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NEW EXPERIMENTS ON ETHER DRIFT

WHAT is said to be a new point in favor of the validity of Einstein's theory of relativity is contained in a series of experiments recently completed by Dr. Roy J. Kennedy, of the California Institute of Technology, which have just been reported to the National Academy of Sciences.

The experiments were a repetition of the Michelson-Morley experiment, named after the physicists who first performed it many years ago. It was intended to show whether or not the earth, on account of its motion, was drifting through the ether, which was supposed to permeate all space, and to be the medium in which light waves vibrate. When first performed, an almost negligible result was obtained. It was partly in an effort to explain this unexpected result that the theory of relativity was formulated. When repeated last year by Dr. Dayton C. Miller, of the Case School of Applied Science, Cleveland, working at the Mt. Wilson Observatory in California, a mile above sea level, an apparent effect was found. While this was not as great as had been originally expected, Dr. Miller said that it could be explained by a motion of the sun, and the earth with it, towards the constellation of the Dragon, at a speed of over a hundred miles a second.

Dr. Kennedy has repeated the experiment with an improved form of apparatus, in which the beam of light, which is divided into two parts and then recombined, causing alternate light and dark "interference" bands, travels only about 13 feet, instead of more than 200 feet as in Miller's apparatus. The effect sought for is measured by means of a shift in these interference bands as the apparatus is pointed in different directions. With the instrument used by Dr. Miller, says Dr. Kennedy, a difference in pressure of a twenty-five thousandth of a pound per square inch in the air through which the two parts of the divided beam pass would produce an effect as great as that observed. A temperature difference of a five hundredth of a degree Fahrenheit would produce the same effect.

Dr. Kennedy's light path was so much shorter that there was much less chance of such error, and the entire apparatus was small enough to be completely enclosed in a sealed metal case containing helium gas, which was at atmospheric pressure. This prevented circulation of the air and any difference in pressure or temperature in different parts of the apparatus. By means of an improvement in the way of observing the interference bands, the instrument is as sensitive as Dr. Miller's, despite the shorter light path. However, though "a shift as small as one fourth that corresponding to Miller's would be perceived," said Dr. Kennedy, "the result was perfectly definite. There was no sign of a shift depending on the orientation. Because an ether drift might conceivably depend on altitude, the experiment was repeated at the Mt. Wilson Observatory, in the 100-inch telescope building. Here again the effect was null."

OBSERVATIONS ON ETHER DRIFT FROM A BALLOON

MIDNIGHT balloon ascensions a mile and a half high made recently in Belgium may prove to be strong evidence in favor of Einstein's theory of relativity and contrary to the results obtained by Dr. Dayton C. Miller, of the Case School of Applied Science at Cleveland, working at the Mt. Wilson Observatory in California, which were supposed by some authorities to be fatal to the theory. These balloon experiments, just published in Berlin, were made by Professor A. Piccard and Dr. E. Stahel, of the University of Brussels.

Dr. Miller's experiments were said to indicate a drift of the ether which is supposed to pervade all space and in which light travels. This drift was presumably due to the motion of the earth in its orbit through the ether and the experiments indicated that while an almost negligible result had been obtained when they were performed at sea-level, at the mile-high top of Mt. Wilson there was an appreciable drift. This variation with height could not be explained by the Einstein theory.

In the new work, Dr. Miller's experiment, which was first performed many years ago by Dr. A. A. Michelson, of the University of Chicago, and the late Dr. Edward Morley, when they were both professors at the Case School, was repeated at sea-level and from a balloon. A somewhat modified form of apparatus was used, in which the records were made on a photographic film, instead of by the eye, as in Miller's apparatus. As it is necessary to turn the apparatus while the experiment is in progress, so that it successively points in different directions, this was accomplished by providing the balloon with two small electrically operated propellers, turning the entire balloon about two or three times a minute. The illumination of the apparatus, which must be furnished by light of a single color, was obtained from the blue radiation of a mercury vapor lamp.

From measurements of the photographic records, it was found that there was an apparent ether drift of about four and a third miles a second. However, as the thermostat controls of the apparatus, intended to keep it at a constant temperature, were designed to work with the thermometer below freezing, and since unexpectedly higher temperatures were found the night of the ascent, the results may be in error by an amount as great as the value found. However, it was stated, they show that the value of the ether drift does not increase the higher above the earth the observations are made, which was the chief point of antagonism with the relativity theory.

DAILY VARIATION IN PENETRATING RAYS

THAT the penetrating rays from space, first observed by a German scientist, Dr. Werner Kolhoerster, and recently studied by Dr. R. A. Millikan, of the Norman Bridge Laboratory, Pasadena, Calif., undergo a daily variation is shown by experiments recently completed by Dr.

Kolhoerster in Switzerland. These studies, which were conducted on the Jungfrau glacier and in other mountainous regions, were made with the assistance of Dr. Gubert von Salis.

