

ASTRONOMY

Milky Way Age Reckoned

By determining the age of the stars near the center of the Milky Way galaxy, the birth date of the galaxy itself can be fixed, Ann Ewing reports.

► THE MILKY WAY galaxy, the giant pinwheel of billions and billions of stars of which the sun, earth and other planets are a part, was born out of the gas and dust of the universe ten billion years ago.

Astronomers at Mt. Wilson and Palomar Observatories, Pasadena, Calif., found this age from studies of dwarf stars near the galaxy's center, Carnegie Institution of Washington reported in its 60th annual Year Book. The Observatories are operated jointly by Carnegie and California Institute of Technology.

Drs. Olin J. Eggen, Donald Lynden-Bell and Allan Sandage examined the orbits of a large number of dwarf stars around the nucleus of the galaxy. They found that the stars near the center are deficient in metals compared with the sun, and thus were formed at an earlier period in the galaxy's history.

They also found that the age of these stars could be used to fix the birth date of the galaxy itself. This discovery was part of continuing observations of the metal content of stars, showing that stars formed early in the Milky Way's history have substantially less metal and heavy elements than those formed later.

This is additional evidence for the theory that metals and heavy elements are formed in the last days or hours of burned-out stars that are about to explode. The heavy elements are spewed into space by ex-

plosions, and mix with the lighter gases and dusts of the universe.

As younger stars form from this mixed material, they contain more metals and heavy elements than their predecessors. Thus the metals and heavy elements in our sun, and on the earth, are products of exploding stars presumably long dead.

Responding to rising worldwide scientific interest in the moon and planets, the Observatories have been increasing their observations of these nearby objects in space in order to learn as much as possible about them by telescope before planetary probes or manned vehicles are landed.

"Information about the moon and planets can be acquired by these techniques at a cost of much less effort and money than by observations from rockets," Dr. Caryl P. Haskins, president of Carnegie Institution, said.

In another study of space-age interest, scientists at Carnegie's Geophysical Laboratory have been examining sliced meteorites with high-powered microscopes. Drs. Paul Ramdohar and Gunnar Kullerud, in observing more than 100 stony meteorites, discovered 15 new minerals not previously known.

Because these minerals occur in amounts too small for standard chemical analysis or X-ray diffraction studies, only two have been identified. They are a nickel-iron sulfide and a colorless, spinel-type mineral.

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GENERAL SCIENCE

Lone Scientist Valuable

► THE LONE SCIENTIST with an original idea has a high value in charting new avenues of research, the president of Carnegie Institution of Washington, Dr. Caryl P. Haskins, said in Washington, D. C.

Billions of dollars are spent annually for scientific research, Dr. Haskins noted in Carnegie's 60th annual Year Book. Although giant research and development projects such as the space program typify "science" to the average American, scientists working alone in modest laboratories have made valuable contributions to progress.

Practical results often follow theoretical advances, he said. Among such practical results from work of Carnegie Institution scientists, Dr. Haskins cited the following:

Discovery of the genetic principles underlying the development of hybrid corn, providing the basis for an agricultural change that was estimated to have brought an economic gain for the United States of almost \$40,000,000,000 by 1952.

Production by X-rays of a series of *Peni-*

cillium during World War II that yielded a strain producing three to five times as much vitally needed penicillin as the highest yielding strains then known.

Development of a radio pulsing technique for measuring the ionized layers of the earth's upper atmosphere, one basis for development of radar during World War II.

Studies in the field of low expansion quartz glass that later proved basic to the development of pyrex.

Discovery of the basic chemical and physical principles involved in the setting of portland cement, with consequent improvement leading to its widespread use.

Research on effective methods of determining the age of rocks, of great practical importance to mining and oil prospecting.

As an example of a recent scientific achievement of far-reaching significance made with modest resources, Dr. Haskins cited discoveries about the genetic "code" that regulates all life and determines heredity. Scientists have found that all inheritance

of physical characteristics in every type of living creature depends upon a specific kind of chemical coding, somewhat like the coding punched on cards or tape. This coding is engraved on strands of a complex chemical known as DNA, for deoxyribonucleic acid, which is located in the chromosomes of every cell.

Dr. Haskins called this advance "most important" in the understanding of the fundamental nature of life on earth.

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ASTRONOMY

Einstein Theory Affects Distance to Mercury

► THE EINSTEIN THEORY of general relativity does affect the distance to the planet Mercury, but the difference between the figures according to Einstein and Newton is so small it cannot be measured.

Dr. G. M. Clemence, director of the U.S. Naval Observatory in Washington, D. C., has calculated the corrections required by Einstein's theory to the distance of any planet according to Newton's theory. Mercury is the most favorable of the planets for testing by observation the differences between Newton's and Einstein's theory.

Dr. Clemence assumed in his calculations that the sun and its system of nine planets is neither expanding nor contracting. No measurements made so far contradict this assumption.

His calculations concerned the radius vector, which is the straight line joining the center of the sun with that of a planet.

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ASTROPHYSICS

Earth Bombarded by X-rays from Outer Space

► EARTH is being bombarded by X-rays from space far beyond the solar system itself.

How important this is in its effects upon earth is being puzzled out by physicists. Evidence for this X-ray bombardment was found from instruments carried 135 miles above the earth's surface by an Aerobee rocket launched from White Sands, N. M. The experiment was intended to measure X-rays from the moon's surface.

It was found that the measurements actually made can best be explained as being made by soft X-rays from sources outside the sun's system. Soft X-rays do not penetrate very far into the earth's outer atmosphere. Those found in the Aerobee experiment have about one-tenth the energy of the X-rays used for routine chest examinations.

Their discovery was reported in Physical Review Letters, 9:439, 1962, by Dr. Bruno Rossi of Massachusetts Institute of Technology and Drs. Riccardo Giacconi, Herbert Gursky and Frank R. Paolini of American Science and Engineering, Inc., both of Cambridge, Mass.

They report that the soft X-rays could be produced by synchrotron radiation by cosmic electrons.

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