

# Tesla's Connection to Columbia University\*

by

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*"The invention of the wheel was perhaps rather obvious; but the invention of an invisible wheel, made of nothing but a magnetic field, was far from obvious, and that is what we owe to Nikola Tesla."*

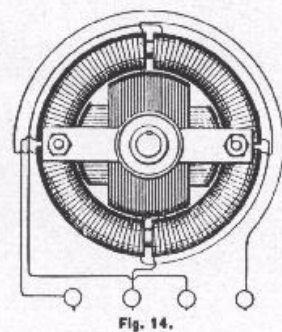
Professor Reginald Kapp, 1956

## INTRODUCTION

The Electrical Engineering curriculum at Columbia University, though not the first in the US, is one of the oldest and most respected EE programs in the world. From the beginning, a conscientious effort was made to base it on a foundation of science. It has been guided by the specific philosophy stated by Professor Michael Pupin: "Professor Crocker and I maintained that there is an '*electrical science*' which is the real soul of electrical engineering."

Arguably the most stunning and significant lecture in modern history was presented one spring evening, more than a century ago, at Columbia University. The wealth of nations turned on its merits. Weighing on the balances would be our vast cities, civilization, and quality of life.

But, what was it? . . . Whatever it was, its impact has been as momentous for the progress and prosperity of civilization as the invention of the wheel! . . . It was Tesla's great discovery and analysis of the rotating magnetic field, and a means for the electrical distribution of energy.<sup>1</sup>



"To obtain a rotary effort in these motors was the subject of long thought . . . The object has been attained by placing within the ring a properly subdivided cylindrical iron core wound with several independent coils closed upon themselves. Two coils at right angles as shown in Fig. 14 are sufficient, but a greater number may be advantageously employed."

Nikola Tesla, May 16, 1888.

$$\tau = \frac{Wb}{m^2}$$

As a result of the analysis presented in this lecture, the great Falls of Niagara would soon be harnessed for the benefit of mankind and launch civilization into the "Electromagnetic Century".

The Engineering Council for Professional Development (now called ABET) has defined "Engineering" as "*that profession which utilizes the resources of the planet for the benefit of mankind*". AIEE President Charles F. Scott assessed Tesla's contribution to engineering with the following words,

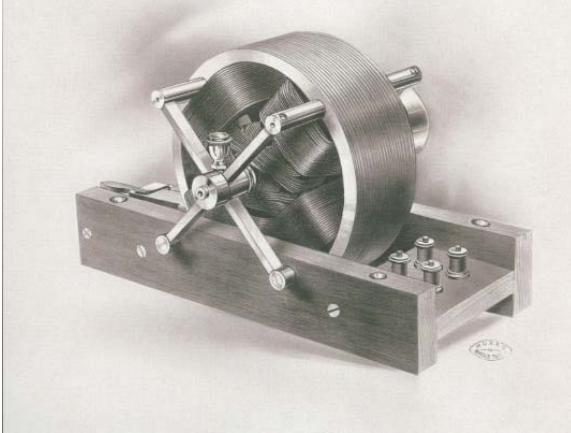
"The evolution of electric power from the discovery of Faraday to the initial great installation of the Tesla polyphase system in 1896 is undoubtedly the *most tremendous event* in all engineering history."<sup>2</sup>

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\* The question was recently asked, "What do Columbia and Tesla have in common?" This note was prepared in response.

Assembled in that Columbia lecture hall were not only members of the academic world, with representatives from Columbia, Cornell, MIT, Yale and Johns Hopkins, but also the giants of industry from Westinghouse, Edison and General Electric, and also delegates from various trade journals, which soon spread the news of this great discovery and “*revelation to science and art unto all time.*”\*

