

TESLA'S LEGACY AND THE YOUNG GENERATIONS

Jasmina Vujić

Department of Nuclear Engineering, University of California, Berkeley, CA, USA

Abstract-In his visionary ideas Tesla was so far ahead of his time. Somebody said that Tesla was working on "inventing the future". He was a pioneer in many fields, but commonly misunderstood. His work paved the way for widespread electrification and information technology, and forever changed our lives. Still, Nikola Tesla reminded the great forgotten genius through the history of science in most parts of the world, with his name usually unknown, even among scientists. In this paper we will not talk about the reasons for this great injustice. We will discuss one of the ways to pass Tesla's legacy on to the next generation: the freshman course about Nikola Tesla and his inventions offered for the first time ever at the University of California at Berkeley.

INTRODUCTION

The National Academy of Engineering (NAE) provided leadership in developing the list of 20 Greatest Engineering Achievements of the 20th Century. The Achievements list was announced during National Engineering Week by astronaut/engineer Neil Armstrong on behalf of NAE at a National Press Club luncheon in February, 2000. In his presentation Neil Armstrong, the first man on the Moon, said jokingly that his astronomic feat did not even rank among the top 10 engineering achievements. In fact, space exploration came 12th, right before the Internet and right after highways. On the top was widespread electrification, based on the key criterion of improving the quality of life for the most people.

I was excited to see "Electrification" on the top of Greatest Engineering Achievements. "Radio and Television" was on the sixth place. However, while visiting official NAE Web site (<http://www.greatachievements.org/>) to find more information about "The Greatest Engineering Achievements", I was surprised to find that Nikola Tesla's name was not mentioned at all!

Although I was Tesla's admirer all my life, and read all the books about him that I could find, I never wrote anything about Tesla. Actually, when I think about it, I did write a letter to the Mercury News, the major newspaper of the Silicon Valley, CA, to protest their article about the history of radio in which the author prized Marconi, without even mentioning Tesla! As it was to be expected - my letter was never published.

As any Serb, particularly those that live and work in the USA, I was painfully aware of the extent of ignorance, minimization, discreditation (either planned or unintentional) of both Tesla's work and his personality. This time I decided to do something. As an educator, I decided to offer the freshman course about Nikola Tesla at the University of California in the Fall 2000. This paper is about a successful story on popularizing Tesla's legacy to the young generation.

ORGANIZATION OF THE FRESHMAN SEMINAR ON TESLA

The omission of Tesla's legacy by the U.S. National Academy of Engineering (NAE) from two (No. 1 Electrification and No. 6 Radio and Television) out of the 20 Greatest Engineering Achievements of the 20th Century (<http://www.greatachievements.org/>), prompted a flood of letters with the requests for corrections. The original presentation included:

Electrification: "In the early days of electric power transmission, stations generated direct current (DC), whose voltage was difficult to raise or lower. Only people located near a generating plant could be connected, because electricity was sent out of the station at the same voltage that a customer would use. Currents were large and so were losses - the farther the current had to travel over transmission lines, the greater the loss. In the early 1920s Charles Steinmetz and George Westinghouse pioneered alternating current (AC) which easily "transformed" one voltage to another. In spite of much debate among engineers - Thomas Edison championed DC - this development enabled large blocks of power to travel far, and soon became the preferred system."

Radio and Television: "Guglielmo Marconi was the person most responsible for taking the theories of radio waves out of the laboratory and applying them to practical devices. His "wireless" telegraph demonstrated its great potential for worldwide communication in 1901 by sending a signal - the letter "s" - in Morse code a distance of 2,000 miles across the Atlantic Ocean. Radio technology was just around the corner."

The letters prompted NAE to correct their presentation. This is the reply to my complaint:

From: rgibbin@nae.edu
 X-Lotus-FromDomain: NAS
 To: Jasmina Vujic <vujic@newton.me.berkeley.edu>
 Date: Thu, 2 Mar 2000 15:50:15 -0500
 Subject: Re: Forgotten Tesla?

You are right! Leaving Tesla out of the electrification write-up was an big oversight on our part and we are working quickly to make it right. Check back next week for new material!

