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DR. SILBERSTEIN'S CRITICISM OF THE GENERAL THEORY OF RELATIVITY

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PROBABLY no field in modern science is attacked more often than the general theory of relativity. In a recent paper to *The Physical Review*, Dr. Ludwik Silberstein, of Toronto, Canada, using a method developed by the Italian mathematician Tullio Levi-Civita, solved the, so-called, gravitational equation of the general theory of relativity for empty space for the special case of symmetry. Dr. Silberstein claimed that the solution which he obtained is "regular," that is, all right, throughout all space except for two special fixed points called singular points. An idea of a singular point may be obtained by analogy with a line. In this case a singular point will be a break or a sharp corner in the line.

In the interpretation of his solution Dr. Silberstein took the two singular points to represent material particles and reached the conclusion that the general theory of relativity predicts no mutual acceleration of the two particles. This, of course, is known to be wrong as two material particles in free space will attract one another and move accordingly. It seemed therefore that the theory of relativity is incorrect.

In publishing their answer to this charge, Professor Einstein and his assistant, Dr. Nathan Rosen, say that, in the first place, it is not correct to represent a material particle by a singular point in the field theory of general relativity as did Dr. Silberstein. This makes the latter's premise wrong. In the second place, even granting this premise, Professor Einstein and Dr. Rosen show that in the solution of the gravitation equation there appear, in addition to the two singular points, other singularities. Therefore, the conclusions drawn by Dr. Silberstein can not, in any case, be made. These facts were pointed out by Professor Einstein to Dr. Silberstein even before the latter published his results.

So to date there has not been brought any valid argument, either theoretical or experimental, against the general theory of relativity.

THE CYCLOTRON AT PRINCETON

THE installation of a cyclotron, calculated to bombard atoms with particles moving almost half again as fast as those produced by existing machines, began this week with the arrival of forty-one tons of steel at the Palmer Physical Laboratory of Princeton University.

The bombarding particles will consist of hydrogen ions, and deutrons or charged particles of heavy hydrogen. Results obtained from paper calculations and from a small working model show that they will travel with a velocity of 19,000 miles a second. Their maximum energy is expected to be twice that of particles from present machines. A large magnet, built especially for use in the cyclotron, makes possible the attainment of this high speed. It is hoped that the machine will shed further light on the old problem of disintegrating the atom.

A breastwork of earth will protect the operators of the machine. Water tanks may also be constructed as an additional safeguard, as cyclotron experimenters are exposed to hazards somewhat similar to those the early x-ray pioneers faced.

When the cyclotron is in use the two vacuum tubes, which produce high-frequency oscillations at 20 meters, will require 50 to 60 kilowatts, as much power as is used by a large metropolitan broadcasting station. The oscillations take place inside the magnet, which prevents the waves from interfering with ordinary radio reception in the community.

Drs. Malcoln C. Henderson, instructor in physics at Princeton University, and Milton C. White, a National Research Council fellow at Princeton, are the designers of the machine. Both men participated in the pioneer cyclotron experiments at the University of California.

Explaining how the Princeton installation is expected to be the most powerful in existence, Dr. White said: "The tip of the pole pieces of the Princeton installation will be 35 inches in diameter, while the most powerful similar apparatus, of Dr. E. O. Lawrence at the University of California, has 27-inch diameter pole tips. Since the energy of the accelerated particles produced increases as the square of the diameter, we get 35 squared divided by 27 squared or approximately 1.7. However, the more powerful oscillators at Princeton will perhaps permit operation at higher magnetic fields than is now possible at Berkeley so we expect, theoretically, to attain twice the present obtainable energy."

Other devices more powerful than the Princeton machine are now contemplated, but none is likely to be in operation before the apparatus is completed in September.

FLOW OF BLOOD THROUGH THE CAPILLARIES

A METHOD of gaining new knowledge on obscure diseases of blood vessels and on the watery swellings known as edema was described by Dr. Eugene M. Landis, of the University of Pennsylvania Medical School, at the meeting of the American College of Physicians in Detroit.

For the development of this method, Dr. Landis was awarded the John Phillips memorial medal of the college. The method is designed to give information about the state of minute artery endings called capillaries. These are found at the tips of the fingers and toes, in the nail beds, and just under other outer surfaces of the body. In certain conditions like Raynaud's disease, in which the fingers and toes are always cold and an unhealthy white color, physicians know a disturbance of the blood flow through the capillaries is to blame. Just what the disturbance is and what to do for it are still unsettled questions which are engaging more and more the attention of medical research workers.

The method Dr. Landis devised for investigating the

state of these capillaries is to insert a very tiny glass tube called a pipette into a single capillary in the bed of a man's nail or in tissues of other animals. The capillary blood vessels and the glass tube are both so small that the work must be done under a microscope.

