

continued, "we assume that in the auroral region the atmospheric matter is brought to high altitudes through the effect of electrical forces, which result from the photoelectric action of sun's rays of short wavelength."

Singularly enough, there are no spectrographic lines indicating the presence of the light gases, helium and hydrogen, at these elevations; or at most they are exceedingly faint and feeble. This runs quite counter to the assumption often made that layers of these "balloon gases" float on the top of the earth's atmosphere. On the contrary, all the gases in the atmosphere seem to be thoroughly mixed.

By comparing spectra of auroral light with those of laboratory light sources at known temperatures, Prof. Vegard concluded that auroral light centers are active at temperatures about 22 degrees below zero Fahrenheit.

*Science News Letter, May 6, 1933*

#### ASTRONOMY-PHOTOGRAPHY

### Planet Photographed Eclipsing Star

**P**HOTOGRAPHS showing the rare event of the eclipse, or occultation, of a star by a planet, which took place late on the night of April 20 and during the wee hours of the twenty-first, were made with the great forty-inch refracting telescope of the Yerkes Observatory, Williams Bay, Wis., by Otto Struve, C. T. Elvey and W. W. Morgan.

The star was of the ninth magnitude, far below the limit of naked-eye visibility, so that a powerful lens was required to get its photograph at all, especially as it approached and began to be lost in the brilliant light of the great planet. Being such an inconspicuous object the star has no name of its own, only a number in an astronomer's catalog: "BD plus 8 degrees 2456."

Describing the photographs, from which the drawing was made for SCIENCE NEWS LETTER, Director Struve of the Observatory said: "It will be noticed that on the first plate the star is quite far away, while on the last it nearly touched the limb (edge) of Jupiter. The four black spots on the other side of Jupiter are the four brightest satellites of the Jovian system.

"It is reasonable to expect that about one occultation (by Jupiter) in four or five years will be observable at any given observatory."

*Science News Letter, May 6, 1933*

#### EVOLUTION—MATHEMATICS

## New Mathematical Method Charts Course of Evolution

**A** NEW mathematical method, which makes the course of evolution a measurable thing, was demonstrated to the National Academy of Sciences by Dr. Harry H. Laughlin of the department of genetics of the Carnegie Institution of Washington, located at Cold Spring Harbor, N. Y.

It takes cognizance of hereditary differences hitherto considered too small to be bothered with, and by charting the direction of their development with great exactitude will enable scientists to foretell, on the basis of measurements of a few generations, the present trend of evolution at the close of a great many generations.

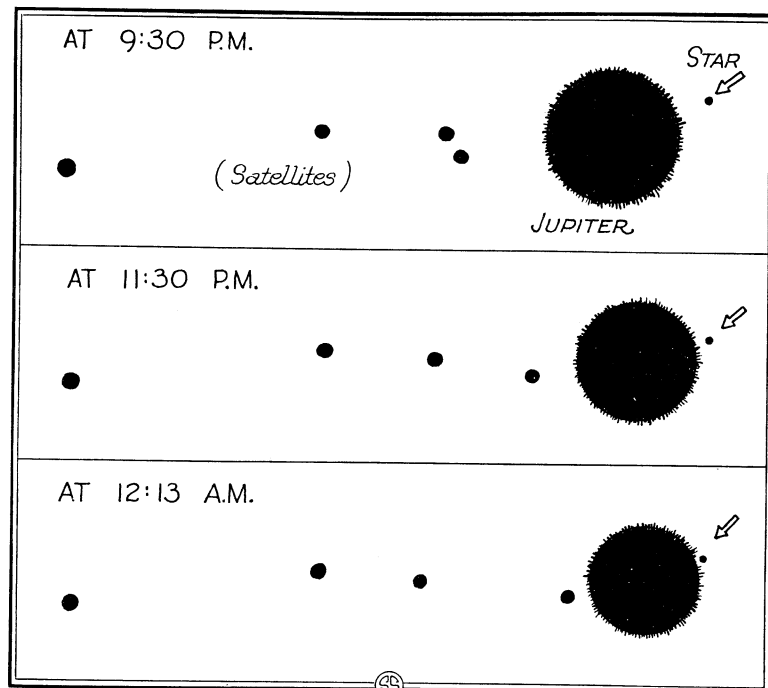
Since the application of the Mendelian principles to the science of genetics, students of that subject have been interested quite largely in characters determined by single "genes" or hereditary units, or at most by a small number of genes. But some of the hereditary traits of greatest practical and social importance, like running ability in thoroughbred horses or height in men, have defied analysis into separate genes. They are probably due to the in-

teraction of thousands of genes, and only their net results, as they show themselves in departures in offspring from average conditions in parental stocks, can be measured.

Dr. Laughlin's method takes such a departure from a parental average—say an increase of a fraction of an inch in height of offspring over height in parents—and maps its course through several generations. On the same graph he traces another line, representing the thing with which comparison is to be made. Neither line is straight, but in both a direction can be traced.

The two lines tend to converge, and the point where they intersect represents the culmination of the evolutionary development of that particular character—the genetic mean. This is the present evolutionary goal.

