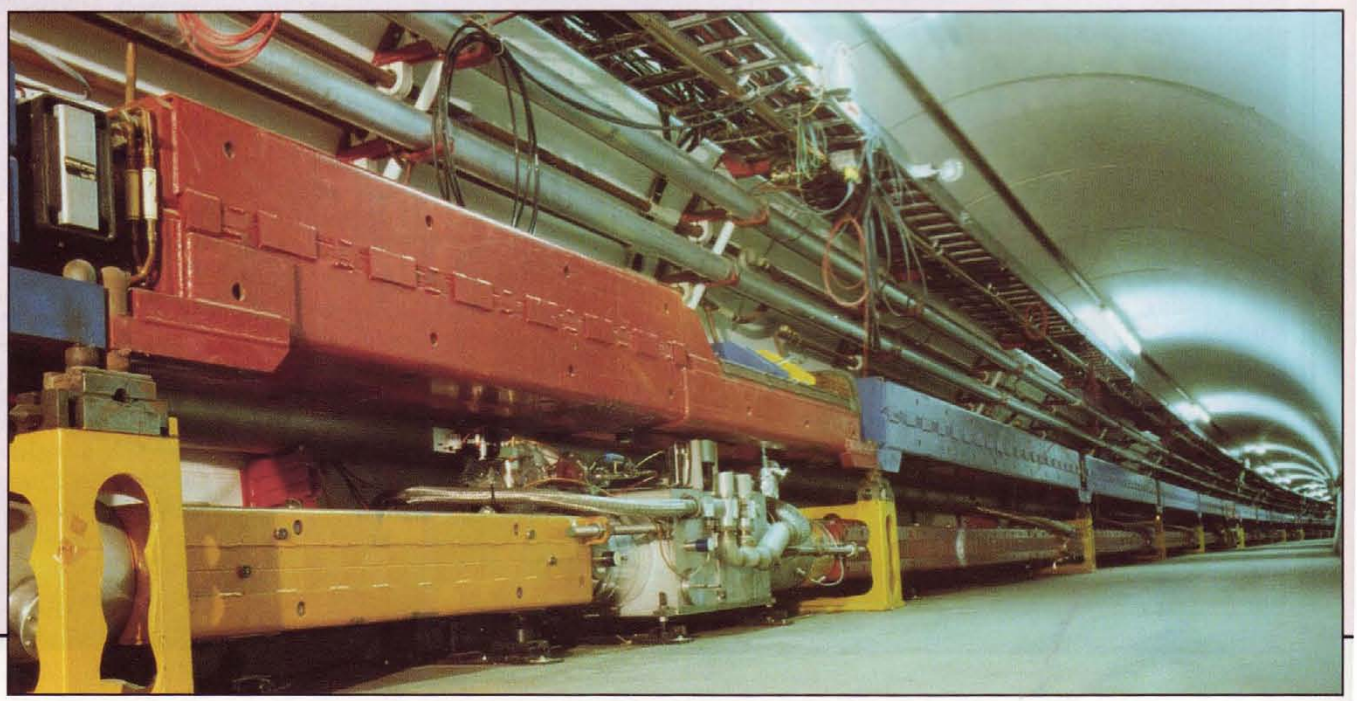
By studying the behavior of these particles, some of which last for less than a trillionth of a trillionth of a second, scientists are able to increase their understanding of the basic structure of matter.

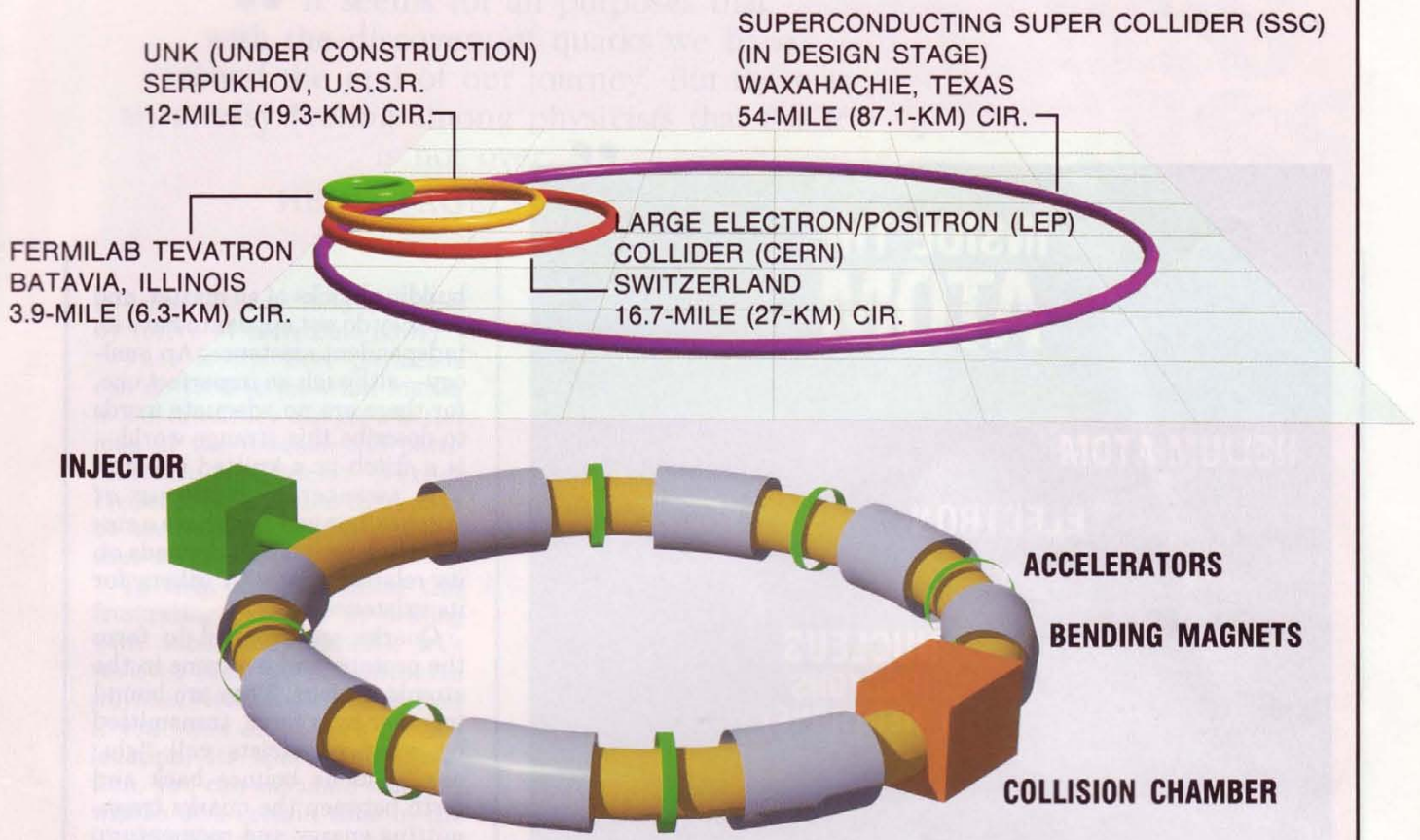
Using particle accelerators, scientists hope to simulate the conditions extant in the first moments of the universe's existence. To produce such high levels of energy, the particle beams must be accelerated to as close to the speed of light as possible. Higher collision energies generally mean bigger accelerators.

