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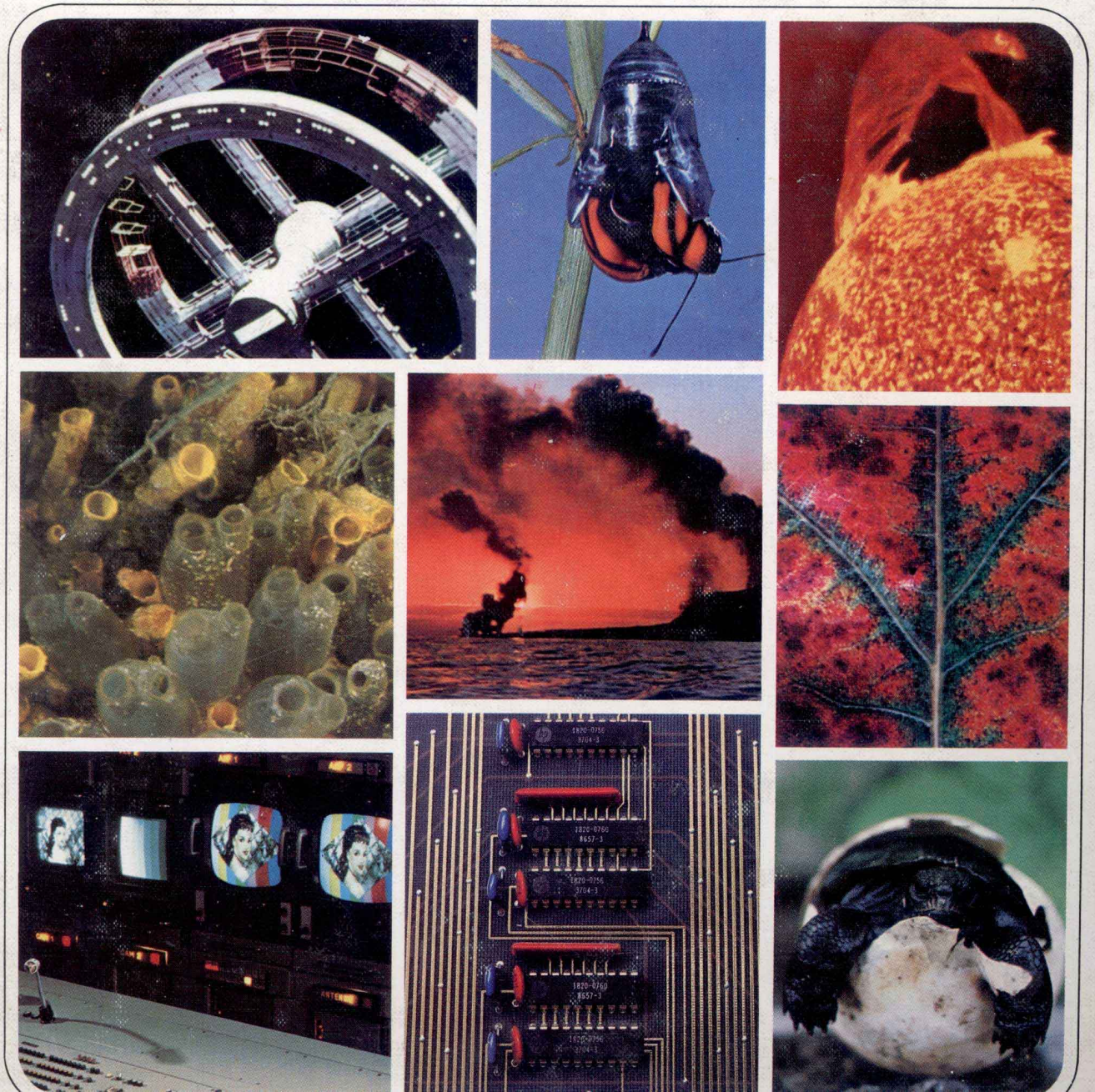
THE NEW BOOK OF POPULAR SCIENCE



