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GRAVITY, ELECTRICITY AND MATHEMATICS

UNIFICATION of the laws of electricity and magnetism with those of the gravitational field, a problem upon which Professor Albert Einstein and other mathematical physicists have been working, was given a possible solution by Professor Cornelius Lanczos, visiting professor of Purdue University, who made his announcement before the American Mathematical Society meeting at Columbus, Ohio, on November 28.

This new "field-theory" promises to arouse great interest in science circles because of the recognized need of linking Einstein's theories of relativity with magnetism and electricity. Previous attempts, even those announced by Einstein some two years ago, have not been considered wholly successful.

Professor Lanczos, who, as professor at the University of Frankfurt, Germany, is a countryman of Professor Einstein's, derived from the same principle two different functions, one of which leads to gravitation and the other to electromagnetism. Thus it appears that he has brought together the two diverse fields of physics that have heretofore developed so fruitfully along parallel lines.

The fascinating feature of Einstein's general theory of relativity, Professor Lanczos said, was that it gave a satisfactory explanation of gravitation on purely geometrical grounds. For this purpose, a new and curious kind of geometry, called Riemann's geometry, had to be introduced into physics in place of the long-familiar Euclid's geometry.

Professor Lanczos has made a further extension of the Riemannian geometry to physics. He makes the supposition that the "principle of least action," which has a very wide application in physical science, also exists in the Riemann space.

Two formulae result from this operation. One of these leads to the laws of gravitation. The other gives the new and consistent explanation of the laws of electricity and magnetism.

Thus a new theoretical basis for physics has been set up which welds several diverse fields into a whole. Previous attempts to generalize Einstein's point of view with respect to electromagnetism have met with great difficulties, according to Professor Lanczos. "At present, however," he stated, "no evidence has appeared which would tend to show a probable connection between this field theory and modern quantum theory."

BEHAVIOR OF THE ELECTRON

WHERE an electron is and how fast it is moving can be measured, but science can not tell exactly where it is going, Professor E. L. Hill, of the University of Minnesota, told the meeting of the American Physical Society meeting in Chicago on November 28.

Professor Hill restated the famous "uncertainty principle" which has so profoundly modified the conception of the reliability of physical science in recent years. The original uncertainty principle, enunciated four years ago, led physicists to doubt if future physical events can be predicted with complete certainty.

"According to the ideas of the new quantum mechanics, as they have been developed in the last few years," Professor Hill explained, "it is not possible to follow in detail the motion of an electron in the manner in which astronomers can follow the motion of the planets or the comets. Instead one can, generally speaking, only find the chance that an electron will be found at a given place or that it will move with a given speed.

"In 1927, Heisenberg, in Germany, enunciated his principle of 'indetermination' or 'inexactitude,' which states, among other things, that if an electron is known to be at a given point then one can not tell with what speed it is moving. This limits one very greatly in forming an idea of the way in which electrons behave. Following a suggestion made by the Russian physicist, Professor J. Frenkel, I have found that the equations of wave mechanics permit of a somewhat different interpretation, according to which an electron has a definite speed when it passes through a given point, but that one can not tell which way it is going.

"The speed which it has is just the speed it would have if it were governed by Newton's dynamical laws, but the inability to tell in which direction it is moving is a result of the fact that the electron obeys the laws of quantum mechanics instead of Newton's laws. This result somewhat lessens the structure of Heisenberg's principle, and makes the behavior of the electron much easier to understand.

"The details of this interpretation are not yet completed, and will require discussion by physicists before they can find general acceptance."

WAVES AND PARTICLES

THERE is no need to regard the electron as made of waves rather than as a particle, according to Dr. R. M. Langer, of the University of Minnesota, speaking before the American Physical Society.

Since the discovery, recently, that a beam of electrons can be diffracted by a metal plate like a beam of light by a grating, physicists have thought of the electron as being sometimes very unlike a bullet, which was the old idea of the electron. Electrons may behave sometimes like waves, sometimes like particles. The wave property of the electron, which has played such a large part in the recent revolution of physics, is not, Dr. Langer, said, necessary to explain any experiments so far performed.

"According to the present attitude," said Dr. Langer, "the old controversy between the wave theory and the corpuscular theory of light is unimportant because either one can be made complete and self-consistent. The same holds with regard to the theory of matter. However, the wave theory has had a certain advantage in the discussion of experiments on diffraction by gratings or crystals both for the optical and the electronic or atomic case. This advantage which was merely in the simplic-

ity of the deduction of the diffraction formulae no longer obtains because with our newly acquired knowledge of the solid state, an argument originally proposed by Duane can be developed which makes the corpuscular description even simpler than the other. The important property of a solid body in this connection is that the electrons in it can take on only certain particular velocities or momenta. This property is sufficient to insure, for example, the selective reflection of light or electrons into definite directions without postulating any wave-like characteristics in the impinging electrons or light photons.

