

## ASTRONOMY

# New Energy for Earth?

► THE UNIVERSE'S greatest explosions, colossal bursts of energy in the depths of space, hold the promise of being an immense source of energy here on earth if astrophysicists solve the puzzle of what causes these "quasars."

Astrophysicists remember that speculation gave the clue to the greatest manifestation of earthly energy. Theory as to the way the sun is stoked led to the fusion of hydrogen atoms to create the energy of the hydrogen or thermonuclear bomb.

Will history repeat?

Relativistic astrophysicists, concentrating on the universe and the quasi-stellar radio sources, "quasars" for short, hope that speculation may provide some clues. Quasars are the brightest and most radiant objects ever discovered in the sky. About 34 of them are now known. They shine in the farthest reaches of the universe with a brightness a trillion times greater than the sun.

How they get their energy for such a tremendous outpouring of radiation, both as light and radio waves, is not known. One suggestion is that quasars are stoked by gravitational collapse when huge clouds of matter, perhaps entire galaxies of billions of stars, shrink under their own weight.

Quasars probably have energies "hundreds or thousands of times greater" than scientists have thought, Dr. G. R. Burbidge of the University of California, San Diego, told the Second Texas Symposium on Relativistic Astrophysics in Austin, Texas.

The reason for suggesting that these objects have such tremendously high energies, Dr. Burbidge said, lies in measurements made on earth with the powerful atom smasher of CERN in Geneva. These measurements showed that the rate at which energy was pumped in was "3,000 times greater" than that needed to make relativistic electrons, which are electrons traveling at nearly the speed of light, or 186,000 miles a second.

Nature must be several hundred or thousand times more efficient than man at making relativistic electrons, which are believed responsible for the observed outpouring of radiation. The mystery is where the electrons get their relativistic energy.

An understanding of how this occurs, Dr. Burbidge said, will bring about a revolution in astronomy similar to that of 25 years ago when Dr. Hans Bethe showed how the sun was stoked. This is by the fusion of atomic nuclei, the same reactions unleashed on earth in thermonuclear bombs.

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## Two New Neutron Stars

► ROCKET FLIGHTS have revealed eight new sources of X-rays in the sky, giving scientists a new way of looking at the universe. Three of the total of ten X-ray sources now known may be neutron stars, with each cubic inch weighing a billion tons. This would be like squeezing the sun's

matter into a sphere only ten miles in diameter.

Discovery of eight new X-ray sources was reported to the conference on relativistic astrophysics by Dr. Herbert Friedman of the Naval Research Laboratory, Washington, D.C. The ten were discovered by instruments lofted high above the earth's atmosphere during rocket flights, the latest of which was made on Nov. 25.

Three of the ten X-ray sources are not connected with any sources of visible or radio waves, Dr. Friedman reported. These are the three believed to be neutron stars.

Another three of the X-ray sources can be linked to visible objects, two to supernova, the explosion of a star that suddenly flares up to millions upon millions of times its usual brightness. The third lies close to the center of the Milky Way galaxy containing billions of stars.

All ten of the X-ray sources lie close to the center line, or plane, of the Milky Way, Dr. Friedman reported. Even though they appear to be of two distinct types—those associated with visible objects and those not linked with radio or light waves—the pattern of their distribution suggests they are all associated with supernovas.

## Energy Caught in Act

► A "QUASAR," the universe's energy champion, has been caught in the act of exploding in far-distant space.

Astrophysicists see this new object, possibly the most distant ever discovered, as a potential clue to the most powerful source of energy ever imagined.

The discovery was reported by Dr. Allan R. Sandage of Mt. Wilson and Palomar Observatories, Pasadena, Calif.

Further studies of this puzzling object, known as the quasar 3C-2, should give scientists clues to the unknown way in which it and other similar sources manage to be such tremendously powerful radiators of light and radio waves.

The other new objects discovered, besides 3C-2, bring the total of known quasars to 34, Dr. Sandage said. Some identifications are considered tentative.

The optical brightness of 3C-2 has increased at least four times during the last three years, an inspection of previously exposed astronomical plates showed. It is the faintest quasar so far discovered, which should make it the most distant yet spotted.

Observation of the new object means that man is now looking over an even larger fraction of the entire universe than before.

The most distant quasar previously known was 3C-147, whose light left its source when the universe was only half its present age of 15 to 20 billion years.

Quasar 3C-147 is traveling through space away from earth at more than half light's speed of 186,000 miles a second.

No change in the intensity of the radio waves sent out by 3C-2 has been detected in the last three years, Dr. Sandage said.

A variation in optical brightness without a change in the radio brightness means that whatever occurred in the object affected only the light source.

## Universe Model Progress

► EINSTEIN'S THEORY of general relativity, which describes the structure of the universe, gives a model of the cosmos that does not pulsate.

A pulsating universe is sought because it would make Einstein's theory agree with the way the observed universe appears. So far, no one has been able to construct a model of the cosmos that resembles the actual structure as far as it is known. This is a universe that is dust-filled and in which rotation occurs.

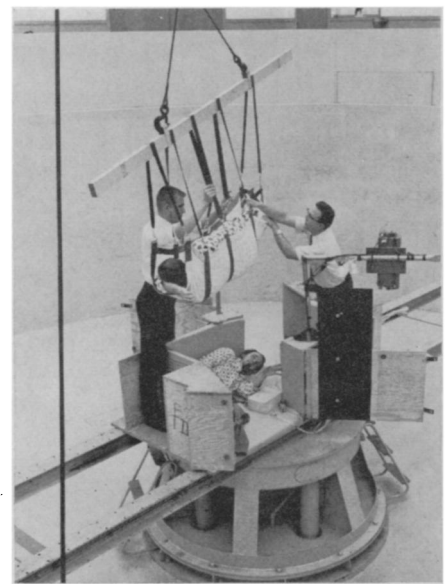
Models of the universe's structure are important in understanding how stars collapse said L. C. Shepley, a Ph.D. candidate at Princeton University.

There is a connection between models of the cosmos and the behavior of stars, he said. The fate of a collapsing star could also be the final fate of the universe, Mr. Shepley suggested.

Einstein's general theory of relativity seems to predict that the universe has existed only for a definite time, now thought to be 15 or perhaps 20 billion years. Mr. Shepley said that the question of whether or not the cosmos has a definite lifetime remains unsolved.

He examined a number of cosmological models in which rotation is allowed and found that three have existed for a definite time.

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Douglas Aircraft Company

*EASY DOES IT — Pajama-clad biomedical subject Guy King is being gently lowered in a special net hammock into a centrifuge carriage that is part of an experiment to simulate weightlessness and test the effect of centrifugation on the cardiovascular system.*