The current version that appears on the NAE Web presentation (<http://www.greatachievements.org/>) is somewhat corrected, but still does not give Tesla full credit for his contributions:

Electrification: "At the start of the 20th Century, electric power was young but growing rapidly. Thomas Edison's work had led to the first commercial power plant for incandescent lighting and power in 1882. However, Edison's system used

direct current (DC), which could only be profitably distributed in a limited area around the generating station. The work of engineers such as Nikola Tesla and Charles Steinmetz led to the successful commercialization of alternating current (AC), which enabled transmission of high-voltage power over large distances."

Radio and Television: "Key figures in the late 1800s included Nikola Tesla, who developed the Tesla coil, and James Clerk Maxwell and Heinrich Hertz, who proved mathematically the possibility of transmitting electromagnetic signals between widely separated points. It was Guglielmo Marconi who was most responsible for taking the theories of radio waves out of the laboratory and applying them to practical devices. His "wireless" telegraph demonstrated its great potential for worldwide communication in 1901 by sending a signal - the letter "s" - in Morse code a distance of 2,000 miles across the Atlantic Ocean. Radio technology was just around the corner."

This event prompted me to organize a course (Freshman Seminar) about Tesla's life and his most important inventions, and examine how his inventions influenced the technological (and social) changes in the twentieth century. My colleague Prof. Vojin Oklobdzija from the Department of Electrical and Computer Engineering, the University of California at Davis, joined to help in organizing this seminar. The title "Nikola Tesla: The Genius that Lit the World" was borrowed from video-documentary with the same name that was jointly produced by the Tesla Memorial Society and the Nikola Tesla Museum.

The course was offered for the first time in Fall 2000 at the University of California at Berkeley. This course was organized as a one-unit course in 15 one-hour lectures, one per week on Mondays from 3 - 4 pm, starting on August 28 and ending on December 4, 2000.

The number of first-year students was limited to 20 by the University, but due to a great interest, we accepted 23 students. There was no prerequisites required, and the seminar was open for engineering and non-engineering freshman students. The course was sponsored by: the Chancellor of the University of California at Berkeley (UCB), the College of Engineering, UCB, the Department of Nuclear Engineering, UCB, Westinghouse Electric Co., and Fry's Electronics. The funding was used to buy the textbooks for all

students attending the class, and to pay travelling and local expenses of the guest speakers.

In the preparation for the course, Prof. Oklobdzija and I contacted many experts in various areas related to Tesla's work and received incredibly positive responses. All were ready to come to Berkeley and give a lecture. The only reason to decline our invitation was a conflict in their time schedules. Interestingly enough, the only negative responses we received were from the recipients of the prestigious IEEE's Nikola Tesla Award [1]. One of the recent awardees (a professor at one of major U.S. universities) gave us a very strange reason (as an educator) why he had to decline our invitation:

"This type of subject is not in my area of interest. I am a no-nonsense researcher not a historian. I can not deal with the types of issues addressed by the other speakers in the series. I am afraid that what I prefer to talk about will be over the heads of the audience. I really don't want to come to talk to freshmen and non-engineering students. Therefore I would like to withdraw my agreement to participate."

My only comment is: if a professor cannot "reduce" the level of his lecture so that freshmen engineering and non-engineering students can understand, he is in the wrong profession!

A newly published book by Margaret Cheney and Robert Uth "*TESLA: Master of Lighting*" [2] was chosen as a text book, together with "*My Invitations: The Autobiography of Nikola Tesla*" [3].

The course was envisioned as a series of lectures with invited guest speakers who are experts in a particular area. The course schedule is presented on Table 1, with the title of the lectures, and the names and affiliations of the guest speakers. It must be pointed out that the response of the invited guest speakers was excellent. All of them volunteered their time and did not ask for any honorarium.

The reading assignments closely followed the chapters of the textbook and the lectures, as show on Table 2. The discussion during the class was encouraged, and the students were required to work on either an essay or a Web presentation about Tesla and his legacy.

In addition, due to a great interest by the local Serb community and their friends, we opened the door to the guests. Every lecture was fully attended and greatly appreciated.