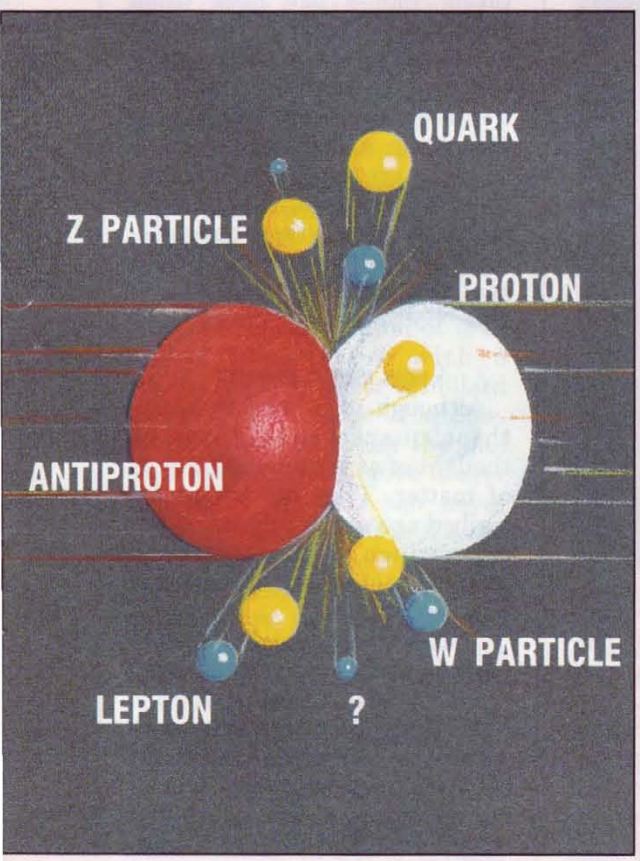
The largest accelerator in existence today, near Geneva, Switzerland, is 16.7 miles (27 kilometers) in circumference. The Superconducting Super Collider (SSC), to be built in Texas, will be 54 miles (87.1 kilometers) in circumference. The SSC will project beams to energies 20 times higher than has so far been possible, enabling physicists to probe ever deeper into the heart of the atom.

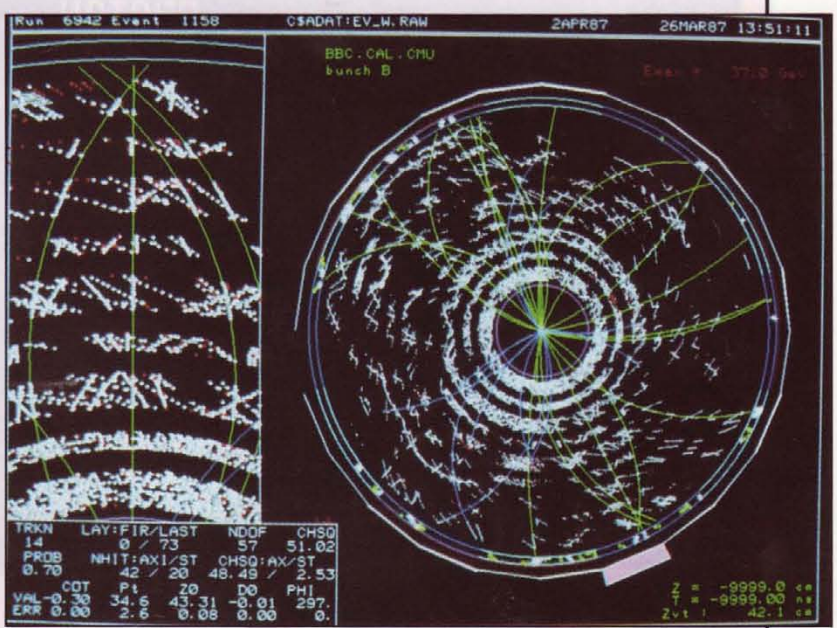


Sophisticated detectors, such as the collider detector (top) at the Fermilab Tevatron accelerator near Chicago, are used to record results of subatomic particle collisions. When in use, the detector is rolled to the right beyond a shielding door where it becomes part of the accelerator beam line. Fermilab's main accelerator tunnel (below) is 3.9 miles (6.3 km) in circumference. Yellow and red components are superconducting magnets that keep the particles on course.

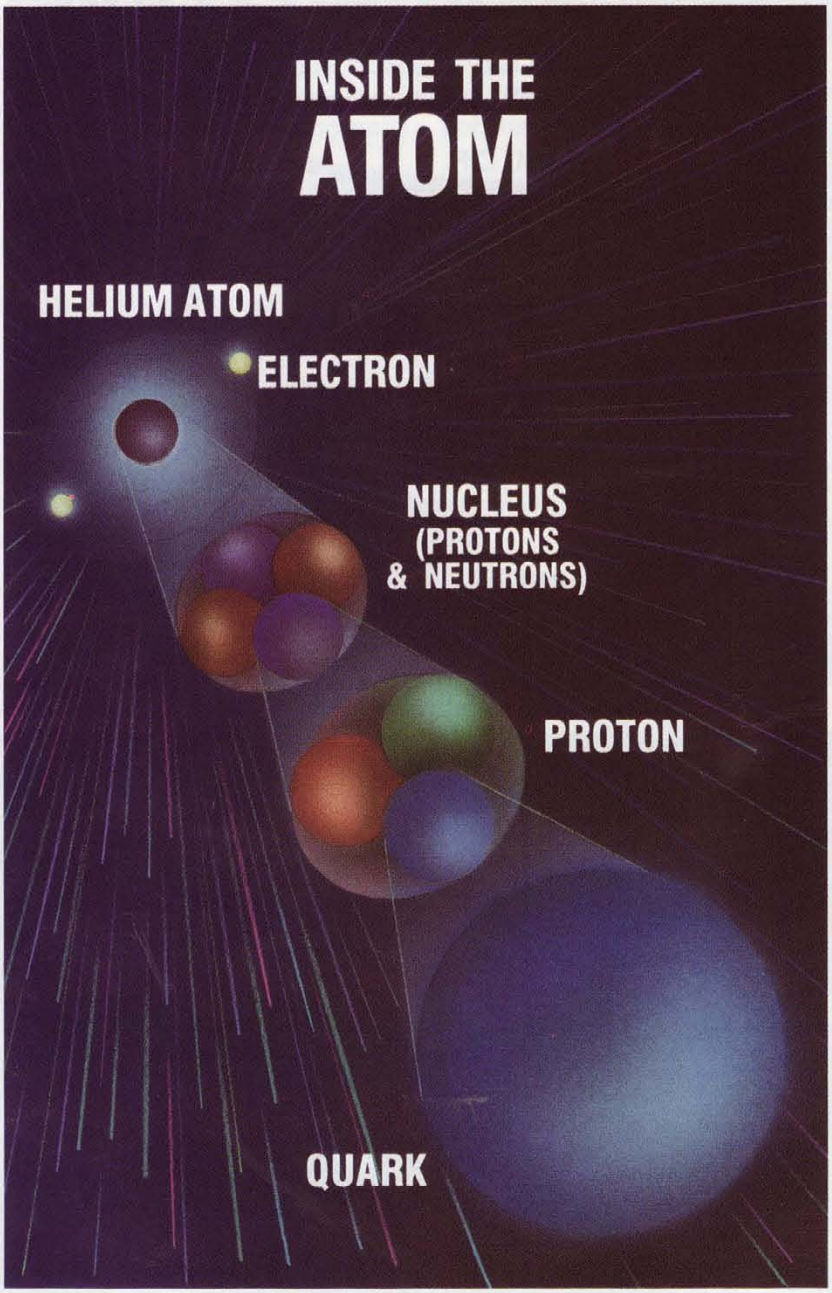








Top diagram shows relative sizes of largest particle accelerators now running, under construction or planned. Simplified diagram (center) shows an accelerator and its key components. The violent collision of subatomic particles produces tremendous energy, some of which is converted into new, short-lived particles of matter (left). These particles leave characteristic tracks that can be viewed on a computer screen (above).



Until about a hundred years ago, the atom was thought to be the smallest unit of matter. Since then, scientists have discovered that atoms consist of a number of tinier, subatomic particles. As shown in the above diagram of the helium atom, protons and neutrons are clustered within the atom's central region, or nucleus. Swirling around the nucleus is a third subatomic particle, the electron. Each proton and neutron in the nucleus is made up of three tinier particles called quarks, which scientists now believe to be the smallest units of matter. Are quarks the ultimate building blocks of matter? Only time will tell!

building blocks of all matter, and yet they do not appear to have an independent existence. An analogy—although an imperfect one, for there are no adequate words to describe this strange world—is a stitch in a knitted sweater. The sweater is made up of stitches, but you can't have a single stitch by itself. It depends on its relationship with others for its existence.

Quarks are grouped to form the protons and neutrons in the atomic nucleus. They are bound together by a force, transmitted by what physicists call "gluons." Gluons bounce back and forth between the quarks transmitting energy and momentum, rather like a ball does when children play catch with it. But once again, no analogy really conveys the wonder of this weird dance of the quarks as they jump and gyrate together to make up the nucleus. Scientists have given the various types of quarks they have discovered such whimsical names as "charm," "strange," "top" and "bottom."