"The particle point of view is for many physicists an easier one to visualize and they will prefer to think entirely in terms of particles when they find that no unnecessary complications are involved in such a course. This will make it easier to interpret and devise new experiments. For many purposes a solid can be visualized as a structure through which many electrons surge back and forth. The atoms themselves will be unimportant except to give mass and shape to the system. The agents with which outside influences interact are the electrons and they determine what the nature of the interaction will be."

A CENTRIFUGE MICROSCOPE

A NEW type of microscope, that can watch what happens to living cells when they are whirled about at speeds up to ten or twelve thousand revolutions per second, has been developed by Professor E. Newton Harvey, of Princeton University, and Mr. Alfred L. Loomis, of Tuxedo Park, N. Y. As the result of preliminary calculations already made with its help, it is indicated that revision of existing ideas of some of the properties of living matter will be necessary.

Despite the fact that the cell is being whirled about, thousands of revolutions a minute, the new microscope presents the observer with a clear, steady picture of it throughout the process. The principle may be compared to that of a motion picture projector, with the whirling cell taking the place of the film and the eye of the observer the screen. By this mechanism a series of images is transmitted to the eye with such regularity and rapidity that they blend in a continuous picture.

A disc or turntable, about as large as that of a phonograph, is rotated at high speed by an electric motor. A hollow aluminum bar one half inch thick is mounted on the disc, extending along its diameter. Into this narrow bar the lower lens system of a microscope has been built. This is contained beneath an opening at one end of the bar and is, therefore, near the outer edge of the disc. Above this opening is placed the slide holding the cell which is to observed. By an arrangement of mirrors similar to that employed in periscopes, the image is carried to the center of the bar and is reflected upward through a second opening to the upper lens and the eyepiece of the microscope. This working end of the microscope is stationary, being supported directly over the center of the disc.

By this contrivance a means of constantly observing the cell when it is in motion is provided; but the image, if seen at all at a rapid speed, is only a blur. The problem of obtaining a clear image was solved by the adaptation of the principle of the motion picture projector.

When a light is flashed at regular intervals above the whirling disc, a movie-like series of images is produced. The light is so regulated that its flashes coincide with the passage of the cell beneath it. The flash lasts for approximately the space of one one-millionth of a second. It is produced by a small mercury light.

The new microscope is capable of developing 8,000 revolutions a minute, its speed being limited by the resistance of the air to the bar. In another model now in preparation, the bar has been stream-lined; this new model is expected to develop speeds of 10,000 to 12,000 revolutions a minute. At a speed of 12,000 revolutions the cell will be subjected to a centrifugal force 17,000 times greater than gravity. This may be compared to a pull of eight and one half tons upon an object which weighs one pound.

A NEW FORM OF VITAMIN D

A CRYSTALLINE form of vitamin D, more potent in its ability to prevent and cure rickets than any similar preparation now known, has been prepared by a group of investigators working at the National Institute for Medical Research in London.

The men who have made this remarkable scientific contribution are Drs. F. A. Askew, H. M. Bruce, R. K. Callow, J. St. L. Philpot and T. A. Webster. The leader of the group, Dr. R. B. Bourdillon, was prevented by illness from taking active part in the last stage of the work.

This new form of vitamin D is called "calciferol" by its discoverers. They say of it: "The antirachitic activity of calciferol is the highest yet recorded in known units for any preparation."

Calciferol has more of this antirachitic potency than the crystalline preparation of vitamin D recently reported by the German Nobel Prize winner, Professor Adolf Windaus, of Göttingen, Germany, the British investigators state in their report to *Nature*.

Professor Windaus has two vitamin D substances which he calls vitamin D_1 and vitamin D_2. Calciferol is not the same as D_1 but is much like vitamin D_2 in such physical properties as have been described. Professor Windaus' vitamin D_2, however, has approximately the same activity against rickets as D_1. In this it differs from calciferol, which has much greater antirachitic activity than D_1. Consequently it is concluded that the two substances, calciferol and D_2, are not identical.

Calciferol has been proved by them to be a direct product of the irradiation of ergosterol, known for some time as the parent substance of vitamin D. It has the same elements in the same relative proportion as ergosterol, although the structure of its molecule may be different from that of ergosterol.

A EUROPEAN PARASITE LABORATORY

ABOUT 500,000 parasites will be this year's contribution of the U. S. Bureau of Entomology's European Parasite Laboratory to the unceasing fight carried on

against the European corn borer, the great enemy of the largest American crop.

