SCIENCE NEWS

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KNOWLEDGE OF PAST AND FUTURE IN QUANTUM MECHANICS

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PROFESSOR ALBERT EINSTEIN has concluded that past events of any sort can not be described with precise certainty. This extension of the principles of the new physics is contained in a letter to the editor of *The Physical Review*, journal of the American Physical Society. Professor Einstein, jointly with Professor Richard C. Tolman and Dr. Boris Podolsky, of the California Institute of Technology, wrote this communication just before he left Pasadena to return to Germany. The issue of *The Physical Review* containing the letter will be distributed in a few days.

Not only does Professor Einstein conclude that there is an uncertainty in the description of what has happened in the submicroscopic world with which the most recent theories of physics usually deal. He applies this disconcerting principle of uncertainty to such every-day happenings as the opening and closing of a shutter on a camera. We can not know exactly just when a shutter opens or closes.

Professor Einstein and his two colleagues write: "It is of special interest to emphasize the remarkable conclusion that the principles of quantum mechanics would actually impose limitations on the localization in time of a macroscopic phenomenon such as the opening and closing of a shutter."

The idea that it is impossible to predict the exact path of an object in the future was advanced some two years ago by a young German physicist, Professor W. Heisenberg. This principle of uncertainty has had an influence on the philosophy as well as the practice of science comparable with the idea of relativity introduced by Dr. Einstein.

As the opening paragraph of the Einstein-Tolman-Podolsky letter states: "It is well known that the principles of quantum mechanics limit the possibilities of exact prediction as to the future path of a particle. It has sometimes been supposed, nevertheless, that the quantum mechanics would permit an exact description of the past path of a particle."

Professor Einstein laid one of the foundations of the quantum theory, building on the work of Professor Max Planck. The Einstein classic paper of 1905 applied the quantum theory of energy to light and electricity. The quantum idea that energy is not continuous but in packets or gobs like matter has been one of the most fruitful conceptions of the new physics.

Now Professor Einstein adds the latest building block to our conception of matter and energy by telling us that the past as well as the future is uncertain.

Professor Einstein's associates in his new pronouncement are on the staff of the California Institute of Technology at Pasadena, where he worked during his recent stay in America. Professor Tolman is one of the leading authorities on thermodynamics. His theory of a non-static universe replaced the Einstein theory of the universe. Dr. Podolsky is a young physicist, Russian-born but now an American citizen. He was a National Research fellow in physics for several years.

The title of the letter to appear in *The Physical Review* is "Knowledge of Past and Future in Quantum Mechanics."

VIBRATIONS OF THE NUCLEUS OF THE ATOM

VIBRATIONS in the innermost core of the atom have been proved to exist by firing high-speed alpha rays into aluminum atoms, scientists of the Physical Institute of the University of Halle report.

According to Dr. H. Pose and Professor G. Hoffman the capture of a helium bullet by the excessively small heart or nucleus of an aluminum atom has been used in this work to probe the last great secret of the structure of matter. For this collision of the alpha particle with the aluminum atom is the signal for the ejection from the aluminum nucleus of a still faster kind of rays, the proton rays.

Those protons have been successfully cross-questioned by Dr. Pose and made to tell the story of the aluminum nuclei they have so suddenly left. Actually they are the cores of hydrogen atoms in rapid motion.

Four to five million volts would be required to give the hydrogen cores their high speeds by artificial means.

The speeds of those protons and of the particular alpha ray projectiles which start them on their way give the new evidence of vibrations in the target atoms of the aluminum. At least Dr. Pose calls them vibrations.

Nothing material vibrates, however. Only a mathematical function with an incomprehensible formula and the Greek name Psi. Physicists have been wary of making concrete pictures of the inside of the atom recently since the arrival of the new quantum theory.

The Psi vibrations are found in tune with oscillations which accompany certain of the alpha rays on their journey, called the De Broglie waves, another of the conceptions of the new physics. A proton is ejected when these two kinds of oscillations get into step, just as an organist by playing the right note may wreck a building.

Distances traveled by the hydrogen particles before coming to rest in the air are used to measure their starting speeds. Dr. Pose found that three groups of hydrogens of differing speeds were sent out by the aluminum atoms.

The two faster groups which pass through 20 and 24 inches of air before stopping appear only when special speeds of alpha-helium rays are present in the projectile atoms. The speed of the alpha rays determines the frequency of the accompanying De Broglie waves.

Dr. R. W. Gurney, working at the Institute of Phys-

ical and Chemical Research, Tokio, Japan, had previously suggested that resonance phenomena might be found in the nucleus similar to that observed in the outer layers of the atom. Dr. Pose believes that his own experiments show this. Slower projectiles with a voltage equivalent of 10 to 20 volts, for instance, cause the emission of colored light from the target atom when their speeds reach a very definite value.