HOW REAL IS REALITY?

Although it is hard to grasp, these quarks should not be thought of as the smallest pieces of matter. They are better described as swirls of dynamic energy, which means that solid matter is not, at its fundamental level, solid at all.

This booklet, which seems so solid, is really a quivering, shimmering, lacy lattice of energy, pulsating millions of times every second as billions of fundamental particles gyrate and spin in an eternal dance. At its most fundamental level, this booklet is ener-

> "It seems for all purposes that with the discovery of quarks we have reached the end of our journey. But there is an uneasy feeling among physicists that the trip is not over."
>
> HEINZ PAGELS, PHYSICIST

gy—just energy held together by forces of incredible power.

That is the best physicists can do to describe what matter is like until they can get a better look at the fundamental particles. But physicist Werner Heisenberg indicated there may be an insurmountable problem that will prevent this.

To help us understand this frustrating problem in dealing with subatomic particles, let's review a basic law of Newtonian physics. Newton showed us that if you know an object's present location, its speed and direction, you can calculate where it will be at a certain time in the future. For example, you can know where a car traveling at a constant speed down a straight highway will be in, say, half an hour. But at the subatomic level, things aren't so simple.

Heisenberg's theories led him to the conclusion that we can know either where a particle is *or* how fast it is traveling. But we cannot know both. The very act of measuring the particle alters its behavior. Think of it as trying to measure with a wooden ruler how far a billiard ball is from the edge of a table. As soon as you touch the ball with the ruler, you move it ever so slightly. So you can never know its exact distance. It's the same with particles.

Measuring the particle's speed alters its position, and measuring its position alters its speed. You can have one or the other, but not both. The best you can have are probabilities.

IS NOTHING CERTAIN?

Fortunately, none of this alters anything in our everyday, predictable world. When we fly, or drive, or turn on the radio, everything works according to the basic laws of classical Newtonian physics. Up is still up, and down is still down. Newton's laws of physics even work well for most of the things we want to do in space. His formulas enable us to calculate accurately the speed and direction of a spaceship in orbit. They proved a reliable way to calculate a path to the moon and back.

In the everyday world, nature behaves normally. But as we go farther out, or deeper in, nature's laws seem less precise and less predictable. As we probe deeper and deeper into nature, we seem to enter a hazy, will-o-the-wisp, never-never land where nothing is solid or certain. It is a region where the five senses can't go, and where the mind can only wander briefly, and quickly get lost.

> "In a certain sense . . . you won't really understand quantum mechanics deeply unless you also understand the nature of mind."
>
> FREEMAN DYSON, PHYSICIST

Is it the end of the road? Are quarks the ultimate? Or are there yet smaller, even more basic building blocks to the material universe? Are there still other basic forces? If scientists do succeed in unifying the four basic forces into a grand unified theory, will it be the final triumph of theoretical science? Or the beginning of a new chapter?

How many dimensions are there? Most of us have enough difficulty trying to imagine four, but some physicists are seriously speculating that there may be as many as 10 or more.

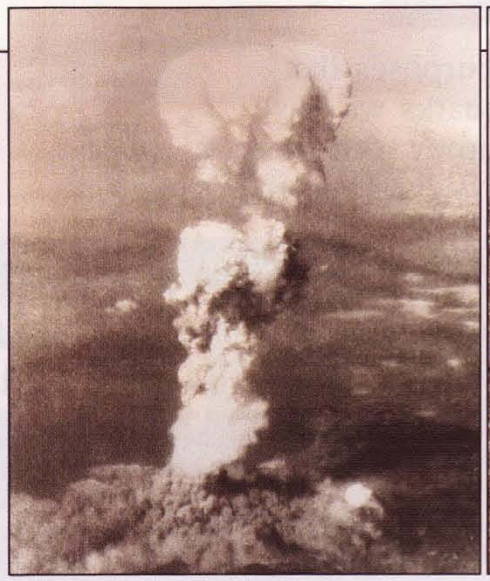
The world, as we are beginning to understand it today, seems more tantalizing yet more difficult to understand and more obscure than we had ever dreamed.

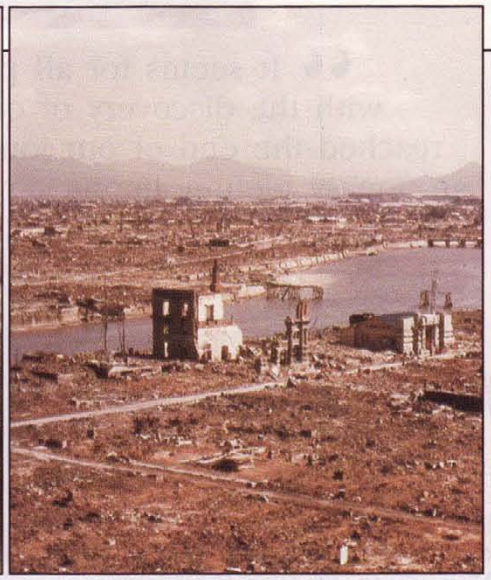
Isaac Newton, reflecting on his astonishing voyages of discovery, said: "I do not know what I may appear to the world, but to myself I seem to have been only a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me."

We have pushed the frontiers of knowledge back further and further, only to learn that we may be still only on the edge.

According to physicist John Bell, "Somehow we have come to the end of the human capacity to form sharp pictures of what is going on."

On August 6, 1945, a single atomic bomb was dropped on Hiroshima, Japan, devastating most of the city (far right). Photo of mushroom cloud (right) was taken several minutes after bomb was detonated.





THE POWER OF THE ATOM

Einstein's theories shattered some time-honored assumptions about the nature of matter. He showed that mass and energy are interrelated. Like ice and steam, they are different forms of the same thing and in certain circumstances are interchangeable.

Scientists had known that matter could produce energy as a result of a chemical reaction. For example, if you were to set this booklet on fire (please don't) it would produce heat, light and some sound. But this chemical process would only release a small percentage of this booklet's total energy potential. If the reaction were to take place at the subatomic level, the amount of energy released would be enormous.

To accomplish this, the actual mass of the atoms that make up the elements of the paper would need to become "unfrozen" and turned into energy. The energy could then be calculated by the famous equation $E = mc^2$ (where m is mass and c^2 is the speed of light squared).

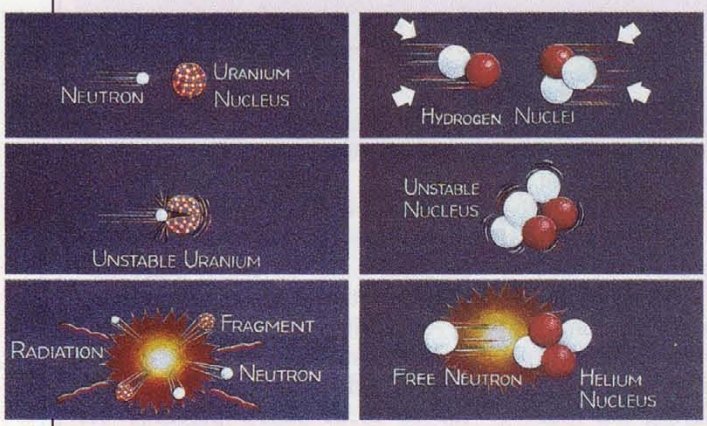
If all the energy compacted in this 2½-ounce (71-gram) booklet could be released (it can't by any means now known to science), it would supply enough energy to run a city the size of San Diego, California, for 99 days. As you can see, the energy potential of what you are holding in your hands is enormous!

We had a dramatic demonstration of the power locked in the heart of the atom on August 6, 1945. About 22 pounds (10 kilograms) of uranium were used in the atomic bomb that exploded over Hiroshima. Of that, it has been estimated that only a fraction of the mass of the uranium (about the size of a pea) was converted into energy.

Mankind had learned how to unleash the awesome power of the atom.

It is the awesome power of nuclear energy that fuels the stars. The massive reactions that take place deep within our sun convert about 4 million *tons* (3.6 million metric *tons*) of the sun's mass into energy every second. The sun is just one medium-sized star in our galaxy of some 100 billion other stars. Our galaxy is just one of an estimated 100 billion other galaxies, each having perhaps 100 billion stars. And, on average, each is converting matter into energy at the rate of millions of tons every second. Remember, it took just a pea-sized fraction of uranium in an atomic bomb to destroy Hiroshima.