THE NEW BOOK OF POPULAR SCIENCE

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GUIDE TO THE NEW BOOK OF POPULAR SCIENCE

Astronauts blast to the moon and bring back samples from another world; one person's heart beats in another's body; newspapers report work on creating new forms of life in a test tube...These are just some of the most startling of the advances in science that have excited people in the last few decades. Is nature now under human control? The first rumblings of an earthquake, the appearance of a new island where only ocean was visible, the discovery of a hitherto unknown form of life deep in the dark and unfavorable ocean abysses answer that question, once again revealing the power and mystery of nature.

The 12 sections of which THE NEW BOOK OF POPULAR SCIENCE consists present the major fields of science and discuss their applications in the world of today. The section Astronomy & Space Science, for example, explores people's long fascination with the heavens, explains what we have learned through the centuries, and discusses how this knowledge and the quest for more has led to the exciting age of manned space exploration. The section on Earth Science and the closely related Energy and Environmental Sciences sections take us on a tour of our home base, probe how its vast energy is being and can be used, and describe how nature and people both work to change the earth.

The arrangement of articles in each section provides, as far as possible, a logical, step-by-step presentation of the subject matter in a particular field. Each article, however, constitutes a unit in itself and can be read as such. The articles are essay length, providing a well-rounded introduction to a particular topic. Subheads and sideheads within the text of each article help give the reader a quick and concise overall view of the article's contents. The metric system of measurement, long used by scientists throughout the world, is used throughout THE NEW BOOK OF POPULAR SCIENCE.

Illustrations are a very important part of THE NEW BOOK OF POPULAR SCIENCE. Plentiful and beautiful color photographs and artwork as well as black-and-white illustrations make THE NEW BOOK OF POPULAR SCIENCE a very attractive set that invites you to wander through its pages. A description of a solar flare is made real when you see the striking yellow and red outbursts from the solar disk. The entire story of the exploration of the moon comes alive as you see the astronauts on the moon, gathering and examining lunar rocks. Complex concepts in chemistry and physics become simple and the human body reveals its marvelous organization through clear diagrams. Electron micrographs of viruses and bacteria, underwater photographs of deep ocean life, views of animals in their natural habitats provide a beautiful panorama of life's diverse forms. Throughout, the illustrations complement the text, explaining, expanding and beautifying it.

For readers who wish to have additional information on a given subject, the editors have provided a bibliography, called Selected Readings, at the end of each volume. It contains not only a list of informative books but also a brief evaluation of each book that is listed so that the reader may have some idea of what it contains.

An alphabetical index for the six volumes of THE NEW BOOK OF POPULAR SCIENCE is given at the end of Volume 6. It enables the reader to find easily and quickly specific items of factual information

in the articles. Instructions for the use of the index are given on its first page. The index makes it possible for the reader to obtain the fullest possible benefit from the set.

In the pages that follow, we list the 12 sections of THE NEW BOOK OF POPULAR SCIENCE, and we give a brief account of the contents of each.

ASTRONOMY & SPACE SCIENCE Vol. 1

No area of science has excited the immagination of civilized earthlings as much as have astronomy and space science. We dream of dodging among stars and through intergalactic systems, of shifting into hyperspace, and of finding little, green, one-eyed creatures at the edge of the universe. At the same time, earth-bound events such as the sight of a clear, full moon, or a spectacular orange-and-purple sunset still bring out feelings of romance and beauty.

In the section Astronomy & Space Science, we look at our universe and what we know about it. We consider first the face of the sky and the ways we have to study the skies. Then we discuss the star that we call the sun and the celestial bodies that form the solar system. Turning then to other stars, we learn about their composition, their brightness, their movements in space. Then we explore some of the most mysterious events in space—phenomena such as black holes and quasars. Finally we consider how astronauts have taken their first steps into space. We look at rockets, at space probes, at the problems and successes of manned space exploration, and review what we have learned from our visits to the moon. We end this section wondering about the possibility of life on other worlds and about unidentified flying objects.