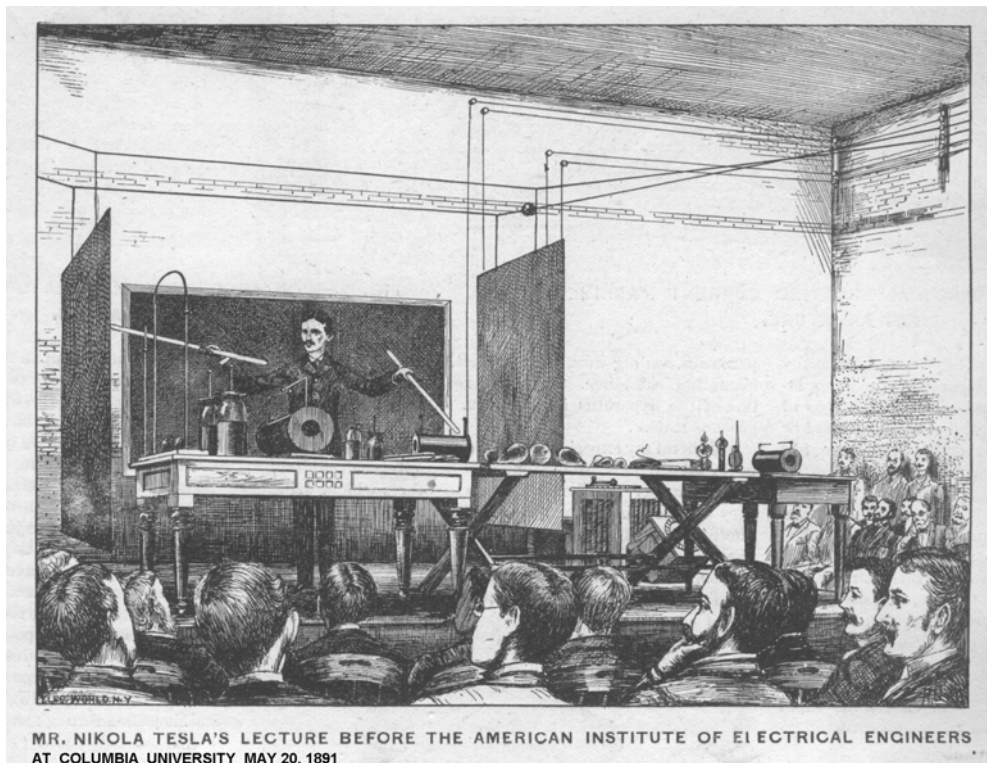
Thomas Commerford Martin, editor of *The Electrical Engineer* and third President of the AIEE (1887-1888), introduced Nikola Tesla that evening. Mr. Tesla then presented his analysis, and



demonstrated two small motors: the salient pole induction motor, shown in the famous photo on the left, and probably also the non-salient pole machine shown in Figures 1-9 of his initial patent.<sup>3</sup>

Following Mr. Tesla’s lecture, Professor William A. Anthony (who, at Cornell, had initiated the country’s first Electrical Engineering program in 1883) addressed the meeting. (Anthony would later serve the as AIEE President, 1890-1891.) Professor Anthony reported to the audience that he had tested these two motors in his laboratory at Cornell during the winter of 1887-1888.

In the same Columbia University atmosphere, three years later, in 1891, Tesla would present his discoveries in the realm of high frequency engineering and demonstrate the principle of coupled tuning. He would announce and demonstrate a technology that would raise the *average* power developed by RF sources *five orders* of magnitude! Such a remarkable innovative feat has never been repeated.



[From: *The Electrical World*, July 11, 1891, p. 19.]

\* This quote, made in New York City on May 18, 1917, is from Harvard Professor A.E. Kennelly, Chairman of the Edison Medal Committee.

