

ASTRONOMY

Changing View of Universe

Discoveries of the last 50 years have profoundly changed man's view of the universe, from the invisible core of the atom to man himself and outward to the far galaxies.

By ANN EWING

► **MAN'S VIEW** of the universe around him—from the ultra-tiny world of the atom to the far-flung, star-filled heavens—has drastically changed during the last 50 years.

These changes are recounted in depth by Dr. Harlow Shapley, retired director of Harvard College Observatory, Cambridge, Mass.

In discussing major scientific advances of the last 50 years leading to a change in man's way of looking at life, Dr. Shapley groups them into eight categories.

These are the laboratory creation of life-like chemicals, cosmic evolution of elements and stars, Einstein's theories of relativity, the use of the entire electromagnetic spectrum to explore the world around us, "sputnikery," the expanding universe, medical triumphs including discoveries with DNA, and the Freudian exploration of the mind.

Most Important Advancement

Most important, Dr. Shapley believes, is the creation in laboratories, starting with simple nonorganic chemicals, of the organic compounds that are basic to life. The simplest possible chemicals have been joined together to form very complex compounds under conditions believed to represent those of primitive earth.

This achievement, Dr. Shapley emphasized, shows that there is no need for explaining the origin of life in terms of the miraculous or the supernatural. Life occurs automatically whenever the conditions are right. It will not only emerge but persist and evolve.

Space probes are expected to show within a few years whether living forms exist or have existed on the two most likely planets in the solar system, Venus and Mars. However, there are planets circling other stars like the sun where life-ripe conditions can also occur, as they do on earth.

Using even the most pessimistic assumptions about the number of stars having only one planet capable of sustaining life, Dr. Shapley has calculated that the universe contains *at least* 100 million such planets. He believes the figure is more likely in the billions.

The spark setting off the search for experimental investigation of the origin of life came from the Russian biochemist, A. I. Oparin, whose book on the subject by that title is now a classic.

In 1953, Dr. Stanley Miller, who was then at the University of Chicago, manufactured amino acids by exposing such simple chemicals as methane, ammonia, water vapor and hydrogen to an electrical discharge simulating the lightning flashes of earth's primitive atmosphere. Amino acids, basic compounds

of life, and other organic compounds were formed.

Since then, similar experiments have been and are being made in laboratories around the world. Scientists have succeeded in making much more complicated compounds using such other forms of radiation as ultraviolet light to bombard simulated mixtures of the "hot dilute soup" of the primeval oceans that provided food for the first precursors of life.

Another achievement has dramatically changed man's outlook on the cosmos, Dr. Shapley said. This is the discovery of the nuclear processes responsible for the formation of elements, for the birth of stars, their deaths and the creation of later generations of stars from the matter spewed into space when stars die or explode as novae or supernovas.

Eight Nuclear Processes Required

The build-up of all the elements from the primeval cloud of hydrogen gas is now believed to require eight nuclear processes, which occur only as changing conditions for element synthesis become ripe. The stars, which are grouped together in billions of giant galaxies, are each in various stages of evolution.

Although only about 6,000 stars can be seen with the unaided eye, there are estimated to be a hundred billion billion in the universe that can be photographed through the world's largest telescope, the 200-inch at Mt. Palomar in California. Each star radiates a staggering amount of life-giving energy into space around it.

Einstein's theories of relativity, both the special and the general, are another accomplishment of the 20th century rated among the top eight by Dr. Shapley.

The theory of general relativity holds that time and space are linked irrevocably, and that the curvature of space-time is caused by masses and their motions.

Fission and Fusion

Fission and fusion are both dramatic illustrations of the equivalence of mass and energy first suggested by Einstein in his special theory. Fission is the breaking apart of atoms in the atomic bomb and nuclear power station reaction, while fusion is the nuclear synthesis occurring in stellar furnaces and hydrogen bombs.

Fusion is also, hopefully, a reaction that can be tamed to give man a virtually unlimited power source.

The opening up for exploring the universe around us of the whole spectrum of electromagnetic radiation, of which light is only a tiny portion, is another great stride of the past 50 years, Dr. Shapley believes.

This energy spread of more than 50 octaves, in which light is just one octave, has "widened our knowledge of the minutiae of the atomic underworld and emphasized the richness and cosmic significance



Fremont Davis

DR. HARLOW SHAPLEY—Retired director of Harvard College Observatory, Dr. Shapley is world renowned for his astronomical discoveries as well as his deep concern for humanity.



Washburn Observatory

MILKY WAY GALAXY—*This whole-sky photograph shows the Milky Way as seen from the Southern Hemisphere. Many of Dr. Harlow Shapley's important discoveries on the structure of the Milky Way resulted from studies of the Magellanic Clouds, which can be seen only from the Southern Hemisphere.*

of the unseeable," Dr. Shapley said.