COMPUTERS & MATHEMATICS Vol. 1

Our everyday lives are touched in many ways—sometimes without our realizing it—by mathematics and computers. We may tend to think of mathematics as an esoteric field of science. Yet we also use mathematics when we do such simple things as count change or measure recipe ingredients or share a restaurant check. We use calculators to do mathematics homework or balance checkbooks. We depend on computers to provide us with up-to-the-minute weather reports, to keep grocery shelves stocked, to keep our home fuel tanks filled. Yet often the word computer brings images of future robot takeovers and of a dehumanized, push-button society. In the section on Computers & Mathematics we learn some of the basic facts of these sciences and so learning dispel many of our fears. We explore some of the major fields of mathematics: arithmetic, algebra, plane and solid geometry, trigonometry, analytic geometry, and calculus. We discuss some of the applications of mathematics in statistics, probability, and game theory. Then we go on to learn about binary numerals and the tool based on the binary numeral system—the computer. We learn how to program a computer and how to use it.

EARTH SCIENCES Vol. 2

The earth is our home and we are, of course, interested in its foundations, its landscape, its features, its crust. In the section on Earth Science, we examine the earth's crust and some of the ways it has formed and is still changing through the action of earthquakes, volcanoes, and other agents of the tremendous power within the

earth's interior. We look at some crustal features—mountains and caves, for example—and piece together theories on how they have formed and how they are now working to affect the landscape. Then we turn our attention to the protective envelope that surrounds the earth—the atmosphere. We study lightning, wind, rain, and other atmospheric occurrences before we begin our exploration of the earth's third major part: water. Hidden in the ground, coursing through rivers, locked in huge oceans with their own life cycles, water covers three fourths of the earth's surface. We explore its characteristics, its actions, its life. We close this section with a brief look at the early history of our home in space.

ENERGY Vol. 2

Perhaps the greatest challenge facing us today is the quest for sources of energy to power civilization and at the same time preserve the earth for future generations. We open the section on Energy by taking an overall look at how much and in what ways we use energy, at how we now obtain it, and at what our future needs are likely to be. Then we explore the major conventional sources of energy: oil, coal, and natural gas. Then we turn our attention to some of the more exotic sources: geothermal energy and solar energy—heat from the earth's interior and directly from the sun. We also discuss nuclear energy—both fission and fusion. Is it safe? Will it answer future needs for energy? We end the section with a discussion of the way in which most of our energy is used—in producing electricity.

ENVIRONMENTAL SCIENCES Vol. 2

Will earth be a suitable home for future generations? In the section on Environmental Sciences we examine our total environment, or surroundings, and see how the forces of nature and the hand of man have changed and are continuing to change the earth. First, we examine earth's natural resources—water, wood, minerals—and discuss how they can be both used and preserved. Then we see how nature's forces—running water and wind, for example—are carving the land, changing its face. We next see how human beings—through industry, agriculture, transportation, and other activities—are changing the earth. We wonder what will be left, and in what condition, for future generations. We take some plant and animal species as examples illustrating the role of a changing environment and discuss how the existence of some species is threatened and the steps that can be taken to safeguard them and other endangered species. We also explore some of the areas now set aside as specially protected regions where nature wins and people are allowed little or no influence—so-called wilderness areas.

PHYSICAL SCIENCES Vol. 3

What do all things—living and nonliving alike—have in common? They are all forms of matter—that which occupies space. The different forms of matter possess and can be made to possess energy. Matter and energy are the twin bases of all things. In the Physical Sciences section we study chemistry, "the matter science," and physics, "the energy science." We explore matter's different forms and its basic component—the atom. We see how various elements combine to form acids, bases, salts, solutions, and colloids.