TABLE 1: SCHEDULE FOR THE COURSE ENG 24 "NIKOLA TESLA: THE GENIUS THAT LIT THE WORLD"

DATE	DESCRIPTION	LECTURER
Aug 28	<i>Introduction</i>	Prof. Jasmina Vujic, UC Berkeley Prof. Vojin G. Oklobdzija, UC Davis
Sept 11	<i>Nikola Tesla: The Genius Who Lit the World - video documentary and discussion</i>	Prof. Jasmina Vujic, UC Berkeley Prof. Vojin G. Oklobdzija, UC Davis
Sept 18	<i>War of the Currents Demonstrations</i>	Prof. Slobodan Cuk, Caltech and TESLACo
Sept 25	<i>Tesla's Visionary Ideas</i>	Prof. Milos Ercegovac Computer Science Department, UCLA
Oct 2	<i>Remote Control</i>	Dr. Rade Dimitric, UC Berkeley
Oct 9	<i>Who Invented Radio?</i>	Prof. Borivoje Nikolic, EECS, UC Berkeley
Oct 16	<i>The Personality and Philosophy of Nikola Tesla</i>	William H. Terbo Tesla Memorial Society Scotch Plains, NJ
Oct 23	<i>Tesla as Icon</i>	Dr. Bernard S. Finn, Curator National Museum of American History Smithsonian Institution Washington, D.C.
Oct 30	<i>Tesla's Vision of the Wireless Global Communications</i>	Prof. Ljiljana Trajkovic School of Engineering Science Simon Fraser University Burnaby, BC, Canada
Nov 6	<i>Student Presentations</i>	Preliminary Presentations
Nov 13	<i>Nikola Tesla: Form Practical to Untangible</i>	Dr. Marija Ilic MIT, Department of EECS Cambridge, MA
Nov 20	<i>Motors, Myths, and History: An Historian Looks at the Nikola Tesla and the Invention of the AC Motor</i>	Prof. W. Bernard Carlson University of Virginia School of Engineering Charlottesville, VA
Nov 27	<i>My experiences in writing the book: Tesla: Master of Lightning</i>	Margaret Cheney, writer and journalist, California
Dec 4	<i>On the position of Nikola Tesla among the founders of modern electrical science and technology</i>	Dr. James Corum Institute for Software Research, Inc. Fairmont, WV

TABLE 2: ASSIGNMENTS FOR THE COURSE ENG 24 "NIKOLA TESLA: THE GENIUS THAT LIT THE WORLD"

DATE	READING	PROJECTS
Aug 28	-	Two students per project. Options: (1) Five-page essay (2) Web page First draft is due October 30 Preliminary presentations on Nov 6
Sept 11	Textbook: Chapters 1. An old world childhood and 2. Geniuses collide	
Sept 18	Textbook: Chapter 3. War of the currents	
Sept 25	Textbook: Chapter 4. High frequency and 5. Lionized and Ionized	
Oct 2	Textbook: Chapter 6. Niagara Falls	
Oct 9	Textbook: Chapter 7. Who invented radio?	
Oct 16	My Inventions: First two chapters	
Oct 23	Textbook: Chapter 8. X-rays, Earthquakes and Robots	
Oct 30	Textbook: Chapter 9. Colorado Springs and 10. Wardencllyffe Tower	
Nov 6	Textbook: Chapter 11. Powerhouse in a Hat My Inventions: Chapter 3 The Discovery of the Rotating Magnetic Field	
Nov 13	Textbook: Chapter 12. Honors, welcome and otherwise and 13. War by Electrical Means	
Nov 20	Nikola Tesla: Guided Weapons and Computer Technology,	
Nov 27	Textbook: Chapter 14. Poet and visionary, 15. A Weapon to End War, and 16. Enigmatic to the End	
Dec 4	Textbook: Chapter 17. The Paper Trial and 18. The Cosmic Signature	

SHORT DESCRIPTION OF THE LECTURES

Most of the lectures were provided in the Power Point format and are available on the official Web site for the course: <http://www.nuc.berkeley.edu/dept/Courses/E-24/e24.html>. Also, all of the lectures were taped, and will be available in the future. Here we present the summaries of the lectures.

