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DISCOVERY OF THE POSITRON

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THE discovery of one of the building blocks of the universe, the positron, recognized by the award of the Nobel prize in physics to Dr. Carl D. Anderson, of the California Institute of Technology, is one of science's great achievements.

While most things about us seem to be solid, they are in reality made up of widely separated atoms, very tiny particles that in themselves may be thought of as miniature solar systems, consisting largely of open space. Inside the atom are found electrons, protons and possibly other particles.

Electrons have been known and studied for some forty years, ever since Professor J. J. Thomson (now Sir J. J. Thomson) showed that cathode rays consisted of negatively charged particles far smaller than atoms. Dr. R. A. Millikan measured the negative electric charge on these electrons.

Electrons have proved to be nearly omnipresent. They are the stuff of electrical current. Metals are believed to be full of them. They are thought to be responsible for emission, absorption and scattering of light. No atom could be complete without them. The electron is still, despite our changing ideas about the ultimate, a fundamental particle.

In all these years of acquaintance with the negative corpuscle or electron, scientists felt very, very sure that there was no positively charged particle smaller than the proton, which was nearly two thousand times heavier. The first suggestion of a positive electron came from Professor P. A. M. Dirac in 1931, when he put forth his theory of the electron. This prediction of a positive electron made investigators alert to the possibility of finding it in nature. But they did not know where to start to look for it.

The discovery was made in the course of experiments with cosmic rays at the California Institute of Technology. Dr. Carl D. Anderson had set up a Wilson expansion or cloud chamber on its side in such a way that cosmic rays might plow through the greatest possible length. He was photographing the long tracks that the cosmic ray particles leave behind them. An intense magnetic field was used to curve the particles and the amount of curvature gave an indication of the speed and energy with which they were traveling. This investigation was a part of the extensive program of cosmic ray research that Dr. R. A. Millikan had organized. It was not a search for the positive electron.

There was one feature of this expansion chamber, besides the intense magnetic field, that was unusual. Dr. Anderson placed a thin lead plate in it so that the cosmic rays and any particles that might shoot through the chamber would have something to try their energies upon. The Russian, Skobeltzyn, and others had previously watched and photographed cosmic ray cloud tracks, and Drs. Millikan and Anderson had adapted the method because of their hope that it would give information about the nature of cosmic rays.

In 1931, Dr. Anderson found that cosmic rays disrupt atoms of the air and other matter when they plunge earthward. He made photographs that showed particles, writing their paths in water droplets, curving in opposite directions under the magnetic influence, showing that they were oppositely charged with electricity. One such curving track was made, in a pioneer photograph, by an electron of 140 million volts energy. Another was made by a positive particle, which at that time Dr. Anderson guessed was a proton of about 70 million volts energy.

Here were projectiles of much higher power than physicists were in the habit of using in their researches. Here were transmutations on a grand scale of energies. Little wonder that young Anderson gambled harder than ever, risking the exposure of foot after foot of movie film in the hope of catching the atom smashing at exactly the right instant. Only the happenings during a fiftieth of a second could be caught at each try. Since the disrupting of atoms by cosmic rays does not happen every instant, many of the films were blank.

Then came August 2, 1932, and the making of the portrait of one of the most famous particles in all history. It left a water droplet trail five centimeters long even after it plunged through six millimeters of lead. Carefully checking its curvature, inspecting the texture of the trail on the photograph, digging into the Dirac electron theory, Dr. Anderson concluded that the positive electron had been caught. With due caution, he waited until two more similar photographs were obtained and then sent to SCIENCE (September 1, 1932) the announcement of the discovery of the positive electron, a positively charged particle with a mass approximately equal to the ubiquitous negative electron.

He continued to make photographs, slowly accumulating in seven months fifteen photographs of positive electron tracks in a group of thirteen hundred photographs of cosmic ray tracks. Then in February, 1933, news came from Cambridge that in Cavendish Laboratory, the discovery of the positive electron was confirmed. Dr. P. M. S. Blackett and G. Occhialini had arranged their expansion chamber so that the passage of a cosmic ray through the chamber set up electrical impulses in two Geiger counters, one above and the other below the chamber. Only when both counters signaled at the same instant was a photographic plate exposed. The British experimenters found that some of their photographs showed "showers" or bursts of many tracks, all radiating from a single point. It was as though there had been an explosion. In the flying particles were positive electrons. There were ordinary common old-fashioned electrons as well. Dr. Anderson, too, found these showers. In many more cases than can be accounted for by chance,

a negative and a positive electron were found to come from the same point. The significance of this may have important consequences. In giving birth to electron pairs, energy may be turning into matter. But that is another story.