Recent experiments of Drs. J. C. Chadwick, J. E. R. Constable and E. C. Pollard, at the University of Cambridge, England, however, show that "alpha particles which are not in resonance with the nucleus are nevertheless able to cause a detectable amount of disintegration."

The alpha rays used by the German investigators are helium atom kernels given out by polonium, radioactive substance similar to radium.

REPEAL OF THE TENNESSEE ANTI-EVOLUTION LAW

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JUDGE JOHN R. NEAL, chief defense counsel, Dayton anti-evolution trial, writes to *Science Service:*

"The bill to repeal the Tennessee anti-evolution law is a wholly spontaneous movement, originating in the legislature itself. It therefore gives great promise of success.

"Courage on the part of the State University and high-school authorities in supporting this repeal would secure its passage.

"While the Scopes case put an end to the movement for passage of bills similar to the Tennessee anti-evolution law in other states, its effect in Tennessee was not such as had been hoped for by the group of Tennesseeans responsible for originating the famous case. The Supreme Court of Tennessee, while indulging in some dicta upholding the law, based these dicta only on technicalities not relating to the constitutionality of the act, and thus not only prevented an authoritative state decision, but prevented an appeal to the Supreme Court of the United States.

"Emotional misunderstandings aroused in Tennessee by the Scopes case have largely passed away, and the people of the state now see the anti-evolution legislation in its true light. They perceive that the sole question it presents is as to whether we are to have freedom of thought and freedom of teaching in Tennessee.

"With their minds unconfused as to the real issue, the Tennessee Legislature will undoubtedly bring Tennessee back into the ranks of civilized communities that desire for its youth the privilege of making their decisions for themselves."

With Judge John R. Neal, outstanding figure in Tennessee law and liberal politics, expressing his confidence that the Tennessee state legislature will repeal the law that five and a half years ago made the state a storm center of controversy and ridicule, the rest of the principal figures in the dramatic Dayton trial are remote from the new scene of action. They are not indifferent to the outcome of the effort to obtain a repeal of the anti-evolution law, but they apparently feel that the legislators will do away with the law without the intervention of persons from outside the state.

The one man who might return to defend the bill against repeal, William Jennings Bryan, is dead. He was the first to pass of all those involved in the Dayton trial, and he died before the dust of the battle was fairly settled in the town where he had joined issue for a literal interpretation of the Bible against the upholders of science, whom he took to be its enemies.

Bryan's most dramatic opponent, Clarence Darrow, has retired from the practice of law and tries no more cases. He is heard from principally when he splinters a lance in debate over a philosophical or theological question. His associates, Arthur Garfield Hays and Dudley Field Malone, are still in practice in New York, and still make an exciting avocation of championing the cause of the economic and social under-dog. George Rappleyea, the engineer of Dayton whose suggestion over a glass of soda in a drugstore started the whole affair, is now in business in New Orleans.

John Scopes, the blond-haired, quiet young teacher who consented to be indicted and tried to make a test case of the statute and to his amazement found himself the center of a world-wide disturbance, continues his quiet way along the path of science. The trial crystallized a half-formed resolve he had to become a geologist. The autumn after it was over he entered the graduate school of the University of Chicago, and carried on his studies there for two years. Then he accepted a position as field geologist for an oil company, and spent three years in Venezuela. Not long ago he came back to America and now he is back at the University of Chicago, finishing his work toward the Ph.D. degree.

FORESTS OF PORTO RICO

PORTO RICO needs, among other things which will relieve her present economic distress, an entirely new set of forests. The island is a classical "horrible example" among foresters of the evil effects of a too eager stripping to make room for plantations, followed by a close gleaning for firewood and small lumber by an impoverished population.

In the early days, Porto Rico was like all the other larger West Indian islands in having a splendid mantle of forests. The accounts of several of the first explorers who followed in the wake of Columbus tell of dense stands of timber on the rainier slope of the island. Even in the eighteenth century there were still extensive forests there.

But the desire of planters and lumbermen to exploit the wealth of Porto Rico as rapidly as possible has resulted in the clearing away of practically every scrap of the original timber and the prevention of any worthwhile new growth. The island is now almost as denuded as the more densely settled parts of China, and is suffering like that old land from soil erosion and impoverishment.

If Porto Rico's forests are to come back, it will be necessary to spend effort and money on them. There is

a great deal of low-grade bush land on the island, especially on the drier slopes away from the rain-bearing winds; but this will never develop into forests of economic value if left to itself. Much of it can never be turned into good forest land in any case, for the soil is too poor; but even where the soil is good and rainfall sufficient, human assistance is necessary to pull the forest succession out of the vicious cycle of brush into which it has been plunged by greedy and improvident over-cutting.