As a result of Dr. Millikan's observations, it was supposed that these rays, which are very short vibrations, similar to ordinary light and X-rays, but far shorter than either, came in equal quantities from all regions of space, so that their intensity was the same at night as by day. But the new experiments show that they vary, not with the position of the sun, but with the aspect of the heavens. When the Milky Way is most nearly overhead, the intensity of the rays comes to a maximum. When the constellations of Hercules and Andromeda are best placed, the intensity is greater than at other times. This shows, in the opinion of the experimenters, that although the rays come from all parts of space, the chief centers of the rays that reach the earth are the Milky Way and the constellations of Andromeda and Hercules.

The center of radiation in the constellation of Andromeda seems to be the great spiral nebula, which Dr. Edwin Hubble, astronomer at the Mt. Wilson Observatory in California, has shown to be a system of stars similar to that which makes up the Milky Way, and all the stars that we can see, including the sun, and which astronomers call the Galaxy. It would therefore seem that Dr. Kolhoerster's and Dr. von Salis's experiments have provided a new proof of the similarity of these spiral nebulae to our galaxy.

A HIGH-POWER CATHODE RAY TUBE

A SUPER-POWER cathode ray tube, which will take much higher voltages than the tube which he demonstrated recently at the Franklin Institute, in Philadelphia, and which has attracted considerable scientific attention, is now planned by Dr. W. D. Coolidge, assistant director of the General Electric Company's research laboratory. The new form of the tube is described by Dr. Coolidge in an article in the December issue of the *Journal* of the Franklin Institute, which is about to appear.

Briefly, the method which he proposes to use is to "cascade" two or more tubes, the rays from one being fed into another, which speeds them up still further and increases their range. The cathode rays are rapidly moving electrons, small particles of electricity, moving with speeds of a hundred thousand or more miles a second. These electrons start from a small electric light filament from which they come at speeds of merely a few miles a second. With a voltage of 350,000 they are speeded up within the tube, so that they leave it with a velocity of 150,000 miles a second. By building larger tubes, it will be possible to increase the voltage to a certain limit, but when too much power is applied to a single tube the cathode itself is bombarded by positive rays, which move in opposite directions to the cathode or negative rays. This introduces troublesome effects.

By arranging two or more tubes together so that the nickel window at the end of the tube, from which the rays ordinarily emerge into the open air, acts as the cathode of the next tube, they are already moving at great speed when they leave the first tube and when the same voltage is applied to the second tube they are still further accelerated. The window between the two tubes may be made thick enough so that it passes the cathode rays going in one direction, but stops the positive rays going the opposite way, as they are less penetrating. Another advantage of the multiple tube over a single very large one is that it is much easier to supply, for instance, four tubes with 250,000 volts each than one tube with a million volts.

Dr. Coolidge says that he will try out this arrangement of the tubes as soon as the development of the single tube has been pushed to as high a voltage as possible.

MOTOR FUELS

ACCORDING to Dr. Gustav Egloff, who has investigated the possibilities of getting motor fuels from various sources, the potential future gasoline supply will last for hundreds of years and it will come from "cracking" a wide variety of materials such as petroleum, coal tars, shale oil and wood tars. The old-fashioned gasoline was simply evaporated off of the crude oil and had no anti-knock properties. The modern "cracking process" is a way by which heavy oils are chemically broken down into lighter ones suitable for motor fuels. "Cracked" gasoline has valuable anti-knock properties and the gasoline of the future will be a mixture of the two. Motor fuels will yield double the mileage and have anti-knock and easy-starting properties.

But the cracking process has not only created new styles in the quality of gasolines, Dr. Egloff explained, but has also introduced a new variety of colors. Although there are still many specifications that require gasoline to be water-white, the automotive cylinder that transforms "gas" into miles has no preference for any particular shade or tint. In fact color means nothing to the motor. It does, however, mean something to the distiller, for he often tries to doctor up his gasoline to get rid of all trace of color and as a result loses some of the anti-knock properties.

"It is a happy sign to motor over the country and see not only yellow, but pink, red, blue and green as well as water-white gasoline in the visible bowls," Dr. Egloff said. "The motor is no stickler for style. It will operate as well with the yellow as with the water-white, blue, pink, or even red, gasoline. Perhaps some day the motorist will suit the color of the gasoline to the car he uses."

"Not only should the public get used to all sorts of colors in gasoline, but to all sorts of odors as well," Dr. Egloff continued. "The cracking process has given motor fuel new smells as well as new colors and to remove them is a useless waste of labor as well as material."

BROADCASTING LICENSES

SINCE the attorney-general rendered the opinion that the secretary of commerce had not the authority to refuse radio licenses, the Department of Commerce has been forced to grant broadcasting licenses to every one who might properly ask for them. The result is that on July

1, there were 536 broadcasting stations. After five months of unrestricted licensing there are 637, or 101 more stations, and the rush of applicants is increasing.