Just how much power is out there?



Nuclear fission and nuclear fusion are two kinds of nuclear reactions that release tremendous amounts of energy. Nuclear fission involves the splitting of a heavy element, such as uranium, to release energy (far left). Nuclear fusion occurs when two lightweight nuclei combine and form a nucleus of a heavier element (left). Repeated many times, fusion creates the energy of the sun and the hydrogen bomb.

CHAPTER FOUR

IN THE SHADOWS OF PROGRESS

So where are we? Science is now probing at levels in nature where phenomena seem to blur and dissolve into ephemeral wisps of energy. The quest for "reality" has led us into regions that seem decidedly surreal.

If, as John Bell said, we are coming to the end of our human capacity to really grasp what we are learning, will we find ourselves once again groping in the dark? Or are the astounding discoveries of the last few decades pointing us in another direction? That is what we will discuss in the remaining chapters of this booklet.

> "[Science] cannot explain the existence of each of us as a unique self, nor can it answer such fundamental questions as: Who am I? Why am I here? How did I come to be at a certain place and time? What happens after death? These are all mysteries that are beyond science."
>
> JOHN ECCLES, NEUROSCIENTIST

If the tools and methodology of physical science are reaching their limits of discovery, *yet revealing there is still more to uncover,* does this mean that there is an aspect of creation we will never comprehend? If matter, at its fundamental level, is a field of energy, could there be further levels of creation that *are not physical at all?* This is a possibility that must be considered.

In their quest to define the natural world, scientists are suspicious of theories that lean toward complexity. Their experience and intuition tell them that there must be an underlying simplicity and order. As physicist John A. Wheeler wrote: "To my mind, there must be at the bottom of it all . . . an utterly simple idea. And to me, that idea, when we finally discover it, will be so compelling, so inevitable, so beautiful, that we will all say to each other, 'Oh, how could it have been otherwise?' "

Scientific evidence indicates that the universe functions in a systematic and orderly manner. The implication is that it is not the product of blind chance—but of design—intelligent design.

Surely, an intelligent design presupposes an intelligent designer. An intelligent designer designs with purpose, and if there is indeed a purpose to the creation, it must have a meaning.

If there is meaning, should there not be some way to find out what it is?

As Paul Davies wrote in his book *Superforce:* "If physics is the product of design, the universe must have a purpose, and the evidence of modern physics suggests strongly to me that the purpose includes us" (page 243).

Physicist Stephen W. Hawking, in his best-selling book *A Brief History of Time,* concluded: "If we do discover a complete theory [that explains all the phenomena in the universe], it should in time be understandable in broad principle by everyone, not just a few scientists. Then we shall all, philosophers, scientists, and just ordinary people, be able to take part in the discussion of the question of why it is that we and the universe exist. If we find the answer to that, it would be the ultimate triumph of human reason—for then we would know the mind of God" (page 175).

These are not the kind of statements that we are used to hearing from pragmatic men of science. But then, they themselves did not expect to be confronted with this situation. Their discoveries have taken an unexpected turn, and cast them upon an unfamiliar shore. They set out to discover the what, where, how and when of the universe, but have arrived at the point where they must confront the question of WHY. But is it not the traditional role of the philosopher and theologian to question life's purpose and meaning?

WHAT PHILOSOPHERS AND THEOLOGIANS OUGHT TO KNOW

Unfortunately, at a time when learning is increasing in

> "It is hard to resist the impression that the present structure of the universe . . . has been rather carefully thought out."
>
> PAUL DAVIES, PHYSICIST

nearly every field, philosophers and theologians have not kept pace. Stephen Hawking summed it up well: "Up to now, most scientists have been too occupied with the development of new theories that describe *what* the universe is to ask the question *why*. On the other hand, the people whose business it is to ask *why*, the philosophers, have not been able to keep up with the advance of scientific theories" (page 174).

It is surely a sad commentary that, after nearly 2,000 years of Christianity and some 3,500 years of biblical tradition, philosophers and theologians still cannot agree on even the most basic explanations of who and what God is, and his purpose for creating man. In the midst of the modern explosion in knowledge, these questions go unanswered, while those whose business it is to know have lost their bearings and got themselves into a muddle.

Meanwhile, scientific advances and technological breakthroughs have shaped the modern world. There is no question that scientists have proven superbly competent in what they have set out to do.

As we come to the end of the 20th century, we've developed marvelous new technologies, built incredible machines, spliced genes and split atoms. We almost routinely escape the bonds of earth's gravity. And yet a great paradox dogs the footsteps of our progress. In spite of great technological advancements on nearly every front, the world is becoming a more unstable, insecure and dangerous place to live in. The improvement in technology has not been accompanied by an improvement in human character.

Why?

> "There are problems to whose solution I would attach infinitely greater importance than to those of mathematics, for example touching ethics, or our relation to God, or concerning our destiny and our future; but their solution lies wholly beyond us and completely outside the province of science."
>
> KARL GAUSS, MATHEMATICIAN

WHAT SCIENTISTS CANNOT DISCOVER

Natural scientists readily admit that questions of morality and ethics, understanding a purpose for life and laying down the laws by which society should be organized lie outside their expertise.

There are, however, branches of science that do try to address these problems. They are known as the social or behavioral sciences. If social and behavioral scientists had been as successful as the natural scientists, the world might indeed be a happier place. That they have not can be at least partly explained by a major mistake that arose out of the scientific revolution of the last 200 years.

Filled with confidence over spectacular advances in the natural sciences, mankind began to assume that *every* problem could be analyzed and resolved scientifically. Thus, subjects that had never before been thought of as scientific became recognized disciplines of science. Researchers in the behavioral sciences approached subjects as if they were an extension of the natural sciences. This was perhaps understandable since natural scientists, armed with natural laws and the scientific method, were solving problems and inventing new technologies at an ever-increasing pace. So why shouldn't the methods that were working so well for the physicist, chemist and engineer also work for the sociologist, psychologist and political scientist?

Surely, it was just a question of researching the laws that govern human relationships, emotions, morality and ethics using the same techniques that had proven so successful in furthering understanding in the natural sciences. If the intricate relationships between motion and acceleration could be organized along scientific principles, could not also the complexities of organizing a society?

Today, scientists in many disciplines are realizing the limitations of this approach. According to biologist Adolph Portman, "No amount of research along physical or chemical lines can ever give us a full picture of psychological, spiritual, or intellectual processes."

Sir John Eccles, Nobel Prize winner and neuroscientist, said science "cannot explain the existence of each of us as a unique self, nor can it answer such fundamental questions as: Who am I? Why am I here? How did I come to be at a certain place and time? What happens after death? These are all mysteries that are beyond science." Another Nobel Prize winner, physicist Richard Feynman, wrote: "If you expected science to give all the answers to the wonderful questions about what we are, where we are going, what the meaning of the universe is, and so on, then I think you could easily become disillusioned."

> "The scientific picture of the real world around me is very deficient. It gives a lot of factual information, puts all our experience in a magnificently consistent order, but it is ghastly silent about all and sundry that is really near to our heart, that really matters to us."
>
> ERWIN SCHRÖDINGER, PHYSICIST

A WORLD BEYOND THE PHYSICAL?

Not everything that shapes and moves the world can be explained in terms of *physical* phenomena. There are *other* forces at work that decide what kind of a place the world will be.

These forces cannot be measured with instruments, expressed with formulas or controlled by technology. They are emotional forces like love, compassion, courage, loyalty and joy—what we think of as the components of human nature—the way we express ourselves. If these were the only ways we humans expressed ourselves, all would be well. But these positive forces have their counterparts—hate, cruelty, fear, revenge, anger, jealousy and pride.

Much of what has so drastically, perhaps catastrophically, altered the face of the earth in this century has been carved out, not in a spirit of progress, but in the spirit of greed, in the spirit of competition and in the spirit of oppression and envy.

Technological breakthroughs are not able to prevent these problems. Often they compound them. Whereas once an angry man could shoot an arrow a few hundred yards and kill one of his enemies, today he can press a button and hurl a nuclear missile to the other side of the earth and destroy a city.

