PHYSICS

Einstein Principle True

EINSTEIN'S principle of equivalence is true for electromagnetic waves such as radio and light, two physicists at Harvard University have found in very precise experiments.

The equivalence principle is one of the basic assumptions of Einstein's general theory of relativity. It states that no detectable difference exists between the force of gravity and the force produced by acceleration outside a gravitational field.

Earlier experiments have proved the equivalence principle for material bodies, but only recently has the effect of gravity on light, radio waves and gamma rays been detected in the laboratory. If gravity and acceleration are equivalent, Einstein concluded that a gravitational field should lower the frequency of light rays escaping from a gravitational field.

This effect, called the gravitational red shift, had not been conclusively measured until recently. Now, Prof. Robert V. Pound and Glen A. Rebka Jr. have measured the change in frequency of gamma rays as the rays moved up and down through a 70-foot column. They found that gravity raised the frequency of the falling gamma rays and lowered the frequency of the rays rising against the force of gravity.

The Harvard scientists report their results in Physical Review Letters, 4:337, 1960. Their measurements of the gravitational red shift averaged 105% of the value predicted by Einstein, with an experimental uncertainty of 10%.

Another group of physicists at the British Atomic Energy Establishment has also been testing the effect of gravity on electromagnetic waves.

Prior to these studies, scientists were able to study the effect of gravity on electromagnetic waves only by astronomical observations of distant stars. In such observations, precision is low.

The laboratory tests were possible because the nuclei of certain atoms, after decaying from one element into another, give off gamma rays of a sharply defined frequency. Energy of this frequency is absorbed by stable nuclei of the same element as the end-product of the decay.

Prof. Pound and Mr. Rebka started with radioactive cobalt-57 at one end of the helium-filled tower, and iron-57 at the other. They then tested how the absorption of gamma rays by the iron-57 was affected by the upward and downward motion of the cobalt-57.

The overall sensitivity was such that an analogous device for sound would be able to detect the motion of a vehicle moving at about one inch per 3,000 years from the change of pitch of its horn.

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COLUMN OF HELIUM—A 70-foot helium filled column is used at Harvard University to test whether Einstein's principle of equivalence holds for electromagnetic waves. At the foot of the column, Glen A. Rebka Jr. has telephone contact with the top floor where the column ends.

GENETICS

Sperm Heads in Man Differ

WHETHER it is a boy or a girl baby may depend upon whether it is a round-headed or long-headed sperm from the father that penetrates the ovum.

Two distinct types of sperm cells in the human male's semen have been seen and photographed. This may mean that sperm cells with round heads give rise to boy babies while sperm cells with elongated heads give rise to girl babies.

Dr. Landrum B. Shettles, assistant professor of clinical obstetrics and gynecology at the Columbia University College of Physicians and Surgeons, adopted a simple and little-used technique to make the discovery. He had been using standard procedures for staining sperm samples until about a month ago when he hit upon the idea of using no stain at all.

By making a thin smear of sperm cells on a glass slide, allowing the slide to dry and examining it under a phase microscope, he could distinguish one type of sperm cell with small, round heads, and another type with larger, more elongated heads. The more popular preparation techniques made all the sperm look alike, Dr. Shettles explained.

The nucleus inside the cell had the same shape as the cell itself—elongate head, elongate nucleus; round head, round nucleus. In addition, the most centrally situated chromosome in each type of nucleus had the "exact size and shape relationships as the X and Y chromosomes" in the cells from which the sperm developed. From his knowledge of the way sex chromosomes duplicate themselves, Dr. Shettles came to the conclusion that the smaller heads contain the Y (male) factor and the larger heads the X (female) factor.

By studying sperm samples from 30 men, Dr. Shettles found that nuclear size for the two types of sperm remained "remarkably constant" within a given specimen. But the overall size varied to different degrees from one individual to another.

Dr. Shettles, who has been doing research work for more than 20 years, is enthusiastic about the discovery and plans to do statistical studies on his findings. It is generally believed that about 140 boy babies are conceived for every 100 girl babies conceived. If the head shape of the sperm has the significance Dr. Shettles suspects, actual counts will show about 140 round-head sperm for every 100 long-headed sperm. Another study is aimed at showing whether the round-headed sperm can travel faster and penetrate the ovum more easily.

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ZOOLOGY

Temperature May Decide Sex of Sea Urchins

A CRAZY, mixed-up bunch of sea urchins may be the result when nature throws cold water on the sex life of the spiny creature of the tide pools.

Dr. Richard Boolootian, zoologist at the University of California, Los Angeles, has evidence that temperature may play an important role in sex determination of the sea urchin.

First of all there is an indication that warm water generally produces more male sea urchins while cold water produces more females. And recently Dr. Boolootian found that in warm water masses subject to wide fluctuations in temperature there was a relatively large number of bisexual sea urchins.

He theorizes that cold shock may be involved in this bisexual pattern of sexuality. Preliminary laboratory experiments tend to bear out this theory of environmental control of sexuality.

Fortunately all this sexual juggling apparently does not work any hardship on the sea urchins. Bisexual sea urchins can fertilize and produce their own eggs.

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