SCIENCE NEWS

Science Service, Washington, D. C.

PROFESSOR EINSTEIN'S THEORY TO UNIFY GRAVITATION AND ELECTRICITY

PROFESSOR ALBERT EINSTEIN has entered the *fifth* dimension in his mathematical calculations seeking to link gravitation and electricity into one unified field theory which would explain all physical happenings in one broad concept. Thus the man who puzzled millions of people when he introduced the fourth dimension in his famous theory of relativity has gone one step further.

Announcing on his recent sixtieth birthday that he was making progress in his long-sought goal of connecting the force of gravity with the electric fields which make possible such things as light and radio waves, Professor Einstein left undisclosed his method of attack on this toughest of all problems in mathematical physics. Securely buried in the technical literature of mathematics until now, may perhaps be found the hint of what Professor Einstein is now doing.

In the latest volume of the *Annals of Mathematics* is a complex paper by Professor Einstein and Peter G. Bergmann, assistant at the Institute for Advanced Study at Princeton, N. J., entitled "On a Generalization of Kaluza's Theory of Electricity."

Professor Theodor Kaluza, of the University of Göttingen, reports Professor Einstein's important paper, introduced the fifth dimension into conceptions relating gravitation and electricity but used this fifth dimension only as a mathematical idea without physical meaning. Professor Einstein's new approach ascribes a physical reality to this fifth dimension. But with this step the distinguished mathematician finds himself in a kind of space which is truly puzzling.

"There have been many attempts," reports the Einstein paper, "to retain the essential formal results obtained by Kaluza without sacrificing the four dimensional character of the physical space. This shows distinctly how vividly our physical intuition resists the introduction of the fifth dimension. But by considering and comparing all these attempts one must come to the conclusion that all these endeavors did not improve the situation. It seems impossible to formulate Kaluza's idea in a simple way without introducing the fifth dimension."

"We have, therefore, to take the fifth dimension seriously although we are not encouraged to do so by plain experience," explains Professor Einstein. Thus reluctantly, he states that he is entering into still more complex mathematical theories than his previous one.

In his five-dimensional theory, space is closed along a vector indicating the fifth coordinate. This, he says, is the essential difference between his new work and that of Professor Kaluza. "By making this change," Professor Einstein says, "the basic assumptions of the theory are considerably simplified. Furthermore it is much more satisfactory to introduce the fifth dimension not only formally, but to assign to it some physical meaning. Nevertheless there is no contradiction with the empirical four-dimensional character of physical space."

Like his previous theories, which have left strange concepts for the layman to grasp, the new Einstein five-dimensional word has its own paradoxes. For example, a single point P in physical space is represented by an infinity of points in the five-dimensional space. Ordinary space, as most people envision it, consists of the three dimensions of Euclidean space which we call height, breadth and thickness, in speaking about an object like a box. To these Professor Einstein linked time as a fourth dimension in his relativity theories.

The fifth dimension introduced now accounts for properties of the electro-magnetic field which previously have not appeared in relativity. Instead they were accounted for by other theories which had little apparent linkage with gravitation.

As would be expected, the new theory is enormously complex. For example, it is necessary to introduce a special coordinate system in which space is described by 14 different mathematical functions.

ROBERT D. POTTER

THE SPEED OF LIGHT

A HARVARD physicist has solved a three-century-old problem of science, how to measure automatically the fastest thing in the universe—the speed of light. The ultimate velocity of about 186,000 miles per second has been measured by Dr. Wilmer C. Anderson, research fellow, by crimping the light beam with "permanent waves," 19,200,000 of them per second.

This new light-speedometer is the first which has not required visual observation by the human eye, and which has eliminated friction as a possible source of error. It can measure light-velocity with an error of less than two and a half miles per second. It is believed that the apparatus will give the most accurate measurements of light-speed ever made.

The equipment has been put to work on one of the basic problems of modern physics and astronomy—whether the speed of light is actually constant under all conditions or whether it varies. Although many important theories are based on the assumption of a constant velocity of light, past measurements have been inconclusive on this point.

In contrast with the large scale of some types of light-speedometers, which have utilized long outdoor tubes, Dr. Anderson's apparatus is contained in a small laboratory room and hallway. Four separate readings of light-speed can be made per minute.

The beam of a 1000-watt projection lamp is passed through a tube which modulates the beam at a frequency of 19.2 megacycles—or in other words makes the beam fluctuate between bright and dim intensity 19,200,000 times a second. Accuracy of the fluctuations is controlled by a standard frequency generator developed by Professor G. W. Pierce, of Harvard.