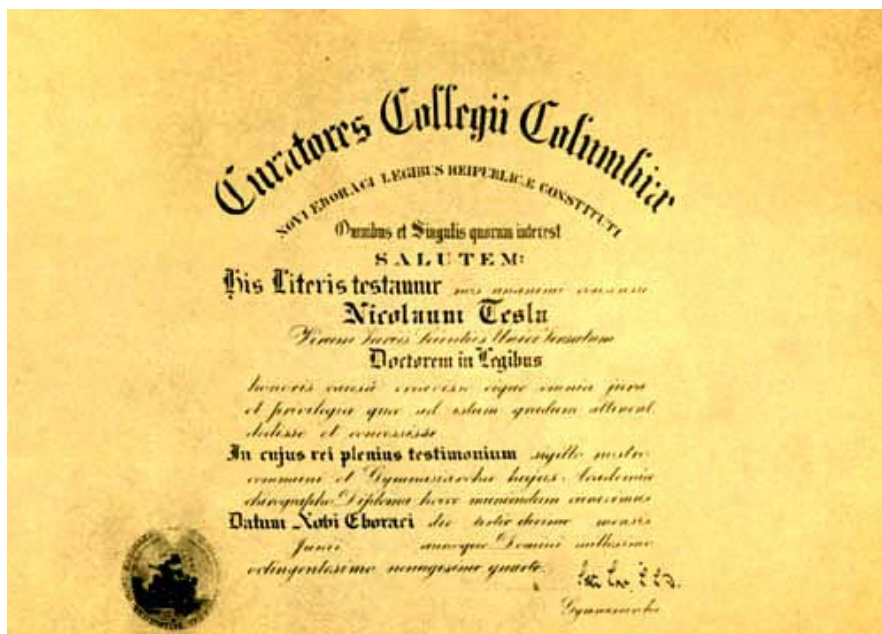
There was a third New York City Lecture, which was read before the *New York Electrical Society* on November 29, 1893. The title of the paper was “Mechanical and Electrical Oscillators”. [See: *Electrical World*, NY, Dec. 9, 1893, pp. 444-446.] The paper has been reprinted by Anderson.<sup>4</sup>

And, there was also a fourth New York City Lecture. It was delivered on April 6, 1897 at the *New York Academy of Sciences*, and it concerned high power RF apparatus, x-ray production, and new frequency measurement techniques. The title was “The Streams of Lenard and Röntgen, with Novel Apparatus for Their Production”. [See: *Electrical Review*, NY, April 14, 1897, p. 175; *Electrical Engineer*, NY, April 14, 1897, pp. 400-401.] This lecture has been the subject of a book.<sup>5</sup>

## SPECIFIC LINKS BETWEEN TESLA AND COLUMBIA UNIVERSITY

There are at least four links to Tesla from Columbia University. Let us enumerate them:

### 1. Conferral of an Honorary LL.D. by Columbia.



It was Professor Henry Fairfield Osborn (1857-1935), Dean of the Faculty of Pure Science, at Columbia, who ushered the recommendation of Nikola Tesla for an honorary doctorate degree. From the Columbia University archives we have:



Henry Fairfield Osborn

“Dean Osborn wrote to college President Seth Low in January 1894, saying in part,

‘I have especially upon my mind two matters which I think will appeal to you very strongly. The first is connected with Mr. Hill of Nyack, and the second with Mr. Tesla of New York. I have learned recently that Mr. Hill is considered the leading mathematician in this country, and there seems to be little doubt that Mr. Tesla is the leading electrician. They are both, in a measure, connected with Columbia through Mr. Hill’s lectures here, and through the fact that Mr. Tesla, at Professor Pupin’s and Professor Crocker’s invitation, gave his first electrical lecture in Columbia. So, we have already established a sympathetic relation with these great men.



I spent an afternoon recently with Tesla, *and regard him as one of the most distinguished men I have ever met*. I happened to meet Professor Crocker shortly afterwards, and learned from him that he had spoken to you in regard to giving Tesla an Honorary Degree. I would like to support this in the most earnest manner. Poulton (Professor of Biology at Oxford) tells me that Tesla was covered with honors while in England and France. We certainly must not allow any other University to anticipate us in honoring a man who lives under our very walls.’

In response to this note from Dr. Osborn, President Seth Low\* recommended, in a letter to the Trustees, dated February 5, 1894, that the honorary degree of LL.D. should be conferred on Nikola Tesla.

(Source: Columbia University Archives)”<sup>6</sup>

Nikola Tesla received the “Doctorem in Legibus” honor on June 13, 1894.<sup>7</sup> Indeed, Columbia has the honor of being the first university to so recognize Dr. Tesla. Honorary doctorates were subsequently conferred upon Tesla by more than a dozen other universities in Europe and in the US. [Columbia, Yale, Paris, Vienna, Sofia, Poitiers, Graz, Beograd, Brno, Bucharest, Grenoble, Zagreb, Prague, etc.] Incidentally, in 1939 both Nikola Tesla and Nicholas Murry Butler, President of Columbia University, received Honorary Doctorates from Sofia University in Bulgaria.