Now that the existence of the positive electron was recognized as the result of work in two laboratories, it was time for it to be christened. Dr. Anderson named the child of the cosmic rays "positron." At the same time, for the sake of uniformity, he suggested that the name of the negative electron be changed to "negatron," but since the electron for forty-odd years has been called by its old name it seems unlikely that scientists will take kindly to the new one. "Positron," since its coining, has been firmly written into the literature and promises to stick.

There was some objection to the disregard of mythology inherent in the word "positron." Professor Herbert Dingle, of Imperial College of Science and Technology in South Kensington, England, suggested the name "oreston" for the new positive particle. This is mythologically correct, for Orestes was the brother of Electra. Other English physicists had in the meantime contributed to the confusion, but not in a serious manner. The discovery of the positive particle came from the cosmic ray tracks that seemed to be bent in the wrong way. Sporting Englishmen immediately thought of cricket and the peculiar hops that the ball takes on bouncing in front of the wicket. These are called "googlies," so the new tracks and thus the particles in laboratory slang became "googlies" also.

PARTICLES IN COSMIC RAYS SIMILAR TO BUT DIFFERENT FROM THE ELECTRON

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DISCOVERY of an unknown particle that may prove to be as important as the positron was made known by Dr. Carl D. Anderson to his colleagues at the California Institute of Technology just a short time after he was notified of his sharing in the 1936 Nobel physics prize for his discovery of the positron.

Dr. Anderson has found that the cosmic rays include electrical particles which make tracks much like electrons, but are quite different from anything heretofore recognized or investigated. The particles seem to have an unusually great penetrating power and do not readily knock electrons out of matter at the rate equally energetic electrons do.

In many thousands of cosmic ray photographs obtained in Pasadena, Pike's Peak and at Panama, there are many examples of presumably ordinary electrons (the fundamental particle of electricity, negatively charged, discovered years ago) which produce showers of secondary particles as they pass through the apparatus. But there is also another phenomenon, lone tracks that traverse lead plates without producing any perceptible secondary effects. These are the hitherto unknown particles. Dr. Anderson does not venture to guess what the unknown particles might be but he indicated that they probably have the same charge as electrons although not the same mass.

This latest report by Dr. Anderson was received with great and serious interest by his colleagues. He has often produced conclusive proofs for startling results, and he has the reputation for careful interpretation of results. The experiments which led Dr. Anderson gradually to his conclusion were carried out in collaboration with Dr. Seth Nedermeyer and Dr. R. A. Millikan, head of the California Institute of Technology, himself a Nobel laureate.

TESTING UNIT FOR CHECKING MOTOR TRUCK SCALES

INVESTIGATORS at the National Bureau of Standards have come to the aid of state and local communities which are responsible for checking weights and measures. A new motor truck scale testing unit is soon to go on extended tour. It will check the performance of scales that measure loads up to 38,000 pounds.

Millions of dollars in coal and other bulk commodities change hands each week on truck loads of fourteen tons and more. Checking the scales which weigh these loads is almost a completely blank spot in the duty of authorities to prevent fraud in short weight. It is estimated that 90 per cent. of the weights and measures jurisdictions in the nation do not have proper testing equipment to make the frequent tests of the heavy-duty scales being used.

The National Bureau of Standards' new testing unit is designed to demonstrate possible inaccuracies of large scales. It is hoped that when the situation has been made known state legislatures will realize the necessity of duplicating the equipment for their own use. In this sense the coming tour of the giant truck and its fifteen 1,000-pound standard weights will be missionary work designed to improve a serious situation. The trend of recent years to carry larger and larger motor truck loads and the increased volume of truck transportation have spurred the National Bureau of Standards in its development.

R. W. Smith, chief of the bureau's division of weights and measures, explained the operation of the new testing unit to Science Service. A 23,000-pound truck carries the fifteen 1,000-pound standard weights to the scale to be tested. A hoist lowers the 1,000-pound weights singly to one end of the scale platform. The scientists thus check the scale from the range of zero to 15,000 pounds. Then by a small special rubber-tired, two-wheeled cart the weights are transferred to the other end of the scale one by one and the other end checked for the same range. Checking of each end separately is desired since the ordinary scale contains mechanisms at each end which combine to give the total weight. Following this part of the test the weights are removed from the scale and the heavy truck rolled on. The scale is then balanced when its load is around 23,000 pounds. Then the hoist lifts the weights, one at a time, back to the truck and the range from 23,000 to 38,000 pounds is thus checked. The allowable error in a weighing of 40,000 pounds is only 80 pounds, or .2 per cent. Frequent checking is needed on heavy duty truck scales to maintain this accuracy.

AN IMPROVED COTTON PICKER

A MUCH improved, more efficient cotton picker is described in two U. S. patents granted to Mack D. Rust and John D. Rust, of Memphis, Tenn., who have invented a cotton picking machine to do the work of a hundred pickers.