With the light issuing from the modulator in waves of

known frequency, the main problem is to determine the exact length of the manufactured waves. Velocity is equal to the frequency multiplied by the wave-length. The fluctuating beam splits at a small sheet of glass held across the path. One side goes up and down a hallway system of mirrors a distance of about 185 yards. This long path is fixed, and its length is known to fifteen thousandths of an inch. The other half of the beam is sent over a shorter path, about two yards long, whose length is slowly varied during the velocity measurement. Each half of the beam has the same wave-form, or light to dark fluctuations, as the original. After traveling their different paths, the two halves of the light beam are recombined and focussed on a special photoelectric cell, a five-stage electron multiplier tube, which translates the light force into electric impulses whose intensity can be easily measured and recorded.

The basic clue to the wave-lengths comes from the intensity of the reunited light beam. The intensity depends entirely on the relation between the fluctuations of the two half-beams as they reunite. If the fluctuations coincide—that is, if the bright parts of one beam enter the photocell with the bright parts of the other beam, then the fluctuations of light intensity will be at their greatest. Conversely, if the two beams "cancel" one another—if the bright spots of one enter the cell with the dark spots of the other—then there will be a minimum fluctuation of the light intensity.

By altering the length of the short path slowly and constantly during the recording, by means of a moving mirror, Dr. Anderson is able to determine the exact point at which the light beams cancel one another. At that point it is known that the long-path beam is entering the photocell exactly 23 half-wave-lengths behind the short-path beam, or, in other words, that the long light-path is 23 half-wave-lengths longer than the short path. Since the lengths of the two paths in meters is very accurately known, determination of the wave-length of the light waves becomes a matter of simple mathematics. Dr. Anderson has spent three years perfecting the equipment, financed in part by the Carnegie Institution, Washington, D. C.

A NEW OPTICAL GLASS

A DISCOVERY which may be a major stride in the advance of photography and which permits lens makers to produce "faster" and better lenses has been made by Dr. George W. Morey, of the Geophysical Laboratory of the Carnegie Institution of Washington.

The discovery of a way to make optical glass out of rare chemical elements instead of common silica permits the production of a glass which has a very high index of refraction and a low dispersion, it is disclosed in a patent, No. 2,150,694, just granted to Dr. Morey. This means a lens which serves the photographer more efficiently. Some of the optical glasses of Dr. Morey have the highest index of refraction (light-bending power) ever reported; more than 2.00. Only comparable refraction is that of the diamond, which is about 2.41. The optical properties of glass used in lenses have long limited optical lens-makers in the exactness of the work they could produce. Dr. Morey's discovery of a new kind of glass should remove this present limitation.

Out of the work should come lenses of greater light-gathering power which would be a boon to all miniature camera fans who ever seek greater apertures. Moreover, high index of refraction and low dispersion permit better corrections for chromatic aberration, the annoying property of some lenses of bringing different colors to different focuses.

Chemical elements most people have never heard of are used in producing the glass. Yttrium, lanthanum, columbium, hafnium, tantalum, zirconium, strontium, boron and barium are typical. The aim of Dr. Morey is to produce a glass with an index of refraction (ability to bend light rays) of over 1.65. One glass, made of 60 per cent. lanthanum and 40 per cent. boron, has a refractive index of 1.72 and a dispersive index of 54.

Another composed of 33 per cent. lanthanum, 41 per cent. thorium and 26 per cent. boron has a refractive index of 1.76 and a dispersive index of 52. As a comparison, ordinary flint glass of a lower refractive index (1.65) would have a dispersion of about 33. Small dispersion numbers mean high dispersion and *vice versa*. The new work is a continuation of efforts made in America since the World War to produce better optical glass. At the time of the conflict, the United States found it had been buying most of its superior optical glass from Germany. Furious war-time research partially overcame the difficulty, but research has been going on ever since to make American optical glass equal or superior to any glass in the world. Dr. Morey's work is a contribution to this end. Patent rights to his discovery have been assigned to the Eastman Kodak Company.

ROBERT D. POTTER

THE EFFECTIVENESS OF SULFANILAMIDE

NEW evidence of sulfanilamide's effectiveness in pneumococcic pneumonia is presented by Drs. Alvin E. Price and Gordon B. Myers, of Detroit, in the forthcoming issue of the *Journal* of the American Medical Association.

The Detroit study is based on 115 cases of pneumococcic pneumonia. These were treated with uniform doses of sulfanilamide and alternated with 40 cases treated with Felton serum and 94 controls who received no specific therapy. For the entire sulfanilamide group, the death rate was 15.7 per cent.; for the controls, 30.8 per cent. The death rate for 57 patients with types I, II, V, VII and VIII pneumonia treated with sulfanilamide was 10.5 per cent., whereas it was 27.5 per cent. for the 40 patients treated with serum.

Some of the patients treated with sulfanilamide developed anemia.

Reported in the same journal were six new cases of pneumococcic meningitis treated with sulfanilamide and 344 cases of erysipelas treated with the new drug.

More than 30 cases of recovery from the deadly pneumococcic meningitis have now been reported. The death rate is not so high under sulfanilamide treatment as under other types of treatment, two Cincinnati phy-

sicians, Drs. Barbara A. Hewell and A. Graeme Mitchell, report in reviewing the literature.