As we turn more particularly to the study of energy in the physics subsection, we see how energy is the basis of work and movement. We investigate the nature of electricity and its relationship to magnetism. We explore how energy is involved in such phenomena as heat, sound, optics, and color. Then we turn to what is probably the scientific theory most closely associated with modern science—relativity—and try to understand its basic premises and applications. We end the section exploring two of matter and energy's most intriguing phenomena: the world of plasma, or superhot, energized gases; and the world of supercooled, superconducting elements.

BIOLOGY Vol. 3

What is life? How did it arise and diversify into the countless forms it now takes on land, in water, and even in the air? In the General Biology section we explore the nature of life. We study its simplest and most basic unit—the cell—learning its structure, tracing the steps of its activities, and marveling at its complexity. We consider how living things—small and large alike—develop from a single cell and how the many varied organisms have attained their present organization through a long series of changes to which we give the name evolution. We see how organisms react to their environments and to one another in a particular community and habitat, forming a complex and completely interdependent web of life. Finally, we see how life forms are classified, or grouped.

PLANT LIFE Vol. 4

The plant kingdom includes forms from the tiny diatom visible only through a microscope to the mighty redwood trees towering over one hundred meters high. In the section on Plant Life we see how these two seemingly diverse forms are related—how they are both plants—and go on to study the characteristics of all plant life. We start with the soil, the anchor for all land-dwelling plants, and proceed from the simplest plants to the highest forms. We see how algae and fungi form an essential part of the cycle of life on earth and how ferns, which beautify the earth in dense and luxurious growths, begin to show some of the characteristics of higher plants. We devote particular attention to the seed plants, the dominant form of vegetation on earth. We study their roots, stems, leaves, flowers, and fruits. We also consider how various plants adapt to their environments. We end this section with a discussion of some plants of particular importance and interest to humans—vegetables, cacti, houseplants, and trees.

ANIMAL LIFE Vol. 4

The animal kingdom is vast and includes strikingly diverse forms—from tiny one-celled protozoans to highly complex mammals—including people. The section on Animal Life surveys the vast panorama of animal life. The story begins with the invertebrates, or animals without a backbone: protozoans, sponges, starfish, worms, mollusks, lobsters and other crustaceans, spiders, and many types of insects. Then comes the backboned animals, or vertebrates: fishes, amphibians, snakes, and birds—similar in some ways, yet each exhibiting a unique adaptation to a particular way of life.

MAMMALS Vol. 5

In the section on Mammals we explore in somewhat greater detail many of the most important mammal groups. We start with two highly unusual types of mammals—egg-layers and marsupials. Then we discuss the dominant and highly varied placentals—rabbits, rodents, aquatic mammals, dogs, bears, weasels, cats large and small, hoofed animals—to name just a few. We end the Mammals section with a discussion of the primates, the mammal group to which we belong.

HUMAN SCIENCES Vol. 5

People are similar in many ways to animals and are in fact a part of the primate mammal group. Yet people are different from even their nearest mammal relatives. In the section on Human Sciences we deal with peoples' similarities to other animals and also with their differences. We start with a survey of the human body, studying its structure and how the various organ systems work. We then consider what personality is, what emotions are, and how memory works. We go on to see the human life cycle—heredity, development, growth, decline, and old age. We find that many factors—diet, sleep, and exercise—play important roles in our health. We see how a person's mind and body interact and how psychological stress can affect physical health. We discuss particular problems such as alcoholism, smoking, and drug abuse. We also consider a few of the particular diseases we commonly encounter—allergies, influenza, cancer, and arthritis—and end with a brief discussion of organ transplants and antibiotics, just two of the many advances of modern medicine.