Lecture 1: INTRODUCTION

Lecture 2: Screening of the video documentary NIKOLA TESLA: THE GENIUS WHO LIT THE WORLD AND DISCUSSION

Lecture 3: NIKOLA TESLA AND WAR OF CURRENTS (with demonstrations), Dr. Slobodan Cuk, Founder & Chairman of the Board of TESLAcO, Formerly of Caltech as EE Professor, <http://www.cco.caltech.edu/~peg/cuk.html>

“The presentation will consist of three parts. The first part will briefly review in a form of slide and video presentations Tesla's life and place his major inventions on a time scale. Second part will provide a condensed, popular/scientific explanation of his major inventions. This will include polyphase alternating current, induction (AC) motor and principles of the synchronous and asynchronous motors and generators, and the system of generation, transmission and distribution of power with his three phase system and his attempts to transmit power without wires- the TESLA coil. Third part will illustrate some of his most important inventions on a small scale laboratory demonstrations. Demonstrations will include Tesla's Columbus egg experiment, a specially adapted 2 phase induction motor with coke-can rotor and a small Tesla coil lighting the fluorescent tubes with no electrical contacts.”

Lecture 4: TESLA'S VISIONARY IDEAS, Prof. Milos D. Ercegovic, Computer Science Department, UCLA, milos@cs.ucla.edu, <http://www.cs.ucla.edu/~milos/>

“Besides revolutionary discoveries to the fundamental electric technologies such as the AC motor, generator, and polyphase power distribution, Tesla conceived many ideas, some controversial, which are related to several of today's mainstream technologies ranging from wireless communication systems, radar, and television to robotics and remote control. In this lecture we will discuss some of Tesla's visionary ideas and relate them to today's technologies.”

Lecture 5: REMOTE CONTROL, Dr. Radoslav Dimitric, University of California at Berkeley, CA

“The ubiquitous devices for control without wires have their origin in work of Nikola Tesla. I will discuss his patents and other work related to the issue.”

Lecture 6: TESLA AND THE INVENTION OF RADIO, Prof. Borivoje Nikolic, Electrical Engineering and Computer Sciences, University of California at Berkeley, CA,

bora@eecs.berkeley.edu,
<http://divine.eecs.berkeley.edu/~bora/>

“This seminar will give an overview of the development of radio in the past hundred years. Tesla's early experiments on wireless transmission will be discussed, with his early patent which was the key to the development of radio, and related work. The ideas from early radio systems will be related to modern wireless technologies.”

Lecture 7: THE PERSONALITY AND PHYLOSOPHY OF NIKOLA TESLA, William H. Terbo (grandnephew of Nikola Tesla), Executive Secretary of the Tesla Memorial Society, Scotch Plains, NJ

“Tesla's personality and accomplishments as inspiration to other inventors and scientists Acknowledgment by Lee DeForest, inventor of radio amplifiers, etc. Impact of Tesla's inventions on reducing physical labor and increasing leisure time. Benefits of AC power quickly recognized by general public as increasing productivity and improving their well-being. Invention of radio revolutionized communications and provided leisure entertainment. Turn-of-the-century fame ebbed after his death in 1943. American society can absorb only limited number of "icons". Name kept alive by scientific community and people who share his Slavic and Serbian background. Name not attached to any important company. Seminal work in electricity and radio often credited to others. "Tesla Coil" is only important invention bearing his name. Public persona was a man of intellect, dedication and perseverance.”

Lecture 8: TESLA AS ICON, Dr. Bernard Finn, Curator, Electrical Collections, National Museum of American History, Smithsonian Institution, Washington, D.C. <http://www.si.edu/>

“Factor to be discussed include: Characteristics of the science/technology that Tesla was pursuing. Tesla's own perceptions of that science/technology. Tesla's personality. The roles of John O'Neill and Kenneth Swezey in popularizing Tesla. Recent attempts to get the Smithsonian to devote more attention to Tesla”

Lecture 9: TESLA'S VISION OF THE WIRELESS GLOBAL COMMUNICATIONS, Prof. Ljiljana Trajkovic, Simon Fraser University, Canada, ljilja@cs.sfu.ca, <http://www.ensc.sfu.ca/~ljilja>

“I will describe Tesla's pioneering work on a system that was intended to provide both wireless global communications and power transmission. Tesla believed that the future is wireless, and that a global wireless communication system will be used for transmissions of information and electrical power to any point on the earth's surface. His pioneering work on wireless transmission systems begun in 1899 with experiments on wireless propagation in Colorado Springs. In 1901, he begun constructing a prototype wireless communications station on the North Shore of Long Island, New York, known as the Wardenclyffe Tower. Tesla's World

System was based on the use of the earth's surface waves, and was quite different from today's radio broadcasting stations.”