Of the 344 cases of erysipelas treated at Bellevue Hospital, New York, the adult death rate was 1.5 per cent. and the child death rate, 12.9 per cent. The conclusion was that sulfanilamide is considerably more effective than treatment with erysipelas antitoxin or with serum, ultraviolet rays, x-rays or local treatment with dressings.

COOPERATIVE AGRICULTURAL RESEARCH BETWEEN BRAZIL AND THE UNITED STATES

THE arrangement for cooperative agricultural research included within the new Brazil-U. S. trade agreement is part of a greater plan which is intended to extend American research facilities to all tropical American countries, with a view to mutual interchange of products that will not interfere with existing agricultural systems. Possible developments under the new arrangement include: reestablishment of the Para rubber industry, now largely in the hands of the British and Dutch in the East Indies; stimulation of existing trade in cacao, cubé (for insecticides), palm oils and waxes, manioc, etc.; development of traffic in tropical fruits through better refrigeration facilities; experimentation in new crops like tea, spices, hemp and jute.

Bills now before Congress call for appropriations to finance three specific projects: The establishment of a new agricultural attaché in Rio de Janeiro; a survey of the tropical resources of Brazil by scientists of the U. S. Department of Agriculture; and the loan of Department of Agriculture research workers to investigate problems of Brazilian farms and forests.

Similar set-ups for other Latin-American countries are contemplated. Additional agricultural attachés are planned for Mexico City, Havana and Panama. There is already one in Buenos Aires.

Other parts of the general plan call for the training of South American meteorologists by scientists of the U. S. Weather Bureau, the establishment of a tropical forest experiment station in Puerto Rico, cooperation with radio companies for the transmission and dissemination of information, and the publication of scientific results after translation into Portuguese, Spanish and French.

ITEMS

BY March influenza should be on the wane. Instead the number of cases reported each week to the U. S. Public Health Service continues to increase. The number for the week ending March 11 was over 18,000. The total number for the previous week was 14,228. Virginia has been hardest hit of all the states and again reported the largest number of cases, 1,991 for the week. The epidemic seems headed westward. Cases in New Mexico jumped from 57 to 677, in Arizona from 144 to 191, in Oregon from 97 to 261, in sparsely populated North Dakota from 364 to 741, and in Wisconsin from 584 to 1,516. The brunt of the epidemic, nearly three fourths of the cases, was borne by the following six states: Wisconsin, Virginia, South Carolina, Kentucky, Alabama and Arkansas. New England and the Middle Atlantic states have had practically no influenza this year.

A SINGLE cosmic ray of high energy can create 50,000 other particles in a tremendous "burst" of atomic energy, Professor Enrico Fermi, Nobel laureate in physics for 1938, told the joint meeting of the Washington Academy of Sciences and the Philosophical Society of Washington. Professor Fermi, formerly of the University of Rome and now at Columbia University, said that a cosmic ray with a thousand million million (1,000,000,000,000,000) electron volts of energy could produce such bursts over an area of about three hundred square yards. Discussing the "mesotron" particle—the new atomic particle which is about one hundred times as heavy as an electron—Professor Fermi credited the young Japanese physicist Yukawa with predicting the existence of such particles several years before their discovery in cosmic radiation. Yukawa, however, suggested the particles to interpret the inner binding energies with the hearts of atoms. It is the mesotron particle that now appears to account for the enormous piercing power of many cosmic rays which can pass through a whole yard of dense lead or into the earth, where they have been detected in deep mines.

THE lag in aeronautical research behind Europe is the chief cause for alarm in the American aviation picture, G. Grant Mason, Jr., member of the Civil Aeronautics Authority, told the Society of Automotive Engineers at its national aeronautic meeting in Washington. Expanded European research facilities, combined with quantity production facilities, may produce a surplus of high performance commercial airplanes which will cut seriously the American export market. "With that situation confronting us, the President has transmitted to Congress a request for an additional $12,140,000 for the construction of new research facilities at Langley Field and for a new laboratory at Sunnyvale, California, for the National Advisory Committee for Aeronautics. Congress is considering additional legislation designed to stimulate greatly increased experimentation and development by the industry."

A PRACTICAL radio tube generating an ultra short-wave but five and a half inches long—short enough for the radio echo altimeter now under development to show pilots how high they are above the ground and to warn them of other planes near-by—is announced by two engineers of the General Electric Company, W. C. Hahn and G. F. Metcalf. Its waves, a fourth as long as the waves now used in experimental echo altimeters, can be directed like the beam of a searchlight. Waves as short as a single centimeter—about two fifths of an inch—can be generated by a tube working on the same principle. The shortest wave received on a home radio set is about five meters, or more than 15 feet. The tubes can also be used for guiding ships through dense fogs by enabling them to measure the distance to land or other vessels.