The belief that something must be done quickly to stem the tide of licenses led Representative White, of Maine, and Representative Dickstein, of New York, to introduce resolutions for temporary legislation on the first day of the meeting of the congress. Mr. White's resolution would prohibit the licensing of new broadcasting stations until permanent legislation can be enacted. The Dickstein resolution gives Secretary of Commerce Hoover power to control radio operation during the period of the emergency.

Mr. Dickstein's resolution is to be considered at a committee hearing early next week.

"There is little hope for permanent legislation at this short session of congress," Mr. Dickstein said recently. "And unless the present situation is brought to a halt complications and confusion will be enormous."

He pointed out that the public is the sufferer. While the congress is taking time to work out the best law to govern radio wave lengths, the public is much confused and is not getting fair return on its investment in radio apparatus.

The Department of Commerce has been receiving communications from different parts of the country which indicate that the disturbance to radio reception is growing. In the immediate vicinity of New York City there are about 52 broadcasting stations, according to W. D. Terrell, chief of the radio division. Chicago is also a center for about 50 stations, all claiming their share of the air and the public's attention.

"Up to the time of the attorney-general's decision, we were licensing stations and giving the wave lengths on which they could be operated with the least interference," said Mr. Terrell. "Now, the station owners select their own lengths and they frequently select those used by other near-by stations. If they operate simultaneously with these stations, interference is inevitable."

We have at the present time only 89 wave lengths and Canada uses five of these, leaving the United States 84. This in itself explains the confusion that exists among the 637 broadcasters.

Increasing the number of wave lengths is possible, but would involve difficulties, he explained. Radio receiving apparatus is now made to cover the broadcasting band from 200 meters to 545. Amateurs use lengths below 200 meters. Lengths above are reserved for ships.

If broadcasting stations were allotted wave lengths outside the present range radio apparatus would have to be altered to permit reception. Another difficulty would be encountered in changing the ship wave lengths, because of their number, and because of the fact that the ships are controlled by other governments besides our own and international agreements are involved. The wave length of 600 meters, for instance, on which S.O.S. signals are given, is reserved by international agreement for distress purposes. Even if the broadcasting band was widened, the situation would continue to be chaotic, if stations should continue to multiply.

ITEMS

WILL bacteriophage, mysterious sub-microscopic subject of endless scientific controversy that has been called the disease of bacteria, become a cure for one of the oldest and most common of mankind's afflictions, painfully famous ever since the days of Job? Utilized in the past by its discoverer d'Herelle to help cure dysentery, a group of French medical workers have found that anti-staphylococcus bacteriophage is a successful agent for clearing up a whole class of infections of the sort responsible for boils, abscesses and carbuncles. The bacteriophage was first tried out on animals and in every case its action on pus from the suppurating sore was first checked in the test tube before being used on the patient. It is injected locally and applied in dressings to the affected region. Lasting cures in about 75 out of 100 cases have been achieved in from four to five days, a report in the *Presse Medicale* claims.

THE Chemical Warfare Service makes an announcement which it is expected will relieve the minds of many people vitally interested in the continuance of the supply of cheap calcium arsenate now used extensively in the warfare against orchard insects and especially against the cotton boll weevil. The officers of the service do not say just what are the substitutes discovered but state that should an emergency arise or the price of calcium arsenate increase too much, the service is prepared with substitutes to correct either evil. It is only a few years since the supply of calcium arsenate on hand was so depleted as to arouse serious fears. The use of arsenicals in war operations and the greatly enlarged demand for calcium arsenate from cotton planters in the South occasioned this great reduction of the poison and resulted in so great a rise in price as to make it almost prohibitive to cotton planters.

A GIANT pendulum, formed by a strange freak of nature, swings in Yellowstone National Park not far from Old Faithful geyser, according to Ansel Hall, government naturalist in charge of the lecture and nature study work of the U. S. National Park Service. It consists of the trunk of a lodgepole pine, suspended by its top between two other trees of the same species and swinging clear at its base, so that a mere touch will set it to swaying. Apparently the tree fell or was blown over many years ago, its top becoming lodged in the tops of its neighbors, which grew out and surrounded it, supporting it securely. Subsequently several feet of its base rotted away, leaving it suspended in midair. One of the park nature trails has been run near this strange natural grandfather-clock and tourists are permitted to set it swinging.

A BEETLE that furnishes the principal decorative motif in a famous shrine in this country has been identified as being the same insect as that figured on certain royal relics recently unearthed from a tomb in Korea. Professor Hachiro Yuasa, of Kyoto Imperial University, speaking before the Pan-Pacific Science Congress, stated that the distribution of the "jewel beetle" and the identity of the materials used in representing it are important evidence of the distribution of a common culture between ancient Japan and Korea.