One line of development to which Dr. Laughlin applied his method had the advantage of being all finished and done with, so that he could make his prediction and then look to see whether it had been fulfilled. It had to do with the skull-length in titanotheres, monstrous beasts that ran their course dur-



ONCE IN FIVE YEARS

ing some fifteen million years early in the Age of Mammals. These animals have been studied in great detail by Dr. Henry Fairfield Osborn, honorary president of the American Museum of Natural History. They started with skulls less than a foot long, and before they became extinct they had skulls about a yard in length. According to Dr. Laughlin's charting, they could have become even bigger-headed, if other conditions had not cut them off before the tendency of their skulls to grow had worked itself completely out.

Dr. Laughlin has been working on his mathematical method for applying the data of genetics to the problems of evolution for a good many years. His full technical discussion will appear as a special publication of the Carnegie Institution of Washington.

*Science News Letter, May 6, 1933*

#### PHYSICS

### Tests Indicate Cosmic Rays Are Particles

**C**OSMIC RAYS smash into the atmosphere of Mexico City with more intensity from the west than from the east, Dr. Thomas H. Johnson of the Bartol Research Foundation has found in the course of an expedition arranged with the cooperation of the Carnegie Institution of Washington.

His experimental results presented to the American Physical Society on Dr. Johnson's behalf by Dr. W. F. G. Swann, director of the Bartol Research Foundation, uphold the idea that cosmic rays are composed principally of positively charged corpuscles or particles.

With three cosmic ray counters arranged in line so that a record was made only when all three were coincidentally discharged by cosmic radiation, Dr. Johnson pointed his instrument at various elevations.

Comparing the intensities of cosmic radiation on the east and west sides of the magnetic meridian of Mexico City, Dr. Johnson found percentage differences between east and west ranging from 1 per cent. at 25 degrees distance from the zenith to 25 per cent. at 65 degrees to the zenith.

"These results are just those to be expected on the basis of the theory of the latitude variations of Lemaitre and Vallarta," Dr. Swann explained, "and they show that the principal corpuscular component of the primary cosmic radiation is positively charged."

*Science News Letter, May 6, 1933*

#### PHYSICS

## Drs. Compton and Millikan Agree On Experiments

### Both Scientists Approve Statement Presenting Similarity; Both Particles and Photons In Incoming Beam

**D**R. ROBERT A. MILLIKAN and Dr. A. H. Compton, two of the leading experimenters upon cosmic rays, have announced agreement in experimental data gathered by different methods upon separate expeditions.

To the National Academy of Sciences meeting in Washington, Dr. Millikan told how delicate instruments borne aloft by airplanes showed that cosmic rays diminish in hardness or penetrating power at the same rate whether the locality is near the equator or in high latitudes such as in the United States. Dr. Compton reported that his experiments on high mountain peaks in this country and in South America in the tropics showed the same effect.

In other words both Dr. Millikan's and Dr. Compton's experiments can be interpreted by assuming that both photons and particle rays, some of them perhaps the new positron particle discovered last year in Dr. Millikan's Pasadena laboratory, are present in the incoming beam.

This article is, in effect, a joint statement by Drs. Millikan and Compton who are often pictured as holding opposite views upon cosmic rays. Both scientists approved the article.

*Science News Letter, May 6, 1933*

#### PHYSICS

### Most of Universe's Radiant Energy in Cosmic Rays

**C**OSMIC RAYS, totally unknown a few decades ago, are now recognized to comprise the greater portion of the radiant energy of the universe, Dr. Robert A. Millikan, of the California Institute of Technology, Pasadena, told the National Academy of Sciences at its meeting in Washington.

As the result of new researches with sounding balloons and airplanes this past year, Dr. Millikan and his associates have determined with great accuracy the way in which cosmic rays vary downward from nearly the top of the earth's atmosphere. The recent experimental results, combined with the findings of Dr. Millikan and other exper-

imenters in past years, allow Dr. Millikan to conclude that the total radiant energy in our galaxy in the form of cosmic rays is nearly the same as that in all the other forms of radiation, such as light and heat emitted by stars.

In the immense spaces between the galaxies of stars the starlight and heat must diminish to a small amount of that found in our own Milky Way galaxy, but the cosmic radiation coming to the earth from far beyond our neighbor stars, from the depths of the universe, must be even greater in intensity in intergalactic space. In this way Dr. Millikan concludes that cosmic radiation forms the greater part of the radiant energy of the universe.

#### 20 Miles Up

One of the sounding balloons launched by Dr. Millikan and Dr. I. S. Bowen reached a height at which only a half of one per cent. of the atmosphere's weight remained above it, equivalent to about 20 miles altitude (16 millimeters of mercury pressure). The cosmic ray electroscope record obtained was reliable up to nearly that height, to within about 92 per cent. of the top of the atmosphere. One other balloon flight, carrying the remarkably light, automatic instruments to great heights in the stratosphere, agreed closely with the record flight, and the two checked closely the results of a similar sounding balloon ascension made at the same time by the German physicist, Regener.

With a cosmic ray electroscope, devised by Dr. H. Victor Neher, that records accurately and automatically under the strenuous conditions of rushing auto, railroad train or airplane, measurements of cosmic ray intensity have been made at altitudes up to 29,000 feet, nearly six miles. U. S. Army bombers and pursuit planes carried the instruments aloft first without screening and second screened by a shield of lead of 10 centimeters thickness at several localities in the United States and at Panama, while commercial (*Turn to Page 286*)