

## PHYSICS

# Cosmic Rays Are Declared Principally Particles

Over Nine-Tenths of Energy Detected by Research Instruments is Thus Accounted For, It is Found

**T**HE GREATEST piece of scientific detective work of modern times—the research to learn the nature of the baffling cosmic rays—is almost completed. Over nine-tenths of all the cosmic rays which scientists measure on stratosphere flights and in their worldwide surveys consist of positive particles streaming to earth from interstellar space.

This is the report which Dr. Thomas H. Johnson, assistant director of the Bartol Research Foundation at Swarthmore, Pa., presented to the American Association for the Advancement of Science.

"It is now possible to say with considerable certainty," declared the cosmic ray researcher, "that the particle part of the cosmic rays accounts for from 90 to 98 per cent. of the total intensity at the top of the atmosphere. It is highly probable therefore that by far the greater part of the cosmic radiation consists of positive particles and there is at the most but a few per cent. to be accounted for in some other way, possibly as a gamma radiation."

Dr. Johnson bases his contention that cosmic rays are really positively charged particles on the clearing up of the three major objections to the corpuscular theory of the radiation's nature. The former objections, he indicated, were:

First, that the particles did not have great enough energies to account for their often remarkable penetration through lead and other dense materials. Theory demanded that the rays (if they were particles) should have energies equal to 10,000 million volts. Most of the cosmic rays observed had only 600 million volts energy.

Second, the stopping of the rays as they came through the atmosphere of the earth was much too great. The absorption of cosmic rays, providing they were corpuscular in nature, was 25 times what it ought to be on theory.

Third, the amount of absorption as indicated by the range of the atom debris, which the rays knocked out of

atoms inside cosmic ray instruments, did not vary with the energy of the incoming radiation. If the theory were correct, the absorption coefficient ought to change with energy. Observations have proved that for great differences of cosmic ray energy the absorption is either independent of the energy, or not related to it.

The first and second objections, said Dr. Johnson, have been advanced by Prof. Robert A. Millikan and his colleagues at the California Institute of Technology. The third is a new mystery advanced by himself, he added.

All three objections to the particle nature of cosmic rays may be solved, the Bartol scientist declared, if one realizes that the incoming corpuscular rays make direct hits on the nuclei of atoms in the air. These direct impacts cause the "showers" or "bursts" of cosmic rays detected by many observers.

It is probable, said Dr. Johnson, that every time one of the high-energy primary particle rays hits an atom nucleus it creates 25 secondary rays of the lower energy. The collision would account for the seemingly 25 times too great absorption of the rays and indicate that scientists have only a twenty-five to one chance of detecting the incoming high-speed particle. The secondary rays produced would be the "soft" 600-million-volt rays observed by Carl Anderson and others in the Wilson cloud chamber apparatus.

The nucleus impact phenomenon, Dr. Johnson added, is a chance occurrence. For still more penetrating rays with energies of 100,000 volts, a direct hit would produce about 1,700 secondary rays with energies commonly observed—the 600-million-volt rays.

With all this mixture of secondary radiation present in the instruments it would be a rare, lucky chance indeed which would demonstrate the existence of a really high-energy particle even though a large fraction of incoming radiation is of the positive particle type, he added.

"Shower production seems to be able," Dr. Johnson concluded, "to explain away the principal difficulties which have been raised with the corpuscular hypothesis and it is extremely unlikely that any other hypothesis would be able, in such a simple manner, to correlate so many cosmic ray effects. In fact, I think we may say that this hypothesis is now substantially proven, as an explanation of the principal part of cosmic radiation."

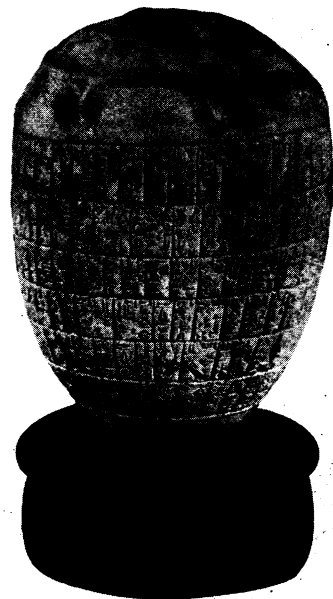
*Science News Letter, June 30, 1934*

## ARCHAEOLOGY

## World's Oldest Peace Treaty Carried a Curse

**I**NTERNATIONAL worries over treaties have not changed much in 4800 years, judging by a look at the world's oldest peace treaty, which is now in the possession of Yale University.

The world's oldest known treaty of peace was made between two rival Sumerian cities, after bloody wars over a boundary line. The city of Lagash finally conquered the city of Umma about 2900 B. C., and the treaty drawn up between the two called for repara-



**OLDEST PEACE TREATY**

*Peace between two cities was guaranteed by the words of this treaty. The conquering city had the clay treaty drawn up on a piece of clay shaped like a hunter's net. That was a sinister bit of diplomacy, meaning that the god Ningirsu would capture in his great net the vanquished people, if they dared break the terms. Curse or no curse, the treaty failed.*