TECHNOLOGY Vol. 6

It is through advances in technology that most of us are made aware of the achievements of science. Technology affects our everyday lives, taking the discoveries of science and putting them into our homes, offices, factories, and cars. The Technology section begins with a discussion of some of the major divisions and functions of modern engineering. Then we survey some of the oldest applications of science—the early technologies in which people found materials for their homes and built homes and other buildings. Next we explore the field of transportation, tracing the development of the automobile, railroad, airplane, and other means of travel. Turning our attention to communications, we see how the world of electronics has provided us with a wide range of communication devices.

Continuing our look at applied science, we see how the chemical industry provides us with a wide range of products, how the use of plastics has changed many aspects of our daily lives, how the use of ultrasonics, fiber optics, and liquid crystals is affecting and will continue to affect our ways of doing things. We see how the development of X rays revolutionized medicine and other fields of science and how radiocarbon dating techniques provided us with means of dating and piecing together the earth's early history. Finally we turn our attention to cybernetics and end by discussing the possibilities of automatic self-regulating systems.

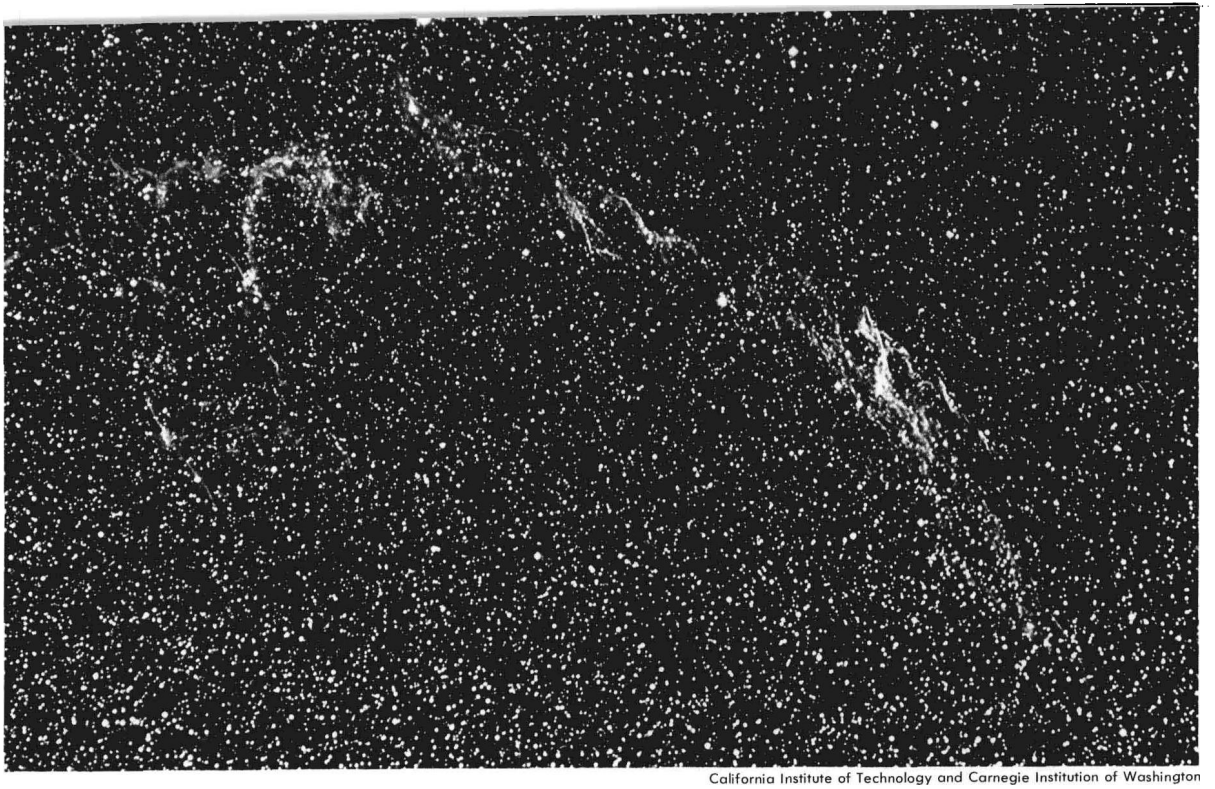
Volume 1

Contents

ASTRONOMY & SPACE SCIENCE

both photos, NASA

The planet Mars began to reveal its secrets as the U.S. Viking space probes approached and landed on the planet. The photomosaic at left reveals Vallis Marineris, the "Grand Canyon" of Mars (upper left of darkened area), and the large impact basin Argyre (lower left of dark area). The photo above shows a Martian sunset.