But, the bond to Columbia goes even deeper than the University’s recognition of his distinguished contributions to science and civilization.

## 2. Tesla’s Lectures at Columbia.

Tesla presented at least two lengthy papers at AIEE meetings held on the Columbia University campus, as well as being present at many more. He was elected to serve for two years as Vice-President of the AIEE: 1892-1894. We can read his participation in meeting discussions that are published in the AIEE Transactions from that period. (See for example, “*A Review of Modern Electrical Theories*,” by Prof. William A. Anthony, AIEE Transactions, February, 1890, pp. 33-42; “*Practical Aspects of Low Frequency Electrical Resonance*,” by M.I. Pupin, AIEE Transactions, June, 1893, pp. 371-394, see pp. 395-399.) Tesla’s Columbia lectures were titled:

- A. “A New System of Alternate Current Motors and Transformers,” presented before the AIEE at Columbia University on May 16, 1888. [See: AIEE Transactions, Vol. 5, 1888, pp. 305-327. The lecture was republished in 1894, 1984 and 1992.<sup>8,9</sup>]
- B. “Experiments with Alternate Currents of Very High Frequency and Their Application to Methods of Artificial Illumination,” presented before the AIEE at Columbia University on May 20, 1891. [See: Electrical World, Vol. 18, No. 2, July 11, 1891, pp. 19-27; Electrical Review, NY, July 11, 1891, pp. 264-269. The lecture was republished as book chapters in 1894 and 1992.<sup>10</sup>]

It has been reported that the publication of this 1891 Columbia University Lecture excited so much interest abroad that Tesla received requests to address the electroscience community in Britain and France. That lecture became a book by Tesla.<sup>11</sup>

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\* Seth Low (1850-1916) was President of Columbia from 1890 to 1901, during which time he led the move of the University from Midtown Manhattan to Morningside Heights. In 1901 he was elected Mayor of New York City (1901-1903).



[The European lectures were presented to the Institution of Electrical Engineers, London, on February 3, 1892 and to the Royal Institution in London on Thursday, February 4, 1892. (A colorful, personal description of the Royal Institution Lecture was published by Professor Reginald Kapp.<sup>12</sup> And, Tesla has described the events that brought it about, as well as the concluding remarks made by Lord Rayleigh.<sup>13</sup>) The lecture was also presented to the Societe de Physique and to the Societe Internationale des Electriciens in Paris on February 19, 1892. (Andre Bondel served as Tesla's assistant in Paris.<sup>14</sup>) The lecture has been published in the Thomas Commerford Martin collection.<sup>15</sup> It was also at this time, in 1892, that Tesla went to Bonn and conferred with Heinrich Hertz.<sup>16</sup>]

### **3. Tesla's Influence upon Columbia, Her Sons, and Her Community.**

Within a year following Tesla's landmark lecture of 1888, the Electrical Engineering Department at Columbia was instituted as a two-year graduate program (in 1889), with two faculty members: Professor Francis Bacon Crocker and Professor Michael Idvorsky Pupin. Its first alumnus graduated in 1891. (See Gano Dunn, below.) Subsequently, the four-year undergraduate BSEE program was established in 1892.

#### **A. Columbia's First Electrical Engineering Faculty**



##### **Professor Francis Bacon Crocker (1861-1921)**

ME, Columbia, 1882; Ph.D.; Founder of Crocker-Wheeler (1888); President of the AIEE, 1897; co-inventor (and first test pilot) of the helicopter.

Professor Crocker published the Proceedings of the 1893 Electrical Congress, which included Tesla's contributions.<sup>17</sup> We see from Dean Osborn's January, 1894 comments above that it was Professor Crocker's desire to honor Tesla, and it was his earlier conversation with President Seth Low that initiated the honorary degree process.



##### **Professor Michael Idvorsky Pupin (1854-1935)**

BS, Columbia, 1883; Ph.D., Berlin, 1889; President New York Academy of Sciences, 1916; President IRE, 1917; President AIEE, 1925; Pulitzer Prize, 1924

"If there is anything in this world that I profoundly believe, it is certainly one thing and that is, that the credit of showing the practical importance of AC for motors belongs entirely to Tesla."

