

## PHYSICS

# Anti-World May Exist

► AN ANTI-WORLD literally made up of atoms of antimatter may well exist somewhere in the universe, a scientist suggested in New York.

Dr. Leon M. Lederman, Columbia University physics professor, and four of his associates presented new basic evidence for the possible existence of an anti-world in reporting their discovery of the antiparticle called the antideuteron, the largest known particle of antimatter.

The antideuteron is the first known antinucleus made up of two fundamental building blocks of antimatter, the antiproton and the antineutron, which were previously known individually. It is the first complex atomic nucleus of antimatter to be found, and is the antinucleus of the heavy hydrogen atom.

To demonstrate its existence, the Columbia research team used the world's most powerful atom smasher, the accelerator at Brookhaven National Laboratory, Upton, N.Y., which imparts energies of up to 33 billion electron volts, or Bev, to protons.

Deuterium is the simplest possible "complex nucleus." It consists of a neutron and a proton held together by the strong nuclear forces, Dr. Lederman stated. Know-

ing that the antideuteron exists means that all the properties of the strong nuclear force are closely mirrored in the anti-world.

These properties determine the nature of the compound nuclei that are successively built up by adding neutrons and protons.

As a result, Dr. Lederman pointed out, "it is no longer possible to question the basic physics part of the cosmological conception of a literal anti-world populated by stars and planets."

The anti-world would be made up of negative nuclei surrounded by positive electrons, the exact opposite of matter as known on earth.

"It is not possible now to disprove the grand speculation that these anti-worlds could be populated by thinking creatures," Dr. Lederman said, "perhaps now excited by the discovery of deuterium."

Technical details on the discovery of the antideuteron are reported in *Physical Review Letters*, 14:1003, 1965, by Dr. Lederman and his associates: David Dorfan, South Africa; John Eades, Liverpool; Wonyong Lee, Korea; and C. C. Ting, Taiwan.

Dr. Lederman said that a new and deeper symmetry of world and anti-world than previously thought is now believed to hold. In this view, the anti-world, which is sup-

posed to be precisely identical to our world, not only has antiparticles instead of particles but is a mirror image of our world and one in which the flow of time is also reversed.

Where the anti-world may be located is a mystery. Investigators have looked without success for evidence that it interpenetrates the known physical universe, Dr. Lederman noted.

However, he said, in cosmological theory, if the whole universe started with an explosion, there is "every reason to believe that the same number of particles and antiparticles were created. In laboratory collisions of high-energy particles, antiparticles and particles are manufactured in equal numbers out of the energy available in the accelerator."

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## PHYSICS

## New Data Indicate Metals Bond in Space

► NEW DATA on the tendency of metals to adhere to each other in the space vacuum environments have been formulated by the National Research Corporation, Newton, Mass.

Metal parts were cleaned and "cold welded" in a simulated space vacuum of orbiting altitudes (about 500 miles above earth) in a matter of three to five minutes.

Initial concern was with the possibility that lunar vehicles might become inoperative through fusion of moving parts.

But, it is claimed, the beneficial aspects might well outweigh the detrimental ones. The phenomenon could possibly be used as a method of fabricating structures on the moon or for assembling orbiting space platforms.

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## PHYSICS

## Atom Smasher to Hurl Electrons at 10 Bev

► THE WORLD'S LARGEST atom smasher to hurl electrons in a circular ring is being planned for the United States.

The accelerator that Cornell University, Ithaca, N.Y., will build under contract with the National Science Foundation is expected to speed electrons up to energies of 10 billion electron volts, or Bev.

The huge circle for the machine will be about half a mile in circumference. The electron synchrotron will give the negative atomic particles energies about four Bev higher than the six Bev machine now in operation jointly by Harvard University and Massachusetts Institute of Technology in Cambridge.

A two-mile-long linear accelerator now under construction at Stanford University is expected to give electrons energies of 10 to 20 Bev. Two other circular electron machines, at Hamburg, Germany, and Yerevan, Armenia, each about the same size as the Cambridge accelerator, are now nearing completion.

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## METEOROLOGY

# Need Weather Research

► THE DAY WHEN MAN can change the weather and, therefore, the face of earth itself could be within reach.

To reach that day, however, a stepped-up program of basic and engineering research is essential. The research is necessary to find out what causes the weather, whether on the small scale that makes a neighbor's lilacs blossom two days before yours or on the large scale affecting half a continent or the world.

No one knows, for instance, whether taking action to end a drought on the Great Plains might also bring a killing frost to Florida. Also no one really knows exactly how rain drops form inside clouds.

To learn more about such weather factors, President Lyndon B. Johnson urged Congress to take action "both in conducting basic research and in developing means to put the knowledge to work."

He noted that development of methods for altering weather and climate for the benefit of mankind would mean "vast economic and social gains."

President Johnson compared the scientific and engineering obstacles that must be overcome with those met in developing peaceful uses of nuclear power or in placing a man on the moon. Weather modification, however, is several steps behind atomic energy and the exploration of space.

Achievement of the ability to alter

weather and the climate in which men live depends upon scientific knowledge not yet acquired. The effort will probably take 10 to 30 years.

Although substantial progress has been made, the "pace has been slow," the National Science Foundation reported in its sixth annual message on Weather Modification, transmitted to Congress by the President.

The past year has seen increased support for atmospheric research by the National Science Foundation, U.S. Weather Bureau, National Aeronautics and Space Administration, Department of Interior and Department of Defense.

The most critical problem in an increased national program of atmospheric research is manpower. The National Science Foundation urged, therefore, emphasis on attracting young scientific talent to work on such programs as reducing the number and severity of hurricanes, tornadoes, and other violent storms, and improving temperature and rainfall conditions in agricultural and industrial regions.

"Imaginative, long-term effort," the report concluded, may make it possible to change the face of the earth by altering the large-scale features of the weather, bringing adequate precipitation to areas that are now semiarid or desert.

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