The new machine strips cotton even from the unopened bolls of the cotton plant. It has a "mechanical gleaner" on it, which salvages any dropped cotton. It is more compact so that it can get between narrower rows of cotton plants. It has a device for directing and manipulating the cotton plants so that the picking spindles will strip the plants for the maximum amount of cotton. It can be operated at maximum speeds to suit the type of field being picked. The faster the machine moves the faster the pickers pick. It does not clog up or jam.

Mounted on a tractor, the machine consists of two picking units, one on each side of the operator, so that when the machine moves down the field it covers two rows of plants at a time, picking them simultaneously. Just as the cotton plants enter the throats of the picking units, they are grabbed between the jaws of a boll crusher. This bursts any unopened bolls to expose their fleecy cotton to the picking spindles. Then the plants pass into the tunnels of the pickers proper where a screen cylinder guides them into intimate contact with moist, rapidly whirling spindles, which like hungry fingers, pick the cotton from the bolls. As the tractor continues to move over the rows of cotton, the cotton-laden spindles move out of the tunnel to be stripped of their cargo. While stripped, remoistened spindles take their place. New cotton plants pass into the throat of the tunnel while the picked plants make their exit. To "glean" any cotton that may drop off the pickers there are two separated troughs which pass between the plants. With this new feature, cotton can not spill over on to the ground. Instead it drops into the troughs where conveyors carry it to suction pipes, which suck the cotton up and deposit it in bags.

ITEMS

HIGH-SPEED motion picture photography in aid of industrial chemistry to throw new light on such problems as the fracture of chemical containers under pressure, was discussed at the Baltimore meeting of the American Institute of Chemical Engineers. Using the high-speed motion-picture system developed by Professor Harold E. Edgerton, of Massachusetts Institute of Technology, Dr. Gustavus J. Esselen and Dr. J. G. Hildebrand, consulting chemists of Chicago, filmed the bursting of a bottle under pressure to show where the initial crack formation began its destructive action. In another study the hitherto unseen behavior of a heavy punch press was studied photographically. In the machine the operation is intermittent and of such a character that at one point in the cycle large amounts of energy are suddenly applied for a short space of time. The camera showed that the heavy machine was actually lifted several inches off its base at each cycle, yet this motion had not even been suspected by the operators. In addition, a heavy supporting beam, which the engineers believed incapable of distortion, was flexed several inches every time the energy was applied. Armed with this information, the engineers were able to redesign a machine that would not be subject to unexpected distortions.

FOSSILS of freshwater fish, found abundantly in Tertiary deposits in Alaska, have been brought back by an expedition headed by Dr. Erich Maren Schlaikjer, of Brooklyn College, to be classified and studied at the American Museum of Natural History, New York. The formation where they were found is approximately 30 million years old. Dr. Schlaikjer also brought back a collection of plant fossils from the Alaska Tertiary. Flying over territory as yet unexplored, he saw further deposits which he plans to visit and excavate.

FRESH pork needs more cooking than it gets, if San Franciscans are typical of pork eaters in general. The parasite that lives in the muscles of hogs and pigs and causes the serious disease, trichinosis, has been found in the bodies of almost one-fourth of a series of 200 persons on whom postmortem examinations were performed. Drs. James B. McNaught and Eugene V. Anderson report this discovery in the *Journal* of the American Medical Association. The records of these 200 persons gave no definite history of trichinosis, yet the disease must have been present in its milder forms. In twenty-five autopsies performed on new-born infants the parasite was not found, thus supporting previous medical observations that prenatal trichinosis does not occur. The authors of the article state that "It is impossible to detect infected pork by practical methods of meat inspection. Two out of ten specimens of fresh pork sausage purchased in first-class markets in a heavily patronized shopping district in San Francisco contained living Trichinella. Therefore, under the present methods of meat inspection, it is necessary for the consumer to assume the responsibility of preventing trichinosis by either avoiding or thoroughly cooking all fresh pork."

WEATHER men studying the origins and migrations of air masses may find it necessary to add bacteriology to other techniques. Dr. Claude E. ZoBell and Dr. Helen M. Mathews, of the Scripps Institution of Oceanography, have conducted quantitative studies on the proportions of land and sea bacteria in breezes blowing both off-shore and on-shore. Land breezes carry preponderant numbers of soil bacteria, while breezes from the sea have a higher ratio of saltwater organisms. Not more than five per cent. of soil bacteria can live in a saltwater medium. While a somewhat larger proportion of oceanic bacteria can survive living conditions like those of inland soil, a large ratio of such organisms in an air mass of unknown origin would seem to indicate that it had traveled over the sea. Dr. ZoBell and Dr. Mathews present their results in the *Proceedings* of the National Academy of Sciences.