

PHYSICS

Electric Charge Sorts Proton From Neutron in Atom Assault

New Theory Explains How Deuteron "Bullets" Can Pierce Barrier Wall Guarding the Nuclei of Atoms

MODERN alchemy, the transmutation of one chemical element into another by bombardment with high-speed subatomic "bullets," is made possible by an electrical sorting arrangement inside each atom.

How the subatomic sorter helps weed out parts of the incoming atom bullets and allows others to enter the nucleus and create a different, heavier atom, is explained by a new theory just announced at the University of California.

Drs. J. R. Oppenheimer and M. Phillips disclose how their explanation of the sorter's operation clears up a mystery of certain experiments performed by their colleagues, Prof. E. O. Lawrence, Dr. Edwin McMillan and Dr. R. L. Thornton. (*Physical Review*, Sept. 15).

Prof. Lawrence's research had found many cases where an element, bombarded with deuterons from his giant sling-shot accelerator, was increased in mass by a unit of one. Thus, aluminum of mass 27, when struck by a deuteron of mass two, turned into aluminum of mass 28 and released a hydrogen particle of mass one, a proton.

Similarly sodium, whose chemical symbol is Na, entered into bombardment reactions of the type: Na^{23} plus H^2 produces Na^{24} plus H^1 . In each case part of the deuteron (H^2) was captured and went to form a heavier atom, while the rest of the deuteron turned into a proton (H^1).

Not a Single Particle

As explanation, Drs. Oppenheimer and Phillips suggest that the deuteron is not really a single particle but a composite unit containing a neutron and a proton; the proton having electrical charge and the neutron being without one.

Don't think of the deuteron, however, the California scientists caution, as a round, hard particle; for its wavelike nature means it is not confined to a sharply limited volume. As a matter of fact, there is a good chance that both, or either, the neutron or proton, of which the deuteron is composed, may be some distance away from the deuteron's center of mass.

Coming up to an atom in the target,

say an aluminum atom, the neutron and proton in the deuteron particle behave quite differently. The strong electrical barrier of the atom nucleus stops the charged particle, the proton; but it has no effect on the non-electrical neutron. The latter goes right through the barrier, enters the aluminum nucleus, is captured, and in joining creates a new and heavier kind of aluminum, envision Drs. Oppenheimer and Phillips.

One way to think of the atomic happening is to conceive an army half of which consists of men with gas masks and half without. The army is attacking an enemy whose sole defense is a cloud of poison gas thrown up around it. The attacking force comes to the gas cloud. Those parts of the deuteron army with gas masks (the neutrons) can go through the gas (electrical barrier). Those parts without masks (protons) must stay outside and retreat.

The analogy falls down in that one deuteron does not consist of many neu-

trons and protons but only of a single pair. A stream of deuteron particles, however, might be likened to the attacking army pictured.

How the neutrons get through the barrier has been explained by such theoretical scientists as Prof. George Gamow, of George Washington University, as a diffraction phenomenon of the waves associated with the neutron. Such a picture explained many of the atomic bombardment experiments until the latest ones of Prof. Lawrence and his co-workers on aluminum.

Deceleration a Factor

Drs. Oppenheimer and Phillips in their new theory show mathematically that when a deuteron particle comes to an atom in the target the probability distribution of the neutron's position can be so far from the center of mass of the deuteron particle that it may very well overlap the center of the impacted nucleus. Among other factors bringing this situation about, is the deceleration of the neutron as it enters the target atom. Such a slowing up, they show, tends to increase the probability distribution density on the side of the deuteron nearest the target atom's nucleus.

Science News Letter, September 28, 1935

Experiments using hydrogen peroxide instead of yeast in bread making have been tried at the U. S. Department of Agriculture.



NASTURTIUMS: A HORTICULTURAL EVOLUTION

Ordinary single (left), double (center) and new "super-double" (right). On the super-double nasturtium, which forms no seeds and is propagated only by cuttings, a patent has recently been granted. This is unique in two respects: it is the first nasturtium to be patented, and it is the first flower of any kind in which more than one color is protected by the same patent. This is possible because the super-double plant, though seedless, does form a little pollen, which can be used for cross-fertilizing other varieties, producing a range of colors all the way from light yellow to dark mahogany. The patent has been granted to the president of a well-known Philadelphia seed firm.