such instrument in 1940. Like the synchrotrons, the present betatron produces high energy beams of x-rays and electrons. It had been under construction for fifteen months and was built with an appropriation of $1,500,000 authorized by the Illinois General Assembly in 1945. It is anticipated that both the Atomic Energy Commission and the Office of Naval Research will submit research problems for investigation.

In Cambridge, a 300 Mev synchrotron is in operation at the Laboratory for Nuclear Science and Engineering of the Massachusetts Institute of Technology. Construction on the MIT accelerator was begun in 1946 and in January of this year it was announced that the machine had passed its first operating tests. Construction was supported in part by the ONR, and the instrument was designed and built under the direction of Ivan A. Getting, professor of electrical engineering. This brings the total of MIT accelerators of over a million volts to seven and, according to J. R. Zacharias, director of the laboratory, work is now in progress on the eighth and ninth MIT accelerators.

Another GE-built synchrotron, a 70 Mev version, was built recently in the Schenectady Laboratory and shipped to Queens University at Kingston, Ontario, where its dedication ceremonies were held in late January. The instrument is the most powerful of its kind ever to leave the United States.

Accelerators still in the building stage include the Oak Ridge National Laboratory's eighty-six-inch cyclotron, the first such instrument in the Southeast, which the AEC expects to have in operation within a few months. The cyclotron, a 20 Mev proton accelerator, is being assembled at the electromagnet plant and will upon completion considerably augment research facilities at Oak Ridge.

As announced late last year, the 80 Mev synchrotron at the Iowa State College Institute for Atomic Research at Ames has undergone certain preliminary tests and should be in full-scale operation at an early date. Another GE product, the Ames synchrotron was built in Schenectady and assembled in Iowa by the physics department staff.

Brookhaven National Laboratory has two accelerators in progress. The first is a 20 Mev cyclotron purchased from the Collins Radio Company that at present is remarkable chiefly because it is so handsomely designed, but which is also expected upon completion to be extremely useful as a research instrument. The second Brookhaven machine is the giant proton-synchrotron (the "cosmotron"), which, it is predicted, will reach energies as high as 2.5 or 3 billion volts. Both accelerators are well on their way to being finished, although no estimates have been made as to when they will be placed in operation.

At the California Institute of Technology a one and one-quarter million dollar contract with the AEC has been signed to design, construct, and operate (for three years) a one billion volt synchrotron. The project is being supervised by Robert F. Bacher, head of the division of physics, mathematics, and astronomy at Caltech. At the same time the AEC announced that a contract had been awarded to the University of Florida for completion of a one million volt electrostatic generator that is now under construction there.

From Stanford University has come word that tests of the fifteen foot prototype model of a projected billion volt electron linear accelerator have given encouraging results. A voltage output of 25 Mev has been reached, which is claimed to be the highest energy obtained to date anywhere with an electron linear accelerator. When completed, the instrument will have an over-all length of one hundred and sixty feet. According to statements from Stanford it is expected that some eighty feet of the accelerator will be in operation by August, giving a possible energy level of 320 Mev.

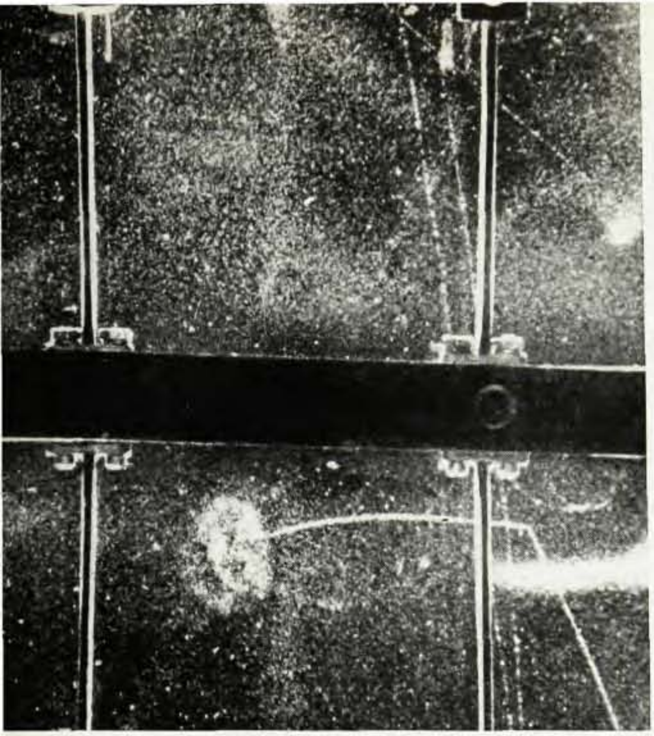
V'S AND DOGS' HIND LEGS

TWO NEW PARTICLES

Most of the exciting events in physics are those that occur during the rare moments when previously unverified observations are duplicated in independent experiments. One recent example is a patient piece of detective work carried out at the California Institute of Technology by a team of physicists headed by Nobel Prize winner Carl D. Anderson and reported at the Washington meeting of the American Physical Society in April. Using a specially rigged Wilson cloud chamber, the group took in the neighborhood of eleven thousand photographs of cosmic ray events to obtain thirty-four pictures giving evidence of two new elementary particles that first had tentatively been reported in England three years ago. The particles, one carrying a charge and the other neutral, were first observed by G. D. Rochester and C. C. Butler of the University of Manchester in 1947. The British scientists had obtained two photographs suggesting the presence of the particles, but despite repeated efforts, neither they nor others were able to find further such evidence.