We know that *invisible* forces tug, pull, push or grip every physical object on earth and in space. Why is it so hard to accept that there could be additional forces, just as real, that influence our moods and emotions?

We know what to expect when we disregard laws that govern the physical world. Planes crash, buildings fall and bridges collapse.

Is it so difficult to accept that when families break up, peace negotiations fail, and nations try to destroy each other, there are also laws that are being broken? And that these are *spiritual* laws? The forces that cause emotion, tempers, attitudes and frames of mind may be hard to measure and define, but they *are* real.

Thousands of years of trial and error have shown that any branch of knowledge cannot really progress until the laws that govern it are understood. Whereas physical forces have been quantified by science and harnessed by technology, the forces inherent in human nature have proven not to be so straightforward.

This is because these forces cannot be studied by the same methods that have helped us understand the natural world. They are outside the realm of observation and experimentation.

Thus a full understanding of these forces can never come

from natural science. Such knowledge must be revealed by another source.

The Bible is that source. In this Book, the Creator God has revealed information we could not discover if left to our own resources. God knew that with our own ingenuity we'd be able to discover the laws that govern the physical world, but not the spiritual laws that govern our minds and emotions. Since we are not able to understand these spiritual laws on our own, *God has had to reveal them.* When we reject revealed knowledge, we cut ourselves off from the only hope of solving our most urgent social, moral and spiritual problems.

> "To my mind, there must be at the bottom of it all . . . an utterly simple idea. And to me, that idea, when we finally discover it, will be so compelling, so inevitable, so beautiful, that we will all say to each other, 'Oh, how could it have been otherwise?'"
>
> JOHN A. WHEELER, PHYSICIST

Somewhere, sometime, somehow, mankind must face the fact that if we are to continue to go forward, we must understand how to solve not only the physical, but the *spiritual* problems that block our path.

German philosopher Arthur Schopenhauer (1788-1860) once said, "There are three steps in the revelation of any truth: in the first, it is ridiculed; in the second, resisted; in the third, it is considered self-evident."

Could it be time to look at the revealed truth of the Bible again, not with the dim light of a medieval monastery, but in the brilliant glow of modern discovery?

A NEW LOOK AT THE BOOK

The Bible is not a science text, but it is not anti-science. It tells us plainly that there are valuable lessons to be learned by observing the physical creation.

"The heavens declare the glory of God," David wrote in the 19th Psalm, "and the firmament shows His handiwork. Day unto day utters speech, and night unto night reveals knowledge" (Psalm 19:1-2).

Many centuries later, the apostle Paul wrote in the epistle to the Romans: "For since the creation of the world His [God's] invisible attributes are clearly seen, being understood by the things that are made, even His eternal power and Godhead" (Romans 1:20).

The physical creation tells us *something* about other things we cannot know, or at least fully appreciate, with our physical senses. We experience this when our emotions are stirred by a magnificent sunset, a thunderstorm or the miracle of birth. The workings of the natural world reflect power, harmony, precision, tenderness, compassion, love and the unexpected. It is as if God gave us an environment in which, the more we understand, the more we can know about him.

In which case, the fascinating details of the creation beginning to be revealed by modern physics should be a treasure house of insight. Although we may not yet fully understand the intricacy, harmony and beauty of our natural world or the power and unfathomable immensity of the universe, should not what we have discovered lead us to a greater appreciation of the "eternal power and Godhead" of the one who created it?

Should it not motivate us to look, carefully and humbly, at what he has to tell us in the Bible? Is it not time to once again acknowledge the truth of the admonition in Psalm 111:10, "The fear of the Lord is the beginning of wisdom"? If we did, then we would begin to understand how to truly live in harmony with not only physical, but spiritual law. We would then discover the way to coexist in peace and cooperation, and to build a world where war, poverty, hunger and injustice are finally conquered.

And most significantly, we would find the answer to the ultimate question—what is it all for? Why do we exist? What *is* the meaning of life? It *is* revealed in the pages of the Bible.

CHAPTER FIVE

AT THE EDGE OF ETERNITY

A technologically advanced age needs an explanation for life that is intellectually satisfying, understandable, plausible and logical, yet also motivating and uplifting. Whatever the purpose of existence is, it must make sense *now.*

We are the only species that has ambition to be more than what we presently are. We have traveled to every corner of the earth. We have even poked our heads cautiously into space. We have walked on the moon and now a manned mission to Mars is in our plans. We dream of one day building colonies in space, and speculate about journeying beyond the solar system to the stars and galaxies. The *Voyager 2* spacecraft, after sending back pictures of the distant planets, is now soaring out to the edge of the solar system and beyond. *Voyager* has been a brilliant feat of technology, but it has also been a sobering reminder of our mortality.

Logically, we accept this—but emotionally we cannot. Mankind seems to be inherently dissatisfied with mere mortality, and the confines of our terrestrial domain. It is as if, somehow, somewhere, deep in our consciousness we know that there is more to existence than this mortal life. It is as Solomon wrote in Ecclesiastes 3:11: "He [God] has put eternity in their hearts."

IN GOD'S LIKENESS

The book of Genesis tells us that God made us after his own likeness and in his own image (Genesis 1:26-27). All other living creatures were made "each according to its kind" (verse 24). Only humans were made in the form and likeness of God, except that each human being has a physical frame. From the beginning, the Bible shows that we have a special relationship with our Creator.

A logical question to ask next is: *If* we are made after the "God-kind," what kind of being is God?

In Genesis 1:26, the Bible uses a plural pronoun "Us," which accurately reflects the intent of the Hebrew word *Elohim* used in this verse to describe "God." In this verse "God" says, "Let *Us* make man in *Our* image." Who are these Beings who refer to themselves as "Us"?

Spectacular view of Saturn, framed by four of its moons. Photos comprising this composite image were taken by the Voyager *spacecraft.*

John, one of Jesus' original disciples, explains: "In the beginning was the Word, and the Word was with God, and the Word was God. He was in the beginning with God. All things were made through Him, and without Him nothing was made that was made" (John 1:1-3).

This is straightforward enough. There was "the Word" who *was* God, who also was *with* God. John then goes on to further explain the relationship. "And the Word became flesh and dwelt among us, and we beheld His glory, the glory as of the only begotten of the Father, full of grace and truth" (verse 14).

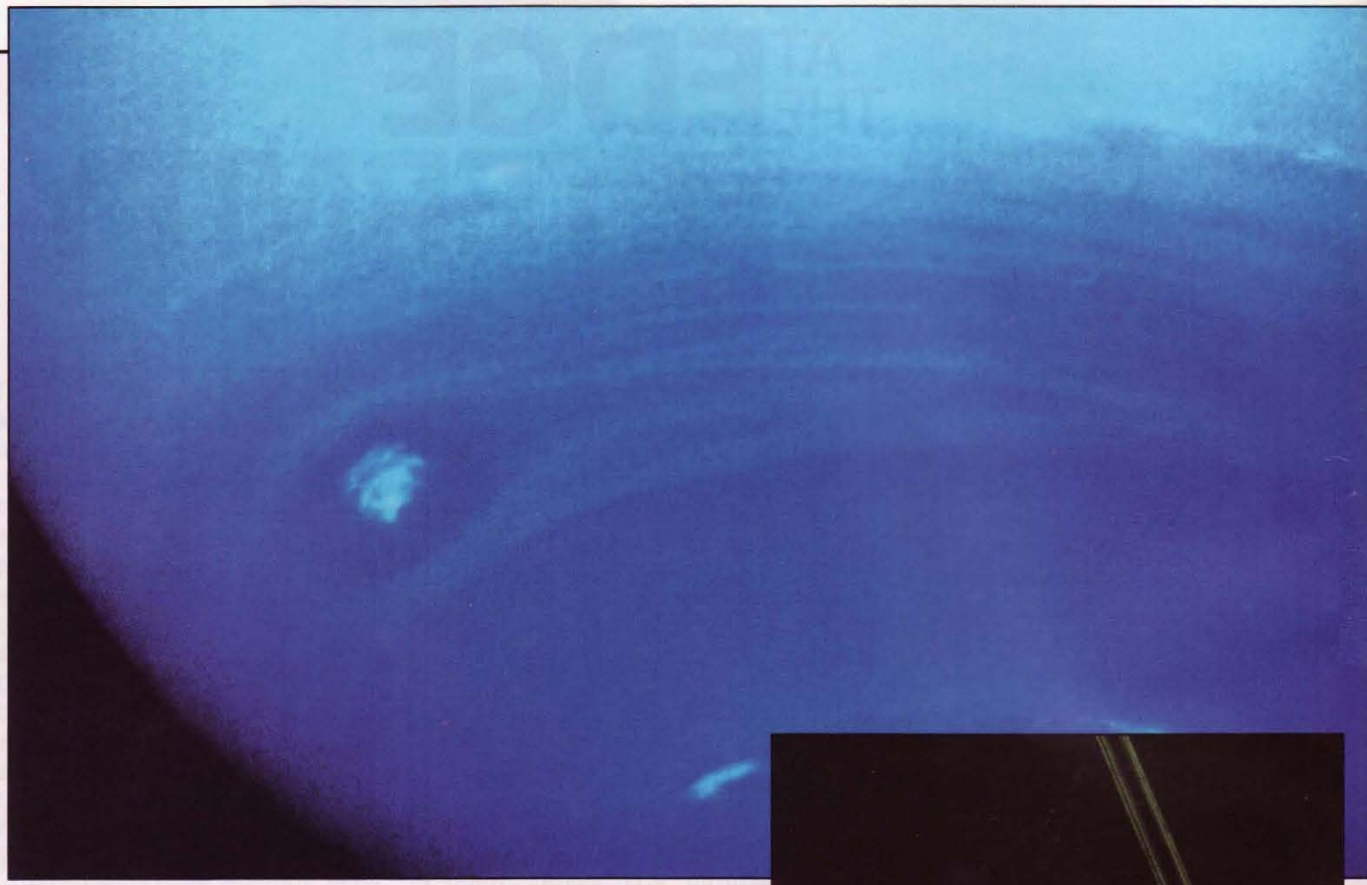
So the one who had been the Word, and who had actually carried out the act of creation, later came to earth as Jesus the Messiah.