By this method the passage of fluid through the walls of normal capillaries into the surrounding tissues was measured. With this as a standard, Dr. Landis measured the passage of fluid when the capillary walls had been damaged by chemicals or by mechanical injury. He found that the fluid passed through the damaged capillary walls from five to seven times more rapidly than normal. This finding shed light on the condition known as edema in which apparently too much fluid passes through the capillary walls.

GREEN LIGHT AND PRIMITIVE GREEN PLANTS

GREEN light is injurious for green plants of the primitive group known as the algae. They seem to find it definitely poisonous, faring worse in its presence than they do in absolute darkness. This hitherto unknown fact about the relation of light and plant life was discovered by Dr. Florence E. Meier, in the laboratories of the Smithsonian Institution.

Dr. Meier has been working for several years, studying the various effects of radiation on plants. For simplicity's sake, she uses the algae, most familiar in every-day life as the green scum that forms on stagnant water, and the green mats that spread themselves over wet soil.

In her present experiments, she first kept a quantity of green algae in complete darkness, though supplied with mineral nutrients in solution. They of course failed to increase in number, and after a time degenerated and slowly died. She exposed a similar quantity to full sunlight. As expected, they increased and multiplied—fourfold in two weeks. Then she tried the effects of various parts of white light. A narrow band of blue light was distinctly encouraging; the algae increased threefold in the same period. Red and yellow light gave results not quite so good—only twofold increase in two weeks.

But green light was worse than no light at all. The cells not only refused to increase in number, but actually decreased. There was no cell division, and many of the cells died. The green light apparently is actually poisonous to these organisms.

Infra-red light—the invisible rays at the lower end of the solar spectrum—seems to have no more significance for plants than it has for the human eye. Under it, the algal cells acted as they had in complete darkness.

PURE PHOSPHORUS

PHOSPHORUS in the 100 per cent. pure elemental form is one of the possibilities of the TVA-powered fertilizer plants. This possibility has developed out of the efforts of the TVA to produce more and more concentrated forms of superphosphate fertilizer.

The story builds up by degrees, like the percentage of phosphorus in the various phosphate products under experiment in the Valley. The raw phosphate rock, as dug in the Tennessee Valley and elsewhere, contains a fair amount of phosphorus. Powdered and put on the land "as is," its plant food would become available so slowly that its use would scarcely be practicable. It is also entirely too bulky in relation to the amount of available plant food it contains to pay for long transportation.

The powdered rock is commonly converted into superphosphate by adding sulphuric acid. This common superphosphate averages from 7 to 8.7 per cent. of actual phosphorus content.

There has also been on the market a "triple-superphosphate" fertilizer of up to 18 or 20 per cent. actual phosphorus concentration which is made by adding phosphoric acid of 45 to 55 per cent. strength to the powdered raw material. The product is moist and gummy and has to be aged and dried before it can be handled. It has never been particularly popular with farmers because of its cost and its poor physical condition. They do not realize that, although this material is higher in price per ton than regular superphosphate, it is cheaper per unit of plant food and therefore more economical.

The TVA phosphate plant has been experimenting with a triple-superphosphate made by an improved method. This has proved successful in limited tests and now is being tried out under actual farm conditions. A new phosphatic compound stepping up the content of elemental phosphorus to about 28 per cent. is now being tested as a fertilizer at experiment stations.

TVA's triple-superphosphate has been made possible by development of methods of mixing high strength phosphoric acid with ground phosphate rock to yield a dry, easily handled product.

What comes out of the rock in the electric furnace is the elemental phosphorus itself in gaseous form at high temperature. At ordinary temperatures phosphorus is a waxy stuff that burns spontaneously if left exposed to air.

A RADIO TUBE WITHOUT A FILAMENT

A NEW type radio tube without a filament and having potentialities in the development of television and the design of light-weight radio transmitters for aircraft was shown for the first time publicly before the meeting of the Institute of Radio Engineers on March 4 by Philo T. Farnsworth, Philadelphia radio and television engineer.

The new radio tube is of the cold-cathode type and is known as the multipactor. The operation of the tube, said Mr. Farnsworth, is based upon the harnessing of so-called secondary electrons which are emitted by certain metals when bombarded by other electrons inside the tube.

High amplification is achieved because a single free electron inside the tube liberates a million electrons from the cold cathode surfaces when it strikes. And it does this in a millionth of a second. Inside the tube the million freed electrons in turn strike the metal surfaces and liberate a million times a million other electrons from the cathode. Enormous currents are thus quickly built up inside the tube which, if left uncontrolled, would release enough electrons to be equivalent to all the electric current consumed by all the electrical apparatus in the world.