California Institute of Technology and Carnegie Institution of Washington

Some of the most interesting and beautiful objects of the universe are glowing masses of dust and gas known as nebulae. Here are two nebulae in the constellation Cygnus. Above: the Veil Nebula; at right: the North American Nebula.

THE STUDY OF THE UNIVERSE

by Katherine Haramundanis

When you look up at the sky on a clear night, what do you see? Most of the dark night sky is dotted with twinkling points of light, which we call stars. The moon may be in the sky as well—perhaps as a thin arc, perhaps as a full circle of light.

The brightest point of light might be the planet Venus, and a reddish one would be the planet Mars. Except for the other planets, all the other points of light are stars.

Sometimes you can see a faint, glowing band across the overhead sky when it is clear and dark enough. It is made up of stars too far away or too small to be seen as separate points of light. This band is known as the Milky Way.

What is it like out there? What are the stars? How far away are they? How did they come to be? Will they go on shining forever? And what of space itself? Does it come to an end somewhere? Or does it go on without end?

OBSERVING THE SKY

Try to imagine, for yourself, how early stargazers learned about what they saw in the sky.

Perhaps you would start simply by observing the night sky over a period of time. After a while, you would begin to notice that the brighter stars seemed to form patterns in the sky. You would remember these patterns when you saw them again. That is what early stargazers did, anyway. They traced out star patterns and named them after gods and heroes, or animals and familiar objects. They called these star patterns *constellations* (from the Latin, *com stella*).

The names given to constellations in ancient times are still in use today—Scor-

Société astronomique de Suisse

pius, Leo, Orion, and 85 others. Most constellations do not look like the mythical figures they are named after—at least not to our eyes. However, they are useful even now for learning our way around the night sky.

Having learned to pick out certain stars by their positions in constellations, you would be able to keep track of their movement across the sky from night to night. This is what the early stargazers did. They also kept track of the movements of the sun and the moon. The star watchers also kept records of all these heavenly bodies over periods of many years.

In this way they came to realize that events in the sky repeat themselves over and over again. From repeated observations about the times when the sun, moon, and planets appear, people slowly came to develop the first calendars for keeping track of time and the seasons. In fact, that was one important reason why people studied the sky.

EARLY IDEAS OF THE UNIVERSE

The first civilization to gain a real understanding of the sky's objects and their motions was that of the ancient Greeks. Some of the Greek astronomers were very careful observers, and kept long and detailed records. But most of the Greek thinkers were mainly interested in developing theories that could explain the universe.

Some of their theories came close to what astronomers now believe to be true. The Greeks did this without using any of the instruments we associate with astronomy today, such as the telescope. For example, most Greek thinkers came to realize that the earth is actually spherical, not flat. One of their astronomers even made a fairly exact calculation of the size of the earth by using the methods of geometry.

Another common belief of ancient peoples, including the Greeks, was that the earth is the center of the universe. After all, that is the way it really looks. The heavenly bodies appear to be circling the earth. The planets look like points of light moving slowly among the stars from night to night. They also seem to be circling around the earth. If you knew nothing about astronomy, it would be only natural for you to think—as the ancients did—that the earth is the center of everything—the universe.

Some Greek astronomers, however, thought of the universe in a different way. In the fifth century B.C., the Greek astronomer Anaxagoras decided that the sun and moon and planets were not simply lights