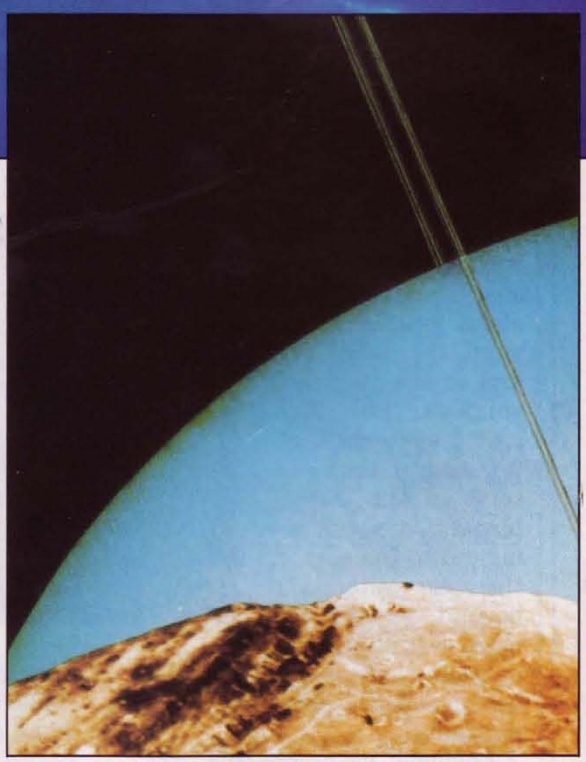
While he was on earth, Jesus made it clear that there was one who held a senior position to himself. He called his superior "the Father," establishing a relationship that human beings can readily understand. There was a Father and a Son—God is a family!

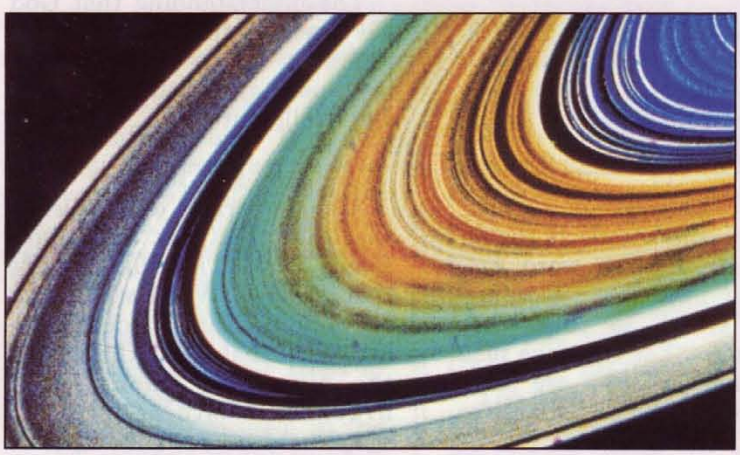
The understanding that God the Father and Jesus Christ share a family relationship leads us in an exciting direction. Let's follow it.

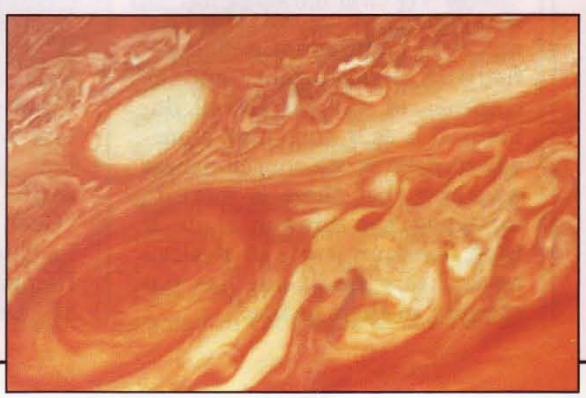
MANY SONS TO GLORY

A characteristic of families is that they *grow.* But does God's family grow? The Bible tells us that it does. When writing to the congregation at Rome, Paul explained that Jesus Christ was the "firstborn among *many* brethren" (Romans 8:29, emphasis ours throughout

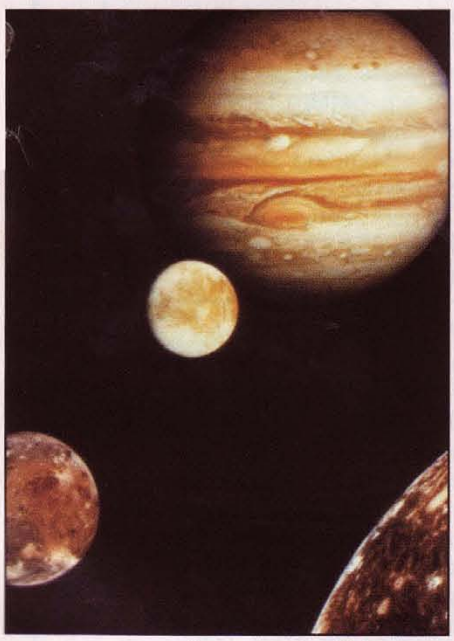








Two Voyager *spacecraft were launched in 1977 from the Kennedy Space Center in Florida. They have returned thousands of photos and voluminous amounts of other data about our solar system. Photos, clockwise from top right:* Voyager *liftoff, Jupiter with three of its moons, Jupiter's Great Red Spot, Saturn's rings (color variations indicate different chemical composition), closeup of spacecraft, cloud system in Neptune's southern hemisphere. Center photo: Superimposed view over horizon of moon Miranda toward Uranus.*



> "The secret things belong to the Lord our God, but those things which are revealed belong to us and to our children forever."
>
> DEUTERONOMY 29:29

booklet). In his epistle to the Hebrews, he explained that God is in the process of "bringing *many* sons to glory" (Hebrews 2:10).

Where will they come from? Is Paul perhaps referring to angels? The Bible makes it quite clear that this is not the case: "For to which of the angels did He ever say: 'You are My Son, today I have begotten You'? And again: 'I will be to Him a Father, and He shall be to Me a Son'?" (Hebrews 1:5).

John, writing to the first-century Church in his old age, explained more about how God would bring "many sons to glory." He said, "Behold what manner of love the Father has bestowed on us, that we should be called children of God!" (I John 3:1). And to quote Paul once again: "For as many as are led by the Spirit of God, these are sons of God . . . and if children, then heirs—heirs of God and joint heirs with Christ" (Romans 8:14, 17).

