

5,000,000 Volts Now Achieved

Physics

The highest electrical potential ever produced by man, over 5,000,000 volts, has been achieved in the laboratory of Dr. Gregory Breit and Dr. M. A. Tuve, at the Department of Terrestrial Magnetism of the Carnegie Institution of Washington.

Using the same apparatus, the physicists have succeeded in applying a voltage of a million volts to a vacuum tube equipped with electrodes outside the evacuated glass bulb. This is the highest voltage ever impressed upon a vacuum tube.

Disintegration of the elements into their building blocks of positive and negative electricity, probing of the constitution of the nucleus or mysterious heart of the atom and other such fundamental achievements in studying the constitution of matter are promised through the development of these powerful scientific tools.

A source of high-speed projectiles, both electrons and atoms, more powerful than the radiation from radium, whose irresistible and natural disintegration now gives the most powerful minute bullets known to science, will be provided through the utilization of the high voltages now developed.

The apparatus, operating on 60-cycle current, sparking 120 times a second, will give out a stream of electrons that it would require two pounds of radium to produce. Over a kilowatt of power at the voltage of 5,000,000 can be emitted.

Although the very high voltages were first obtained nearly a year ago, the results of Carnegie Institution experiments became known to the scientific world only through the publication of a technical communication to the British scientific magazine, *Nature*. Associated with Dr. Breit and Dr. Tuve in the work is Lieut. Odd Dahl, the Norwegian army aviator who was aboard Amundsen's ship *Maud* during its long Arctic cruise. He is the first man to have flown north of the Arctic circle.

Relatively little space is necessary in order to house the apparatus necessary to produce the 5,000,000 volts. An X-ray machine such as used in medical practice provides current at about 50,000 volts which is fed into and charges a large condenser constructed from window glass and lead foil. This condenser discharges suddenly and spectacularly through a spark gap into a small inductance coil,

which is coupled with Tesla coil a yard long, three inches in diameter and wound with 7,000 turns of fine wire. This is the coil in which the 5,000,000 volts is produced. To insulate the wire on the Tesla coil it is immersed in a large tank of transformer oil under pressure of 500 pounds per square inch. Preliminary experiments showed that the oil in an open tank under ordinary atmospheric pressure would insulate the coil sufficiently well for 3,000,000 volts.

It is believed that even higher voltages can be obtained by using larger Tesla coils, but for the past year Dr. Breit has been occupied with the problem of applying to vacuum tubes the high voltages already obtained.

"Five million volts when applied to doubly charged helium atoms, or particularly to alpha particles, or still better to multiply charged ions or stripped atoms should be capable of giving particles with energy much in excess of the swiftest alpha particles so far observed," the physicists declared in their scientific report.

In order to use the high voltages it is necessary to get them inside an air-free tube in which the metal to be disintegrated or the substance to be otherwise affected can be placed. Ordinary vacuum tubes with electrodes inside will not stand voltages of more than about 300,000. The development of the outside electrode tube into which through the glass a million volts can be placed is an important step toward applying the high voltages in disintegration experiments.

The significance of these new achievements can be appreciated when it is realized that one of the ends toward which scientists have been striving is a successful attack on the nucleus of the atom. The atom is composed of a center surrounded by whirling electrons. It is like a minute solar system in which the nucleus is the sun and the electrons are planets. Sweeping off the electrons is easy, but the penetration and disintegration of the small, relatively heavy nucleus is more difficult. Sir Ernest Rutherford, the British physicist, by bombardment with alpha particles from radium has knocked hydrogen out of light-weight elements, such as sodium, potassium, etc., and thus proved transmutation of elements (*Turn to next page*),

NATURE RAMBLINGS

BY FRANK THONE

Natural History



Trillium

When the blessed St. Patrick was arguing theology with the pagan king (who was an Ulsterman, and therefore not to be either convinced or quelled without a stiff dispute) he snatched up a shamrock leaf as the readiest means of illustrating his point. Had a trillium been equally handy, it might have been the national flower of Ireland today. For the trillium is the most orthodox exemplar of the Nicene Creed to be found in the whole floral kingdom: three leaves, no more, around its stem; and in its flower three sepals, three petals, stamens in two rings of three each, a three-parted pistil, and at the last its seeds in a three-parted capsule.

But alas for Ireland: though it has the shamrock, it has no trilliums. The genus *Trillium* is not a large one; only 15 species, according to Engler and Gilg, and these confined to Asia and America. With us, however, the trilliums are well developed, and in the eastern part of our country at least hardly any well-wooded ravine is without them, although reckless picking has practically wiped them out in some too-much-visited spots.

Red, usually a very deep red, and white, tending to become suffused with pink as the petals mature, are the colors favored by trilliums. They are all early blossomers, but perhaps one of the smaller red ones, almost a maroon color, is the most frequent winner of the race with the retreating frost. This species has won for itself the soubriquet of "wake-robin"; though that name is sometimes extended to include all the trilliums.

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5,000,000 Volts—Continued

possible. What is now needed is heavier artillery and that is the object of the Carnegie Institution work. Electrons such as are given off from any electric light filament are immensely speeded up by high voltage current, but they are light in weight. More "beef" is needed, so alpha particles, which are speeding helium atoms, are projected against the nucleus being besieged. When given off from radium these alpha particles are already moving at the speed that would be imparted by some 3,800,000 volts. The Carnegie Institution physicists intend eventually to give them another shove with 5,000,000 or more volts and obtain a more powerful bombardment than radium can produce. Even speedier and weightier projectiles will be obtained by similarly boosting the speeding bare hearts of atoms from which the electrons have been stripped.

By increasing in size the present apparatus and by feeding the voltages from one tube into another, it may be possible to obtain in future years voltages of many times the 5,000,000 now achieved. When 30,000,000 volts are produced and applied, some of the moot questions in physics will probably be settled. Theoretically, it may be impossible to have radiation at this high voltage, since the electron would be damped and all wave lengths would become one. This is also the voltage involved in the creation of the helium atom out of four hydrogen atoms, which Dr. Robert Andrews Millikan believes gives rise to the powerful cosmic rays that bombard the earth from outer space.

The highest voltage produced heretofore was 3,600,000, obtained by the General Electric Company at Pittsfield, Mass., through the use of its so-called artificial lightning apparatus. The highest voltage heretofore obtained within a vacuum tube was 900,000 volts within the cascaded three-in-one cathode ray tubes of Dr. W. D. Coolidge of the General Electric Company.

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The province of Quebec is the world's chief source of asbestos.

Soot falling in London amounts to 288 tons per square mile in a year.

Aerial photography has proved a great help in locating timber for pulp purposes in Canada.