Last year, Anderson, together with R. B. Leighton, E. W. Cowan, A. J. Seriff, and C. Hsiao, began getting cloud chamber photographs of a neutral particle that occasionally revealed itself by decaying into two charged particles, at least one of which appears to be a meson of a type already known. Since the original particle carried no charge, it could not be seen in the cloud chamber, which registers only the passage of ionizing particles. The evidence, then, consists of photographs showing an inverted V with its apex marking the point of disintegration of the original particle. Thirty such pictures eventually were obtained. Calculations of the mass and energy of the two secondary particles suggest that the new particle has a mass at least twice and possibly seven times that of any known cosmic ray particle.

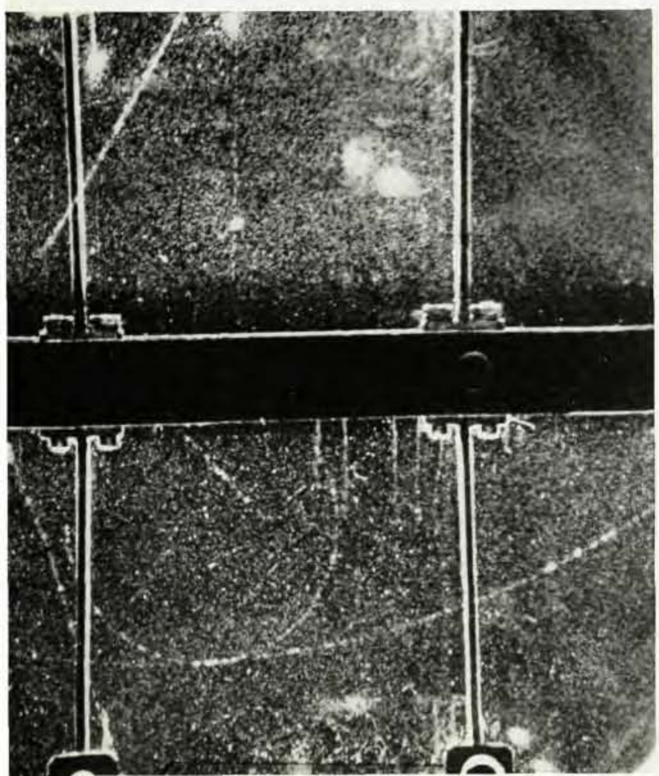
The second new particle, of which only four traces were found, also disintegrates into at least two secondary particles, but in this case only one is charged, the other (or others) being neutral. The observed track is one that appears not as a V, but in the words of a Caltech announcement looks "like a dog's hind leg"—a track that comes down in a straight line and then turns off at a new angle. The upper part of the track is explained as being that of the charged particle itself. The track shooting off



New uncharged particle, which leaves no visible track, penetrates lead plate (dark band at center of cloud chamber) and disintegrates into two charged secondary particles and possibly into neutral particles as well. Measurements of curvature and ionization of the secondary particles from track photographs such as this indicate the probable characteristics of the original particle, even though its track cannot be seen.

TWO NEW PARTICLES

New charged particle appears below lead plate at left. The track suddenly changes direction (by about 6 degrees in this case) at point of disintegration. Lower portion of track is that of a secondary charged particle. The other secondary particle or particles, being neutral, cannot leave a track to be photographed.



at an angle is that of a secondary charged particle, while another product of the disintegration must be at least one secondary neutral particle leaving no track to be seen.

Lifetime of both new particles is about three ten-billionths of a second.

THE DINEUTRON

LOS ALAMOS MAY HAVE FOUND IT

Although continuing efforts have been made, both in this country and abroad, to find convincing experimental evidence that two neutrons occasionally behave as a single particle, the search for the dineutron has been almost uniformly unrewarding. Preliminary results of a set of experiments being conducted at the Los Alamos Scientific Laboratory, however, give hope that the dineutron has in fact been observed.

In another paper given at the Washington meeting of the American Physical Society, Harold Agnew, representing a Los Alamos research group headed by Richard Taschek, described a study of the triton-triton reaction in which the Los Alamos two and one-half million volt electrostatic generator was used to accelerate tritons. The emission of alpha particles in the reaction provides the clue for detecting dineutrons, the maximum energy for the alpha particles for any given angle being obtained whenever two neutrons come off in the same direction, either as separate particles or as a dineutron. In the latter case, according to the Los Alamos workers, a group of alpha particles may be expected which should vary with angle in a predictable manner. The experiments provided some evidence for such a group.

In Great Britain, scientists at Harwell were reported late last year to have unsuccessfully attempted to find evidence for the dineutron in an experiment in which an isotope of bismuth was exposed to the neutron flux of the Harwell pile. The characteristic disintegration products that might have been expected if dineutrons were present were not observed.

METAMORPHOSIS

RADIOACTIVE DECAY OF THE NEUTRON

Letters to the Editor from Oak Ridge and Chalk River appearing in the May 1 issue of the *Physical Review* give results of recent experimental work on the instability of the neutron. A. H. Snell, F. Pleasanton, and R. V. McCord of the Oak Ridge National Laboratory reported an experiment in which neutrons from the uranium-graphite reactor at Oak Ridge were beamed through an evacuated tank and coincidence events observed with an appropriate counting arrangement. Evidence was obtained for the existence of events involving the appearance of low energy positive particles of roughly protonic mass and of others that might have been beta particles. "The observations would be explained completely and without internal contradiction," said the authors, "if neutrons in free flight transform spontaneously into protons with the emission of beta particles having a maximum energy of less than about 0.9 Mev."

The Ontario report, submitted by J. M. Robson of the Canadian Atomic Energy Project, described an arrange-