Could it be plainer? The Scriptures tell us that God is a family, with a Father and a firstborn Son, who is charged with the responsibility of bringing many others to glory. We, the human race, are those potential children. We are physical replicas of the God-kind. John goes on to explain: "Beloved, now we are children of God; and it has not yet been revealed what we shall be, but we know that when He is revealed, we shall be like Him, for we shall see Him as He is" (I John 3:2).

We are mortal, of fleshly birth, subject to death and dependent on the physical environment of earth for life. In that state we cannot reach our full potential because "flesh and blood cannot inherit the kingdom of God; nor does corruption inherit incorruption" (I Corinthians 15:50). So although the men and women of the earth are potential heirs of God, a change must come before they receive their inheritance.

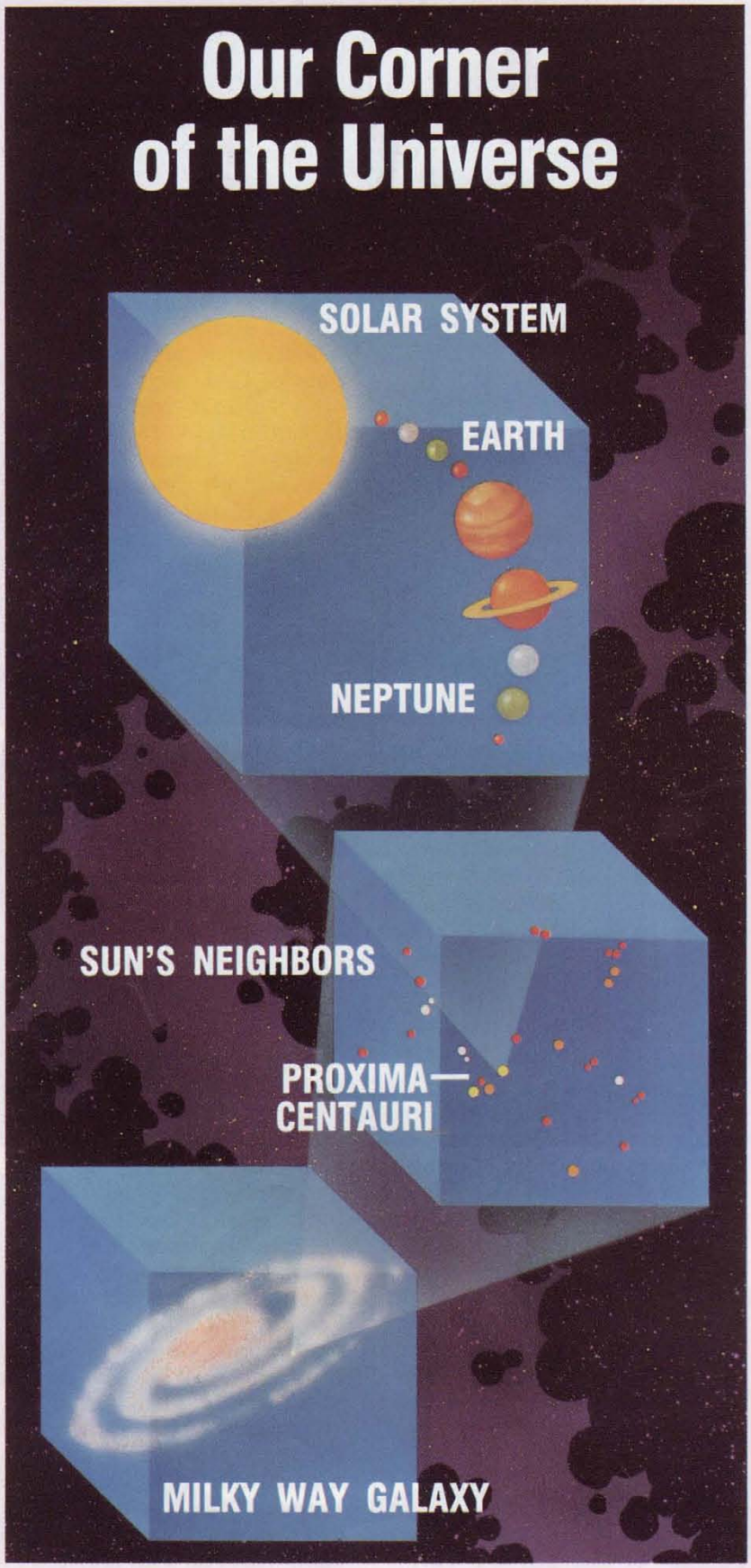
Paul explains: "There is a natural body, and there is a spiritual body" (I Corinthians 15:44). Jesus is the only one so far who has made the transformation. He was a spiritual being before he became a physical man, and lived as a mortal on earth. He was human and experienced the full range of human emotions, even to the point of enduring an agonizing death.

He, the Creator of mankind, allowed himself to be offered as a sacrifice so that he might also become the Savior of mankind.

Before Jesus was crucified, he prayed to his Father in heaven, "Father, glorify Me together with Yourself, with the glory which I had with You *before the world was*" (John 17:5). Jesus knew that he would be resurrected not to physical life, but to the level of God's existence.

Three days and three nights after Jesus was buried, the Father changed the battered lifeless physical remains of Jesus' mortal body into an immortal spirit being. Thus Jesus was able to resume his *eternal* life, at the side of his Father in a spiritual environment that no mortal can experience. God alone "has immortality, dwelling in unapproachable light, whom no man has seen or

Our Corner of the Universe



It took the *Voyager 2* spacecraft more than 12 years to reach Neptune, the eighth planet from the sun. With its mission to the outer planets finished, *Voyager 2* is now soaring out to the edge of the solar system and on into interstellar space.

The distance the spacecraft has traveled is about 1/100 of 1 percent of the distance to Proxima Centauri, the next closest star to earth after the sun.

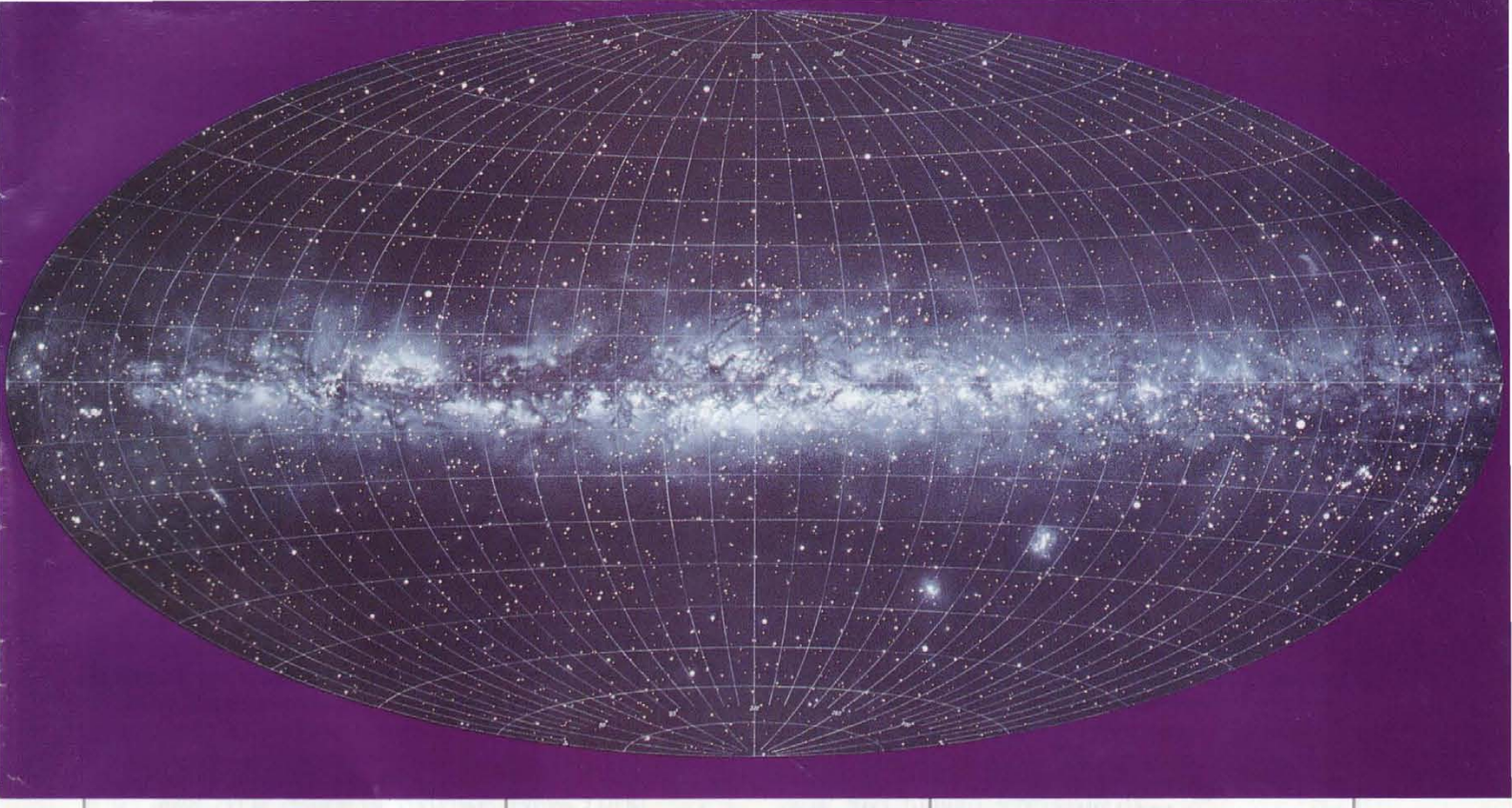
Because the universe is so vast, distances between stars and galaxies are usually measured in terms of light-years. The distance light travels in one year is approximately 6 trillion miles (9.7 trillion kilometers). Neptune is about 4.5 light-*hours* from earth. Proxima Centauri is about 4.3 light-years away.