Lecture 11: NIKOLA TESLA: FROM PRACTICAL TO UNTANGIBLE, Dr. Marija Ilic, MIT, Department of EECS, Cambridge, MA, http://www.eng.nsf.gov/ecs/people/Marija_Ilic/marija_ilic.htm

Lecture 12: MOTORS, MYTHS, AND HISTORY: AN HISTORIAN LOOKS AT THE NIKOLA TESLA AND THE INVENTION OF THE AC MOTOR, Prof. W. Bernard Carlson, Division of Technology, Culture, and Communication, Thornton Hall, University of Virginia, Charlottesville, VA

“One of the central challenges confronting historians studying invention is to reconcile the differences between the recollections of participants and documents generated in the process of invention. This challenge is particularly interesting in the case of Nikola Tesla and the invention of AC induction motor. The standard source for discussing this invention is Tesla's 1919 autobiography, but in the course of my research I have come across additional documents and accounts dating from 1902 and 1915. The problem is that these texts are not consistent in describing how Tesla developed the motor between 1878 and 1888; in each text, the sequence of events and the people involved is different. In my lecture, I will talk about how I have drawn on these multiple sources in order to create a coherent narrative which reflects both Tesla's considerable talent as well as the assistance he received from his backers, lawyers, and assistants. Overall, I will discuss how historians of invention seek to find a balance between genius and luck on the one hand with method and strategy on the other.”

Lecture 13: MY EXPERIENCES IN WRITING THE BOOK: TESLA: MASTER OF LIGHTNING, Margaret Cheney, writer and journalist, California

“In school I never heard of Tesla at all. And when I did hear about him, I was intrigued by the mystery about him. There are several reasons why Tesla is not well known. One was that he was a man who never married and had children. He never worked for universities or for corporations. He was very independent. And he was so far ahead of his time, so much a visionary, that his contemporary scientists really didn't understand what he was doing. The Smithsonian Institution has never adequately credited Tesla for his invention of radio. They have tended to call Marconi the "father of radio," and they have tended to give Edison credit for Tesla's work in alternating current, although Edison didn't work in that area at all. So, there are many reasons why we have not learned as much as we should about Tesla.”

Lecture 14: ON THE POSITION OF NIKOLA TESLA AMONG THE FOUNDERS OF MODERN ELECTRICAL SCIENCE AND TECHNOLOGY, James F. Corum, Ph.D., Institute for Software Research, Inc., 1000 Technology Dr., Fairmont, WV 26554, jcorum@ieee.org, <http://www.arcsandsparks.com/>

“Tesla's fundamental discoveries and inventive creations transformed electrical science from a parlor diversity and inefficient laboratory curiosity into a magnificent new force that powered the sinews of twentieth century industry and surrounded us with modern enchantment. His were the twelve labors of Hercules and, not unlike Prometheus, he wrestled lightning from the sky. The marvelous inventions and discoveries of this independent and prescient mind created new resources, made possible the transformation of cities and communities, and contributed to the safety, comfort and convenience of contemporary civilization. Recognized by his peers and neglected by his modern successors, Tesla's life illustrates a working definition of the word success. His was a lifetime of creative technical achievement. His rewards were scientific discoveries and engineering creations. The electrical power flowing from our great generators, illuminating our vast cities, dispelling the inky blackness of the night, and the telecommunications cohesively linking the homes and businesses of our civilization, across continents, around the globe and through the distant reaches of space - these are all monuments testifying to the successful life of this little known, but uniquely admirable, scientist, inventor, engineer, futurist, and citizen of the world.

This illustrated lecture begins with a brief sketch of Tesla's professional activities (he was a Life Fellow and served two terms as Vice President of what is now the IEEE) and then provides an overview of our experimental and analytical efforts to reconstruct apparatus faithful to the principles set forth by Tesla, and to recast his pioneering electrical achievements into modern engineering terms. The significance of voltage magnification by standing waves and the recent discovery of ball lightning generation by RF discharges will be described. Color slides of the first laboratory production of controlled ball lightning will be shown. During the course of the lecture, the historical evolution of high voltage resonance transformers will be traced from Lord Kelvin's initial discovery of the underdamped, lumped-element RLC network through to David Sloan's helical resonators and W.W. Hansen's introduction of cavity resonators in microwave technology and early particle accelerators.”