Letter dated Dec. 19, 1891.

## **B. Famous Columbia Alumni**



**Robert Andrews Millikan (1868-1953)**

MS., Columbia (1893); Ph.D., Columbia (1895); Nobel Prize in Physics (1923)

“When I was a young man of twenty-five, as a student in Columbia University, I attended [one of your] lectures. . . . it is not merely my congratulations that I am sending to you now, but with them also my gratitude and my respect in overflowing measure.”

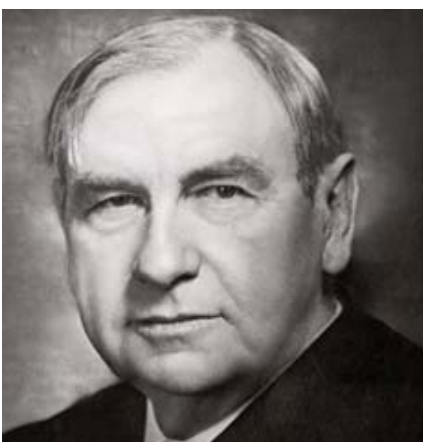
Letter to Tesla, May 30, 1931.



**Nicholas Murray Butler (1862-1947)**

President of Columbia University (1901-1945); B.A., Columbia (1882); M.A., Columbia (1883); Ph.D. Columbia (1884); Republican Vice Presidential Candidate (1912); Noble Peace Prize (1931)

1. Both Dr. Tesla and Dr. Butler were decorated with the Grand Cordon of the White Lion, the highest order of Yugoslavia.
2. Both Dr. Tesla and Dr. Butler were awarded Honorary Doctorates from the University of Sophia (Bulgaria) at the same time in 1939.<sup>18</sup>



**Harlan Fisk Stone (1872-1946)**

Dean of Columbia University Law School (1910-1923); LL.B., Columbia (1898); LL.D., Columbia (1925); Chief Justice of the US Supreme Court (1941-1946).

“The Tesla patent disclosed a four-circuit tuned system ... His patent instructed those skilled in the art that the transmitting system and receiving system should be in resonance ... Tesla thus anticipated ... the Marconi patent.”<sup>19,20</sup>

[US Supreme Court, June 21, 1943]



### **John Stone Stone (1869-1943)**

Columbia University School of Mines; President, IRE (1915)

“Tesla did more to excite interest and create an intelligent understanding [of RF] than anyone else. . . . [Tesla was] a man who we are now compelled, in the light of modern experience and knowledge, to admit was a prophet. . . . [He] was so far ahead of his time that the best of us then mistook him for a dreamer.”<sup>21</sup>

[“Minutes of the Annual Meeting of the AIEE, May 18, 1917 – at the presentation of the Edison Medal to Nikola Tesla”]



### **Edwin Howard Armstrong (1890-1954)**

BSEE, Columbia (1913); Doctor of Science, Columbia (1929); Columbia’s Egleston Medal (1939); IRE’s first Medal of Honor (1917); French Legion of Honor (1919); invented regenerative feedback, superheterodyne receiver, super-regenerative detector, and frequency modulation. Inducted into the Inventor’s Hall of Fame (1980).

“The world, I think, will wait a long time for Nikola Tesla's equal in achievement and imagination.”<sup>22</sup>



### **Gano Dunn (1870-1953)**

Received the first EE degree granted by Columbia (1891); D.Sc. (honorary), Columbia University; Columbia University Alumni Egleston Medal (1939); President AIEE (1912)

“Tesla solved the greatest problem in electrical engineering of his time. . . . My contact as [Tesla’s] assistant at the historic Columbia University high frequency lecture and afterward, has left an indelible impression and an inspiration which has influenced my life.”

Letter dated July, 1931.

Both Professor Armstrong and Dr. Dunn later served as pallbearers at Dr. Tesla’s funeral at the Cathedral of St. John the Divine in NYC. (Tesla died on Orthodox Christmas, January 7, 1943, at age 86.) There were 2000 people in attendance at Tesla’s funeral.



Tesla's funeral at the Cathedral of St. John the Divine at 4 PM on January 12, 1943.



