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THE NATIONAL ACADEMY OF SCIENCES[1]

PRESENTATION OF THE COMSTOCK PRIZE

As Dr. Millikan, chairman of the Committee of Award of the Comstock Prize, is unable to be present, it has become my pleasant privilege to tell you the grounds on which the committee recommended to the academy that the prize be awarded to Dr. Ernest Orlando Lawrence.

Prior to 1919, we had no definite information concerning the interior of the nucleus of the atom. We knew that it had a positive charge equal to the sum of those of its extra-nuclear electrons. In addition to this, it was clear that the nuclei of the various chemical elements were all constructed from the same building blocks. But nothing was known about the nature of these blocks nor of the forces holding them together. The constitution of the nucleus was, then, one of the most fundamental problems that had ever presented itself to physical science.

It was Lord Rutherford who opened the door to this rich storehouse of scientific knowledge. By shooting alpha particles into nitrogen he was able to disintegrate the nitrogen nucleus with the formation of protons and an oxygen isotope. His classical experiment was followed by the bombardment of other elements with natural alpha particles and, in this way, the nuclei of nearly all the lighter elements up to calcium were transformed. With one exception, however, all attempts to transform the nuclei of the heavier elements had failed. Thus arose the urge to produce, artificially, particles having a higher energy content than those projected spontaneously from the radioactive elements. It was clear that, given sufficiently high voltages, such particles could be produced, provided suitable tubes could be developed to withstand these difficulties and seemingly serious limitations.

Dr. Lawrence envisioned a radically different course —one which did not have those difficulties attendant upon the use of potential differences of millions of volts. At the start, however, it presented other difficulties and many uncertainties, and it is interesting to speculate on whether an older man, having had the same vision, would have ever attained its actual em-

[1] Meeting at Rochester, N. Y., October 25, 26 and 27, 1937.

bodiment and successful conclusion. It called for boldness and faith and persistence to a degree rarely matched.

In the magnetic resonance accelerator, or cyclotron, which Dr. Lawrence has created and developed, positively charged particles are accelerated so many times, as they circle about in a strong magnetic field, that they acquire energies of millions of electron volts, even though the actual accelerating potential difference is only a few tens of thousands. Not only this, but the limit to the particle energies which can be generated in this way is not yet in sight.

Many serious difficulties have arisen and been successfully overcome. There has been, for example, the very vital problem of protecting human beings in the neighborhood from the extremely penetrating and dangerous radiations produced by the cyclotron discharge. Without much intelligent care many workers might well have been seriously injured. The value of the new tool is attested by its world-wide adoption and by the variety of scientific uses to which it is being put.

Dr. Lawrence has not only created and developed the cyclotron, but, in addition to this, he has been in the forefront of those actually using high energy particles in the assault on the nucleus. With high energy deuterons he has bombarded various elements, nearly all of which have been disintegrated by these particles, in most cases giving rise to new radioactive isotopes. These new artificial radioactive elements, which will soon be available in large quantities, can be used to investigate not only other nuclear phenomena, but also the mechanism of chemical and biological processes. They may also find important therapeutic uses.

By the bombardment of beryllium with deuterons Dr. Lawrence has been able to produce neutrons at a rate which is enormous compared with the output which had previously been obtained, thus greatly extending the possibilities of their use in both nuclear and biological research.

He has accelerated doubly charged helium ions to energies greater than those available from natural alpha particle sources and with intensities thousands of times greater. The results indicate that the field of alpha particle disintegration can be expanded indefinitely with such artificial sources.

We must credit him not only with his own brilliant work in nuclear research but also with the inspiration and assistance which he has given to collaborating physicists, chemists, biologists and radiologists.

In making its recommendation to the academy, the committee has found itself in the favorable position of being able to do so on the basis of only a fraction of Dr. Lawrence's important pioneering work. I am referring by inference to such of his work as that with Dr. Sloan, in creating and developing a combination high voltage generator and x-ray source, in which a million volts or more is generated and used inside of an evacuated grounded metal tank.

While consideration was given to the names of other men who are doing work of a high order of merit, Dr. Lawrence's work was so outstanding as to make him unmistakably the committee's choice. It then became a pleasure to make the recommendation, which we know will meet with favor both from Dr. Lawrence's colleagues and from the scientific world generally.

In closing, may I express for the committee the hope that with his youth, enthusiasm and joy in scientific work, and stimulated by the richly earned recognition which his work has received, he may continue for many years his epoch-making investigations in physical science.

WILLIAM D. COOLIDGE
GENERAL ELECTRIC COMPANY,
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RESPONSE BY PROFESSOR ERNEST O. LAWRENCE

WORDS fail me in expressing my deep appreciation of this great honor. You all know from your own experience that scientific advances are rooted in the past and always involve, directly or indirectly, the work of many contemporaries—that no individual is alone responsible for a single stepping stone along the path of progress. In my own endeavors this has been particularly true, for from the beginning it has been my good fortune to be associated with men of outstanding ability and devotion to science, a circumstance which has indeed been as much a source of joy as the satisfaction of contributing a little to scientific progress.

In 1930, three splendid students embarked with me on the voyage of experimental research that has reached the destination you have seen fit to recognize so magnificently this evening. In the spring of that year, Niels Edlefsen built the first model of the apparatus which has come to be known as the cyclotron, and although it was very crude, the indications of its performance were encouraging. Perhaps some of you will remember that we presented a paper on these first experiments before the meeting of the Academy in Berkeley. In the fall, Stanley Livingston carried forward with unusual ability and enthusiasm the experimental development begun so well by Edlefsen. Livingston being an untiring worker, it was not long before a model of the cyclotron was evolved, which worked well enough to assume a significant place in nuclear research. He had a prominent part in our work for two years more and all of us in the laboratory greatly regretted his leaving, for he contributed so much to our joint endeavors. A third student of those early days was David Sloan, an experimenter of rare genius. Although he was not primarily concerned