Radio and radar astronomy are part of this new window for gleaning information about the universe. The radio waves broadcast by the sun, planets and stars—and even the far-distant galaxies as well as invisible objects in space—are detected and analyzed to give a much broader picture of the cosmos than by light alone.

The strange objects called quasars, one of which has just been reported rushing away from earth at 80% of light's speed of 186,000 miles a second, were discovered through the joint efforts of radio and optical astronomers. The puzzling quasars pour astonishing amounts of energy into space, many thousands of times more than a normal star.

The newest device in astronomical exploration is the intense light beam generated by laser action.

It joins the other extensions of man's natural sense organs that include photographic emulsions, thermocouples, Geiger counters, image converters and a maze of other electronic gadgetry.

The replacement of man by machines in what has been called the Second Industrial Revolution or the Age of Automation is another way of extending man's senses. Electronic computers make lightning-fast calculations that would take one man years or even decades without such a machine.

Another achievement that is changing man's outlook on the cosmos Dr. Shapley terms "sputnikery"—the launching of man-made objects into space, both manned and unmanned. These space- and planet-probing vehicles promise to give man an ever clearer view not only of earth, the sun and the solar system, but also of the rest of the universe.

Next in Dr. Shapley's list of advances drastically changing man's outlook is the idea that the universe is expanding, with untold billions of galaxies, each containing hundreds of millions of stars. The sun and its system of planets are merely a minor member of a relatively common type of galaxy, which we call the Milky Way. The solar system is not even near the center of the star-speckled Milky Way, but far off at one side.

If the implications of the sun's lopsided position were as widely accepted as the sun's predominance with respect to the planets now is, Dr. Shapley said, the changes in man's approach to his life on earth would be "revolutionary."

Medical Advances

Medical advances that have resulted in the postponement of death through control of such diseases as polio, smallpox, malaria and tuberculosis are another important achievement of recent years.

The promise for the future is an even greater postponement. Also a possibility for the future is some control over inherited characteristics through manipulation of deoxyribonucleic acid, DNA, and ribonucleic acid, RNA, the genetic material of man, animals, plants, microorganisms and many viruses.

Each DNA contains a complex, yet precise sequence of nucleotides that acts as a coding device for storing the information needed for the synthesis of all the matter found in the organism. DNA thus controls and directs its own replication.

The Freudian revolution, which drastically changed man's view of himself, is the last revelation on Dr. Shapley's list.

Dr. Shapley has been one of the world's outstanding astronomers since before he became director of Harvard College Observatory in 1921. He has received virtually every intellectual distinction bestowed in the community of scholars, including honorary degrees from 17 universities.

His honors range from president of the American Association for the Advancement of Science to receipt of the Pope Pius XI prize for science and humanity.

He is a past president of SCIENCE SERVICE and a present trustee.

Among Dr. Shapley's many contributions to scientific advances are his studies on the structure of the Milky Way galaxy. His interests range, however, from the far-distant galaxies to man and his environment and down to the behavior of the tiny ants, his scientific hobby.

Dr. Shapley is hard working, quick thinking and fast talking. His genius in astronomical research is combined with a very warm, gentle personality, and a lively interest in people of all ages and their problems.

Dr. Shapley's sense of humor is wry and dry, and he uses it often on himself, his colleagues and the universe. With it go a quick smile and always twinkling eyes.

• Science News Letter, 88:10 July 3, 1965

Nature Note

Hawaii's Nene

► THE NENE, state bird of Hawaii, is on the edge of extinction.

This greyish brown goose, cousin to the Canada goose, once numbered about 25,000 along the barren rugged volcanic slopes of Hawaii, its native land. But they have been hunted by men, wild dogs, pigs and mon-gooses to the point where, in 1948, there were only about 30 birds left. With careful efforts of conservationists of Hawaii, U.S. Department of Interior and other organizations, young birds have been raised and protected in captivity in U.S. and English zoos.

Today there are about 500 nene (pronounced nay-nay) geese, a number still too small to insure their survival. A new bill has been introduced in Congress to appropriate \$25,000 for conserving this rare bird.

Both the male and female nene are grayish brown, with dark brown on the top of their bodies, light brown on the sides and bellies, and with black tails, wings, bills and feet. The birds have been away from water for so long that their feet have lost the habit of swimming and are only partially webbed.

An adult goose weighs about four or five pounds, is 23 to 28 inches long and has an unmistakable goose honk.

The few wild birds that remain alive make their homes in the strips of forests that extend along the old lava flows on slopes on Hawaii's active volcano, Mauna Loa, and a neighboring extinct volcano. Here they survive on berries and green plants.

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