### **Franklin Delano Roosevelt (1882-1945)**

Attended Columbia Law School (1905-1907); Assistant Secretary of the Navy (1913-1920); 32<sup>nd</sup> President of the United States (1932-1945).

While Franklin D. Roosevelt was serving under Josephus Daniels as Assistant Secretary of the Navy, he became aware of Dr. Tesla's early wireless activities (prior to 1899) and with Tesla's subsequent work on robotics and remote control.

Upon hearing of Tesla's death in 1943, President and Mrs. Roosevelt expressed their gratitude for Tesla's contributions "to science and industry and to this country."<sup>23</sup>



### **C. Columbia Researchers**



#### **Felix Ehrenhaft (1879-1952)**

Director of the Physics Institute at the University of Vienna; also operated a visiting Research Laboratory at Columbia

Professor Ehrenhaft (who had nominated Albert Einstein for the Nobel Prize in 1921) nominated Dr. Nikola Tesla, in 1937, for an undivided Nobel Prize in Physics.<sup>24</sup>

(We have discussed Dr. Tesla's professional credentials in a prior note.<sup>25</sup>)

### **D. Other Honorees of Columbia University**



#### **Brigadier General David Sarnoff (1891-1971)**

President of RCA and the National Broadcasting Company (Honorary Doctor's Degree, Columbia University)

"Nikola Tesla's achievements in electrical science are monuments that symbolize America as a land of freedom and opportunity . . . Tesla's mind was a human dynamo that whirled to benefit mankind."<sup>26</sup>

## **4. The Columbia University Nikola Tesla Collection**

The Manuscript Department at Columbia is a major repository for collections of original papers, letters, manuscripts, and documents. The Department's Science Collection houses the papers of Edwin Armstrong, Michael Pupin, and Nikola Tesla.

## **CONCLUSION**

It was a wonderful thing that Tesla openly published and shared his electrical discoveries with the professional, scientific, industrial and academic communities in the US, England, France and Germany. We are, indeed, fortunate that so many of these lectures on energy conversion devices, power transmission, RF tuning, high voltage engineering, and fundamental electrical phenomena have been preserved and are still available today. A century ago Lord Kelvin was moved to say, "*Tesla has contributed more to electrical science than any man up to his time.*"<sup>27</sup>

Several years ago, at 4:13 PM on August 14, 2003, New York City experienced a dramatic electrical blackout and was soon engulfed with darkness. The event demonstrably reveals where the twentieth century would have taken us, and where civilization around the globe would be without Tesla's wonderful discovery and application of the rotating magnetic field, and the vast technologies that it made possible.



[courtesy of Dr. Ljubo Vujovic]

At the 1917 Edison Medal presentation ceremony in New York City, the Vice-President of the AIEE (now IEEE) was moved to prophesy,

“Were we to seize and to eliminate from our industrial world the results of Mr. Tesla’s work, the wheels of industry would cease to turn, our electric cars and trains would stop, our towns would be dark, our mills would be dead and idle. . . It is particularly pleasing to me to pay my tribute to the inventor of the motor and the system which have made possible the electric transmission of energy.”

(Dr. Bernard A. Behrend, Minutes of the May 18, 1917 AIEE Meeting)

The eerie newspaper photo above shows a great city’s darkened skyline, as the specter of gathering darkness advances its grip on civilization. What a transformation! Tonight, we see New York City, vibrant and alive with light and energy, throbbing with the pulse of life and human activity.

NASA’s “Earth at Night” photo shows the planet from space, with all its great cities and centers of culture connected like a web of priceless pearls.\* This one photo is Tesla’s greatest tribute.

Viewing the wonders wrought by electricity, Professor John D. Kraus of Ohio State University (an Edison Medallist, himself) has called the twentieth century the “Electromagnetic Century”.

It is satisfying to know that the ingenuity of this scientific genius and great benefactor to modern civilization, Nikola Tesla, was recognized, honored, and encouraged by Columbia University’s talented scientific community. The world at large owes a debt of gratitude to Columbia University (with a community of 61 Noble Laureates) and to the IEEE (now the world’s largest professional society) for fostering and encouraging such technical forums as that of May 16, 1888.

\* <http://www.teslasociety.com/earthlights.jpg>

## ACKNOWLEDGEMENTS

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