JOHN FRITZ MEDAL PRESENTATION

TO Dr. M. I. Pupin

ADDRESS, by Bancroft Gherardi

Fifty-eight years ago, late in the winter of 1874, a young Serbian landed at Castle Garden. He was without money or property, without friends or influence, and without knowledge of the language of this country. Many would say that he had nothing; but this would fail to recognize the things which he had. He had good health, character, ambition, a mind eager to find knowledge and to use it, and high ideals. This evening I have been selected as the spokesman of four great engineering societies whose representatives are gathered here to pay a tribute of esteem and affection to him.

Limitations of time compel silence upon Dr. Pupin's early struggle for an education, and his studies at Columbia University, at Cambridge (England), and at the University of Berlin; except only this: that no one can read the account which he gives of this period of his life in his wonderful autobiography, without being convinced that in the earlier influence of his mother and in the period in which he was getting his education, was laid the foundation upon which rest his many achievements during a long and varied career. From the time of his connection with the staff of Columbia University, the story of his life is a continuous record of contribution to our knowledge and our methods of thought. Of these only a few high spots can be mentioned this evening.

Perhaps because I am a telephone engineer, I am starting by referring to his invention of the loaded telephone line. For several years prior to Dr. Pupin's work which led to his inventions and patents on this subject, it was known that the addition of continuously distributed inductance to a telephone circuit would add to the transmission efficiency of the circuit, that is to say, would diminish the losses of the telephone current during its passage through the wires. It had been suggested that similar results should follow from the placing of inductance coils at intervals in the circuit. This had even been tried experimentally without favorable results. By means of a beautiful mathematical investigation Dr. Pupin established the fact that it was not sufficient to place inductance at intervals in the circuit; but that the inductance must be designed with reference to the circuit conditions and must be uniformly spaced at intervals having a relationship to the shortest waves which it was desired to transmit. He confirmed the results of his mathematical investigations through a brilliant series of laboratory experiments and in addition he designed and demonstrated the advantages of the toroidal type of loading coil - a design which fundamentally has persisted even to the present time, although it dates from over thirty years ago.

Dr. Pupin's patents were acquired by the Bell Telephone System and from that day to this his inventions have played a fundamental part in long distance telephony. The time at which Dr. Pupin made these inventions was most opportune: They came just when telephone engineers were confronted with serious problems in the extension of long distance telephone service over greater and greater distances, and also when, due to the unfavorable effects of non-loaded telephone cables, very serious problems were arising in the planning of long distance

lines. These problems were particularly difficult where the numbers of circuits required were so great that overhead open wire constructions presented formidable difficulties, and where the lines had to be brought into large cities.

As part of the mathematical investigation of the loading problem, Dr. Pupin developed a mathematical theory of certain forms of artificial lines or electrical networks. Such artificial lines today have numerous important applications in the communication art.

Dr. Pupin was the original discoverer of the electrically tuned circuit, that is, of the possibility of so proportioning the electrical characteristics of a circuit that it would respond energetically to any predetermined alternating current frequency. The electrically tuned circuit is used today in every important branch of the electrical art, in telephony, in telegraphy, in power transmission, and last but not least, in radio systems. It was first used by him and then by others in the analyzing of alternating currents, that is to say, in their separation into the different frequencies of which they were composed. In a way Dr. Pupin was unfortunate in the time in which he made this invention. At the time that he made the invention the radio art was practically non-existant and for many years thereafter it was used only for incidental and specialized purposes. Today, however, practically every home contains an electrically tuned citcuit in the radio receiving set; but Dr. Pupin's discovery was so far ahead of the development of radio and therefore of the general use of tuned circuits that few realize that, if this contribution of his were to be removed from the radio systems of the present day, they would no longer function.

Immediately upon the discovery of the X-ray, Dr. Pupin made two important contributions. He was the first to discover the phenomenon of secondary X-ray radiation, that is, that when X-rays strike on any matter, that matter becomes itself a source of X-ray radiation. This fact was not only important in itself, but it contributed to many other scientific advances in X-ray work. Dr. Pupin did much experimental work in X-ray photography and he was, I believe, the first in this country to make an X-ray picture with the aid of a fluorescont screen. The advantage of this method over those previously used was that it enormously shortened the time necessary for the photographic exposure and made it possible to take X-ray pictures in many medical and surgical cases where, without a short exposure it would not be practicable to get an effective X-ray picture.

Dr. Pupin was the first to suggest the use of an electrical rectifier in connection with the receiving of radio signals. While his original invention made use of an electrolytic type of rectifier cell, his invention was broad enough to cover the use of any type of rectifier element. Here again Dr. Pupin was unfortunate in that his invention was so far ahead of the development of the radio art that it was many years after his work was done before there was any extensive opportunity to use this contribution practically.

Dr. Pupin has had an important part in the building up of the scientific and engineering departments of one of our greatest educational institutions - Columbia University. Not only has he contributed much in this way, but the graduates of Columbia who studied under him in many cases have made distinguished records in the fields of science and engineering. Of the many, I shall only mention two - Dr. Robert A. Millikan and Gano Dunn, a past-president of the American Institute of Electrical Engineers. These and many others testify with the greatest enthusiasm to what they owe to Dr. Pupin's teaching and to his inspiration.

During the war, Dr. Pupin had an important part in starting the National Research Council. The purpose of this body as defined by President Wilson in his executive order with reference to it was: "stimulating research in mathematical, physical, and biological sciences, and in the application of these sciences to engineering, agriculture, medicine, and other useful arts, with the object of increasing knowledge, of strengthening the national defense, and of contributing in other ways to the public welfare". Throughout the period of our participation in the war, Dr. Pupin devoted his abilities and his boundless energy to the vital problem of submarine detection.

No statement of Dr. Pupin's achievements, however brief, could omit the mention of his autobiography "From Immigrant to Inventor". It is itself a contribution to literature, to science, and to education, and is a wonderful study in the process of Americanization. From this book many native born Americans can learn something of the spirit and aims of our country.

Dr. Pupin's honorary degrees, his membership in societies and his presidencies of them, his American and foreign decorations, medals and awards, are too numerous to mention; but they testify to the judgment of others as to his personality and his work. In 1921 the A.I.E.E. awarded to him the Edison Medal, the highest honor which that Society could confer. Now three other great engineering societies, Civil, Mechanical, and Mining have joined with the Electrical Engineers in awarding to him their great joint honor.

Dr. Pupin, I salute you: an inventor who has made important contributions to the application of electromagnetism to the uses of man; a scientist who has added important facts to our knowledge of science and contributed to scientific idealism; an educator who not only has an enviable record as to those who have studied under him, but who has advanced the cause of education; a citizen who has contributed much to this country; an American who is proud of the country of his adoption, and of whom his country is proud.