PARALYSIS CAUSED BY THE FEVER TICK

THE deadly western fever tick which causes tularemia, Rocky Mountain spotted fever and Colorado tick fever, has been found to cause a strange type of paralysis in humans, dogs, sheep, foxes and to some extent in cattle. Investigations of this curious malady are now being made by the U. S. Public Health Service.

The disease, Dr. R. R. Spencer, of the service, states, is apparently due to the fact that when one of these venomous ticks feeds upon a person it simultaneously injects a paralyzing poison. This form of paralysis is unusual in that the effects cease almost immediately after the tick is removed from the body upon which it is feeding. The paralysis generally starts in the lower limbs and keeps climbing upward until the heart or the respiratory system becomes paralyzed.

The disease, as far as is known, is caused only by the female tick, because the male tick is not a constant feeder. The female tick clings to its host and gorges itself with the blood of its victim. At the time it feeds it injects into its victim this deadly venom. After a day or so the legs of the victim become numb and the paralysis continues until the heart or respiratory system becomes affected, and death results. The paralysis may be stopped at any moment by merely brushing the tick off the body.

The disease is not known east of the Mississippi River and even in the West human cases are rare. However, this venomous and versatile tick exacts a heavy economic toll each year by its destruction of sheep and other animals.

Because of the fact that the symptoms cease as soon as the tick is removed, various theories have arisen regarding the manner in which the tick poisons its host, according to Dr. Spencer. Some scientists are of the opinion that the venom is stored in the salivary glands of the insect and is slowly injected while it feeds. Others believe that it may be a virus with which the tick is infected, which at the time of feeding it imparts to its host. The problem is complicated because the tick may have to remain on a person for a few days before the person becomes paralyzed.

This strange paralysis, as well as all the other tick diseases, is to be investigated in the new laboratory which the U. S. Public Health Service is to erect in the West.

ITEMS

ICE from the North, and what brings it down into the navigated waters of the North Atlantic, will be the subject of a scientific research program lasting throughout the coming summer, under the auspices of the U. S. Coast Guard. Dr. Olav Mosby, of Norway, has been sent out on the Coast Guard vessel *General Greene*, to work among the floes as they drift down the currents off the northeast coast of Newfoundland. The expedition will be based at St. Johns, Newfoundland. The *General Greene* will stay at sea for periods of ten days to two weeks, and will then put back to base for fuel and supplies. Besides the *General Greene*, which will take care of the strictly research side of the ice problem, the Coast Guard cutters *Ponchartrain* and *Mohave* will carry on the usual work of patrolling the steamer lanes in the iceberg regions, breaking up the bergs where practicable and keeping steamers warned of their presence by radio.

CARVED lines, sketchily outlining a pony's head on a scrap of slate, are the first specimen of cave-man art of the period known as Aurignacian ever discovered in Germany. The find was made in a cavern known as Balver Cave, in Westphalia, and is reported in the scientific journal *Forschungen und Fortschritte* by Dr. Julius Andree, of the University of Münster. Aurignacian man represented a stage of the Crô-Magnon development, which reached its highest point in France and northern Spain. It is hoped that other discoveries may be made in western Germany that will throw further light on the human occupation of Europe during the glacial epoch. The caves of Westphalia have lately yielded a wealth of stone and bone implements and weapons of culture-types ranging from the early Mousterian, which was the development of Neanderthal man, to late Magdalenian, very near to the end of the Crô-Magnard domination. Associated with these artifacts are the bones and teeth of animals used for food by the Stone Age peoples. They include cave bear, Arctic fox, wolf, moose and deer.

REPORTS from nine seismological stations to *Science Service* indicate that the ocean bottom off the coast of Chili, in the neighborhood of Santiago, was shaken by an earthquake early on the morning of March 18. The exact location of the epicenter was in longitude 72 degrees west, latitude 34 degrees south. Determinations made by the U. S. Coast and Geodetic Survey showed that the shock occurred at 3:02:03 A. M., eastern standard time, and that the tremors continued for three hours.

AMERICAN complaints of unwelcome animal gifts from Europe, such as the English sparrow and the starling, are returned with interest in the central countries, where the introduced American muskrat has become a pest of the first order. Valuable in his native land as a source of fur, the muskrat is a nuisance in Bohemia and parts of Germany, because of his inordinate multiplication and his activities in burrowing into river and canal banks. A war of extermination, official and unofficial, is waged against him. In Bavaria active efforts have retarded the advance of the muskrat. In one year 17,163 were reported as killed there. In Thuringia 3,493 were taken, and notably in the river systems of the Saale and Main a decrease has been noted.