STUDENT PROJECTS

The grading for the course was “Pass/No Pass”, and weighting factors for the grades were as follows: Reading Assignments 20%, Project 40%, and Attendance 40%. The students were allowed to work on a project in groups. There were two project formats: essay or Web presentation. The preliminary presentations were given in the middle of the course. By that time the students were expected to decide on the project and choose the team. The final presentation was on the last day of lectures. Each student or team had about 10 minutes to present their project and 5 minutes were allowed for the questions from the audience.

A small “quiz” at the beginning of the course revealed that only a handful of students new who Tesla was or even heard of him. Those few were the students of the Department of Electrical Engineering and Computer Science.

TABLE 4: STUDENT PROJECTS FOR THE COURSE ENG 24 "NIKOLA TESLA: THE GENIUS THAT LIT THE WORLD

STUDENT	PROJECT
Vered Anzenberg	Essay: The Man Behind Nikola Tesla's Inventions
Andrew Lee Aquila, Prahallad Lakshmi Iyengar and Patrick Hyun Paik	Web Page: The Multi-disciplinary Fields of Tesla
Maria D. Chang	Web Page: The War of Currents
Morris Jishang Chen and Timothy Shinyu Chen	Web Page: Nikola Tesla: A Man For The People
Glen Ricker Florey	Essay: Nikola Tesla and the Army
Andreja Jovic and Stuart William Neft	Web Page: Tesla: The Hero
Dan Kalmick and Thomas Shoujen Kuo	Web Page: Wardencllyffe and Tunguska
Renee Khuong	Essay: Tesla's Death Ray
Katherine Ann Krumme	Essay: Nikola Tesla and Mark Twain
James Robert Learned and Bryon Hideki Ross	Web Page: Nikola Tesla: The Particle Beam Weapon
Noah Aquino Llanda Jonathan Admon Schaeffler	Essay: Tesla's power struggle with Edison
Anna M Melby	Essay: On Tesla Personality
Eric Robert Ostrem	Essay: Nikola Tesla: A Violin of Anonymity
Samsophear Say	Essay: Nikola Tesla - Is He Getting the Recognition That He Deserved?
Tom Brown	-

The students presentations are listed in Table 4, and can be found on:

<http://www.nuc.berkeley.edu/dept/Courses/E-4/Projects.html>

The students were allowed to choose their topics freely. The students were very excited to write about Tesla or to develop their Web presentations. Some interesting excerpts from the student projects are listed here and show how much they learned about Tesla:

Vered Anzenberg, Essay: "*The Man Behind Nikola Tesla Inventions*" "By looking at his personality and his traits, one gets a different sense of Nikola Tesla. He becomes one that is driven by his work due to his love for nature. His walks and feeding the birds become a huge aspect of his life. He isolates himself by his habits and especially by his treatment of woman companionship. Yet, all of these aid him in becoming the inventor that he was.

Through isolation, he devoted his whole life into his work. His habits make him a perfectionist and one of clear thinking. One simply can't just look at the person's achievement without looking at who the man truly was. There is no question that Tesla was a genius of his time, but to truly understand him, one has to understand who he was."

Andrew Lee Aquila, Prahallad Lakshmi Iyengar, Patrick Hyun Paik, Web Page: "*The Multi-disciplinary Fields of Tesla*", This team has chosen to discuss three areas of Tesla's work: Remote Control, AC Power, and Bladeless Turbine. They developed an excellent Web presentation with animation of rotating magnetic field.

"Tesla, a man that was more influential to our world than Thomas Edison and Guglielmo Marconi combined. One of the only two Americans to get a SI unit named after him

(Magnetic flux density, magnetic induction Tesla: $T = \text{kg/s}^2 \text{A}$).