If *Voyager 2* were heading toward Proxima Centauri (it isn't), it would not arrive there until approximately *80,000* years!

Voyager 2 is hurtling through space at about 40,000 miles (64,000 kilometers) an hour. Even if it were traveling at 30 million miles (48 million kilometers) an hour, it would take more than a lifetime to make even a one-way trip to the nearest star in our own galaxy.

The distances of galaxies from earth are measured in terms of millions and even *billions* of light-years. And scientists say they are getting farther away all the time. This does not diminish the outstanding success of the *Voyager* program, but it does put it in perspective. Mortal man is confined to a very small corner of the universe.

The Milky Way galaxy (bottom cube), one of billions of galaxies in the universe, is approximately 100,000 light-years across. It is so vast that our solar system (top cube) is a mere speck in comparison. The sun and a few of its closest neighbors, including Proxima Centauri, the next closest star to earth after the sun, are shown in the middle cube.



Map drawn from photographs taken from observatories shows the entire celestial sphere of stars visible from earth. White band of clouds and stars is the disk of the Milky Way galaxy.

can see" (I Timothy 6:16).

Jesus Christ was changed from mortal flesh to immortal spirit by means of a resurrection. The same thing will happen to others when he returns to earth. The Bible tells us that at that time, converted children of God will be changed "in a moment, in the twinkling of an eye, at the last trumpet. For the trumpet will sound, and the dead [in Christ] will be raised incorruptible, and we [who are alive] shall be changed. For this corruptible must put on incorruption, and this mortal must put on immortality" (I Corinthians 15:52-53). Other scriptures reveal that every human being who has ever lived will ultimately have an opportunity to receive immortality.

Can we begin to grasp what these scriptures are telling us? God the Father and Jesus Christ want us to share eternity with them as spirit-composed members of their family—spiritual children of the Father, and spiritual brothers of the Son. We were indeed created with the potential to live forever—not for just a few years of mortality on earth.

> "Science cannot solve the ultimate mystery of nature. And it is because in the last analysis we ourselves are part of the mystery we are trying to solve."
>
> MAX PLANCK, PHYSICIST

ETERNITY AND REALITY

The Bible shows us that we can transcend the limitations of physical existence and become members of the family of God. We can only begin to grasp the implications of what that means, for as Paul wrote to the Corinthians, "Eye has not seen, nor ear heard, nor have entered into the heart of man the things which God has prepared for those who love Him" (I Corinthians 2:9). The full wonder of our human potential is beyond our capacity to grasp. But perhaps the discoveries at the frontiers of knowledge can help us understand that there *is* a reality out there beyond our senses.

The words the apostle Paul wrote nearly 2,000 years ago should have an even greater impact today: "For since the creation of the world His invisible attributes are clearly seen, being understood by the things that are made, even His eternal power and Godhead, so that they [the skeptics in Paul's day] are without excuse" (Romans 1:20).

How much more are we without excuse, we who have probed the far reaches of the universe and glimpsed the strange work-

ings of inner space. We are in a better position than ever before to begin to comprehend the power and majesty of the Creator. And to be awed by the realization that we were created to share that immortal spirit life as members of the family of God. And also sobered as we acknowledge our present inadequacies—both physical and spiritual.

In the universe there may be as many as 100 billion galaxies, each with perhaps 100 billion suns, each converting millions of tons of matter into energy every second. We have learned how to harness a minuscule amount of that kind of power. But we use it to build weapons that could destroy our little corner of the universe. We, in our present state, are not ready for eternity!

> "By faith we understand that the worlds were framed by the word of God, so that the things which are seen were not made of things which are visible."
> HEBREWS 11:3

MANKIND ON THE THRESHOLD

Three thousand years ago, David the psalmist looked out into the universe and was moved to write: "When I consider Your heavens, the work of Your fingers, the moon and the stars, which You have ordained, what is man that You are mindful of him . . . ?" (Psalm 8:3-4).

We know so much more today. If we take what we have learned, and examine it with the timeless light of what is revealed in the Bible, we can understand why God is mindful of us mortal humans. We, who are made in the image of God, have the potential to share God's character, his glory and his eternal existence.

We find ourselves part of a magnificent physical creation, which is *part* of a spectrum of all that exists. At the edges of what we can observe, this creation expands into unthinkable immensity and dissolves into unimaginable smallness. Its limits—if there are limits—lie beyond our grasp for now.

And yet, they are attainable. There is one who has shown us that the dimensions beyond our experience will not always be out of reach. Jesus Christ, the Creator who formed the visible creation from that which is not seen (Hebrews 11:3), has paved the way for us.

About 2,000 years ago, Jesus was born as a mortal human being, and lived on earth, sharing the experiences, the problems, the frustrations and limitations of those he had created. He allowed himself to be killed, a sacrifice for the sins of all humanity. But after three days and three nights he was resurrected, and the power and glory he once had as an immortal member of the God family was restored. "He is the image of the invisible God, the firstborn over all creation," wrote the apostle Paul (Colossians 1:15).

But *only* the *first*born. All humanity was created to have a place in God's family. Paul continues: "For by Him all things were created that are in heaven and that are on earth, visible and invisible, whether thrones or dominions or principalities or powers. All things were created through Him and for Him. And He is before all things, and in Him all things consist" (verses 16-17).

As Creator, as Firstborn and as Savior, Jesus Christ plays a central role in the future of every human being. We will not be ready for eternal life until we have learned to live and think as he does. The potential is there, but we cannot make progress by ourselves. It must be a partnership, between willing and humble human beings, and their loving and merciful Creator. Once that partnership has formed, the process of developing godly character can begin.

Only then can we fulfill our ultimate destiny and advance from mortality to immortality—to become spirit-composed members of the family of God!

SOME FURTHER READING

If you are interested in learning more about the subjects discussed in this booklet, you may wish to read some of the books listed below. Most of them should be available at your local bookstore or public library. Although we do not endorse all that is written by these authors, we think they will add to your understanding of the more technical material presented in this booklet. This list is by no means exhaustive, and new material is being published all the time in this fascinating and dynamic field.

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If you are interested in learning more about the purpose and potential of the human race, we recommend the booklets listed below. Like *Groping in the Light,* these booklets are published by the Worldwide Church of God, and are available free of charge. To request your copies, fill in the enclosed card and send it to the address of our office nearest you.

Why Were You Born? The astounding purpose for your life is discussed in detail.

Your Awesome Future Learn more about the awesome future God has in store for us.

What Is Man? Discover what makes us unique from all other creatures on earth—and why.

Is God Real to You? Here's how to establish contact with God and receive his blessings.