Established at Hyères in 1919, the laboratory, first under the direction of Dr. W. R. Thompson and then under that of Dr. H. L. Parker, has been quietly at work to discover what are the parasites of the corn borer in its natural habitat, the European continent, whence it was accidentally introduced into the United States.

Up to date, 33 species have been discovered, but only 15 of these have thus far been collected in sufficient quantity to do effective work in America. From the Hyères laboratory the parasites are sent to the U. S. Corn Borer Laboratory at Arlington, Mass., where they are bred, mated and released in the fields to attack and destroy the corn borers. When the parasites take hold successfully, shipments are made from Arlington to Toledo, Ohio, and Monroe, Michigan, whence distribution is made into the corn belt.

Southwestern France, northern and western France and the Po Valley in northern Italy are the regions which have contributed the parasites sent over to Arlington. However, observers are stationed at strategic points throughout Europe and even in the Far East to send corn borer parasites found in those regions to the Hyères laboratory where they are carefully examined to see whether they represent any new species.

In the case of most of the 33 species discovered, the parasites develop in or on the corn borer larvae and do their destructive work upon this stage of the insect. However, two species destroy the pupae of the corn borer in which they have developed, one species lives in the eggs and destroys them, while still another lays its eggs in those of the corn borer but they do not develop until the corn borer reaches the larval stage, when the attack begins.

The introduction of new parasites is only a part of the well-rounded scheme of the U. S. Department of Agriculture for leaving no stone unturned that will delay the spread of the corn borer in the great corn belt, Dr. Parker pointed out. Other main points in the program are the improvement of cropping methods, the destruction of corn stalks after harvesting, and the development of resistant varieties of corn.

Although the Hyères laboratory is primarily interested in finding parasites of the corn borer, it has also sent shipments to the United States of parasites of other economic insect pests such as the alfalfa weevil, the earwig and the European elm leaf beetle.

ITEMS

A "LOST WORLD" of plants is to be sought in the jungles of South and Central America by an expedition under the leadership of Dr. Ralph W. Chaney, of the University of California, and the Carnegie Institution of Washington, and participated in by scientific men from a number of American institutions. The party is to sail from Boston on December 22, and will return to California on February 27. The primary objective of the expedition is to find plants similar to those that grew in the subtropical forests of North America some sixty million years ago, during the period known to geologists as the Eocene. It is of course not expected that species exactly identical with the ancient fossils will be found, but strong similarities are confidently expected. A reconnaissance trip to Central America, made last year by Dr. Chaney, brought to light strong resemblances between the existing tropical jungles and the fossil forests of Oregon and California.

A COMBINATION of X-rays and a tiny camera which is lowered into the stomach now gives the physician or surgeon a means of determining more exactly the location of ulcers or other lesions in the stomach, Dr. P. E. Thal, of Chicago, told members of the Radiological Society of North America at their meeting in St. Louis. The camera consists really of two cameras, one above and one below an illuminating bulb, Dr. Thal explained. The whole arrangement is small enough to be passed into the stomach easily. A flexible tube from the camera carries the manipulating mechanism. Each camera has four film chambers arranged so that tiny photographs are made of four sides of the stomach walls. Thus eight pictures may be made at one time, covering the entire interior area of the stomach. By means of the X-ray, the physician can see the camera in the stomach and guide it to the best place to take the pictures. When all is ready, the exposure is made by opening the shutter and flashing the light. The films are treated like any other photographic negatives. The resulting picture tells the surgeon just where he may expect to find the ulcer he wishes to remove at operation.

X-RAYS as an aid in the early detection of certain glandular disorders were recommended by Dr. E. Kost Shelton, of Santa Barbara, California, at the meeting of the Radiological Society of North America. Dr. Shelton reminded his audience that a number of conditions arising from disordered function of the pituitary, thyroid and parathyroid glands, for instance, begin in childhood. Unfortunately, they are usually not detected until the patient is much older and the condition is far advanced, with consequent less chance for relief. However, these glandular disturbances have an effect upon bone development which, while it is not very well understood, may be observed with X-rays.

CHARLES H. DAVIES, mechanical engineer of Philadelphia, lost his leg in a mine accident when he was 11 years old. To-day his ideas, which have been recently patented, are revolutionizing the manufacture of artificial limbs. Shortly after the war, according to a report in the trade journal, *American Machinist*, Mr. Davies started making wooden legs. He found them clumsy and ill-fitting. Then he tried using various metals, but the riveted or welded joints were unsightly. Finally, he conceived the idea of using an aluminum alloy, made into a light, seamless tube. He invented a type of hydraulic press to "blow up" this tube to take the desired shape. Now the cost of metal legs is cut in half, and labor and time of production are reduced almost 100 per cent.