While this great current gain is theoretically possible it is, of course, never achieved in practice, for the tube would quickly have its parts fused together. The free

electrons of the tube which start the bombardment and the subsequent amplification gains in current, said Mr. Farnsworth, are normally present in the tube because of the action of natural radioactivity or cosmic rays, or because the electrons are released from metals by the action of light (photo-electric effect). The new tube should be of great advantage in television transmission because of its quicker response and amplification. He also predicted that it would have considerable influence in the design of future radio transmitters, mentioning, especially, transmitting sets for aircraft where the question of weight and simplicity is of the highest importance.

The revolutionary part of this tube is that it operates without a hot filament, whereas in the standard type of radio tubes amplification is secured by the boiling off of electrons from the hot cathodes. This new tube operates by recruiting electrons from a cold surface. Because there is no heating of elements required, there is little loss of efficiency. Radio transmitters thus may be built with fewer tubes, operating at a much higher efficiency.

ITEMS

SCARLET fever cases are more numerous throughout the country than at any time since the U. S. Public Health Service began collecting reports of cases from state health officers in 1912. For the week ending February 29, the latest for which figures are available, there were 8,777 cases of scarlet fever reported to the Federal Health Service. This is nearly a thousand more cases than were reported for the corresponding week last year. Influenza and meningitis are also high, although they have not really reached epidemic proportions. There were 307 cases of meningitis reported for the week of February 29. Census bureau figures from 86 large cities of the country show a high death rate from all causes. The general death rate from these cities was 14.8 per thousand population for the last week in February. This is the highest death rate reported for that week since 1929. Health authorities here do not see any correlation between the high death rate and the prevalence of scarlet fever, influenza and meningitis, however, and are unable to offer any cause for the increase.

BEAVER living in the Interstates Palisades Park have had a hard time of it during the past winter. The ice froze so deep on their ponds that their natural food supply was completely locked away from them, and they were in danger of starving. In the emergency, William H. Carr, of the American Museum of Natural History, bored holes through the tops of the beaver houses and poured in grain. Through a small peep-hole which he made in one house he could see the animals hungrily devouring this unusual food.

WILDLIFE in the remote Vokhsh Valley, near the border of Afghanistan, is migrating. Antelope, wildcats, foxes and pheasants have been seen leaving the region in great numbers. This disturbance in the life-ways of the animal population of the valley is held to be due to the noises of civilization. About a quarter of a million acres of fertile land have recently been put under irrigation there, and the valley re-echoes with the disturbing din of trucks, tractors and excavating machinery.

THE scenic Longhorn Caverns of Texas were visited by prehistoric Americans. This is the deduction from ancient souvenirs of men found in the caverns by Dr. Charles N. Gould, geologist of the National Park Service. Making allowance for the fact that the caves are of the "trap cave" type into which animals and objects can fall, Dr. Gould said that "Longhorn Caverns bear every evidence that they once served as shelters and probably as homes for prehistoric man." The caverns to-day are a state park, noted for their fantastic stalactite and crystal formations. Dr. Gould is continuing his study of the geologic formations, and hoping for further evidence of prehistoric occupation.

APPENDICITIS is more prevalent among adolescents and young adults than among others, and much more frequent among men and boys than among women and girls. This is one of the conclusions to be drawn from a report of three Cincinnati physicians, Drs. Mont R. Reid, D. Henry Poer and Paul Merrell, who have recently studied the records of about 3,000 cases of appendicitis admitted to Cincinnati General Hospital. Details of their study appear in *The Journal of the American Medical Association.* It does not pay to trifle with the disease or to delay surgical treatment. These physicians say that the appendicitis death rate is going to remain high as long as persons are not operated on earlier. When there is delay, complications are more frequent and the hospital stay must be longer. The average time that elapsed in the 2,921 cases was 3.8 days between the first symptoms and admission to the hospital—much too long for proper surgical treatment.

No danger of feet slipping, or of rugs skidding on floors waxed with the non-slippery floor wax for which a patent was recently granted to a Brooklyn, N. Y., inventor. The wax is claimed to give a hard, continuous film capable of yielding a high, lasting, semi-transparent polish. Its novel characteristic is a "higher coefficient of friction," which means that it is less slippery than conventional waxes. Tests carried out by the inventor, using sole leather against wood waxed with the new product, indicate that a floor would be less than half as slippery as it is with conventional waxes. This non-slip property is obtained by adding to the mixture of beeswax and carnauba wax generally used in making floor waxes about 10 per cent. of high grade light-colored raw rubber.

PORCELAIN dinner sets and other fine ware may one day be a product of the Tennessee Valley, as the result of large deposits of kaolin in North Carolina, plus the development of low-cost electric power. TVA chemists are now experimenting with electric-heated kilns, hitherto considered economically impracticable, and the results thus far obtained are considered hopeful. Developments will be made available to the industry. Private manufacturers who have been testing the North Carolina primary kaolin predict that there will be little difficulty in substituting this domestic porcelain mineral for kaolin of foreign origin.