Now a man synonymous only to adds for obscure science texts, and a few engineers (not to mention a seminar class from an unidentified CALifornia college) who look towards him for inspiration. Many of the genius ideas that Tesla had, never materialized. Similar to Leonardo Da Vinci, just another man ahead of his time. His ingenuity "sparked" the modern field of electricity. Such as his work in: Remote Control, AC power, and the bladeless turbine are just a few of the revolutionary ideas Tesla came up with. Many of his inventions forgotten or never utilized find their way into our every day life. After all if you are reading this on your computer, and Tesla hold the patent on the AND logic gate an essential idea to a CPU."

Maria D. Chang, Web Page: "*The War of Currents*" Maria has developed another excellent Web Page about Tesla and the War of Currents. She also added interesting animations and thoughts:

"Welcome to my webpage! My name is Maria Chang and I am a first-year student at the University of California at Berkeley. This is my final project for the seminar Engineering 24, Nikola Tesla: The Genius who lit the world. Have you heard of Nikola Tesla? Surprisingly, many people still do not realize the impact his work has made on American society, and the whole world. You might be wondering, "What is the War of Currents and what does it have to do with Nikola Tesla?" Well picture this...

Two mentalities come to a clash. One relies on the systematic proofs of trial and error. The other uses mathematical principles and theory to derive results. No booms or bangs of detonating cannons, or explosions of

military camps are heard. Only the tension of conflicting beliefs, paired with the piercing buzz of electrical currents penetrating the air. The casualties? A few commoners in a freak electrical accident and some household pets. Not quite like an ordinary war? That's because it isn't. It is The War of Currents, led by the two geniuses Thomas Edison and Nikola Tesla.”...

“I also think that Tesla is one of America's least credited inventors. I myself hadn't heard much of Tesla before taking this class. Once I learned of his many incredible inventions, I could not believe I didn't hear about him before. I started talking about him to peers and friends, and most of them hadn't heard of him either. This is because when people think of electricity, they think of Thomas Edison. Of course Thomas Edison revolutionized the era with his direct current, but people tend to overlook the crucial advancements made since that time. The truth is, that the possibilities with DC were quite limited. The most beneficial advancement was the development of AC, by Tesla. After AC, the possibilities stretched beyond the horizon.

Tesla was a true inventor, who created things to solve a problem. He didn't concern himself with the selling of patents, the promotions for his ideas, or almost anything having to do with money. Those weren't his interests, he left that work to others. In his mind, any energy spent on such issues was energy taken away from his work. I admire this attitude of Tesla's, because as an inventor, he was a purist. Everything in his life revolved around his ideas and their evolution into real tangible scientific marvels.

Another surprising fact: Tesla is not featured in the Smithsonian. Why? Because documents and physical artifacts on Tesla's work are scarce. But like all exhibits in the Smithsonian, Tesla's can be created upon request. To request an exhibit for Tesla, email Dr. Bernard S. Finn, Curator of the National Museum of American History Smithsonian Institution.”

Morris Jishang Chen, Timothy Shinyu Chen: Web Page: “Nikola Tesla: A Man For The People” This team decided to prepare their summary of Tesla's life, inventions and struggles. Some of the topics are:

Childhood Biography: A brief description of Nikola's life up until his departure from Serbia to the United States; *Tesla and Edison*: A summary of the Tesla/Edison rivalry; *Personal Life*: Tesla's Eccentricities; *The Taming of Niagara Falls*: The building of the Niagara Falls Power Project; *Patent Wars*: Tesla's struggles with patents; *Hardships*: A description of the obstacles faced by Tesla throughout his life; *Inventions*: A basic overview of some of Tesla's main contributions; *People*: A listing of Tesla's contemporaries

Glen Ricker Florey, Essay: “Nikola Tesla and the Army” “One of the primary reasons, as stated in the internal FBI documents for the raid was that the FBI was concerned that Tesla's nephew, Sava Kosanovic, would give the notes to the Soviets. The concern about this was so great that no one was allowed to access Tesla's notes at all until many years later.

Concern was increased dramatically when the FBI agent in charge was killed in an airplane explosion over the Atlantic Ocean. As a result of this the FBI initiated a huge search all over New York for any papers Tesla might have written. To this day, many of Tesla's paper are still missing.”

Andreja Jovic, Stuart William Neft, Web Page: “Tesla: The Hero” “The life of a hero can never be considered complacent- living by one's principles and choosing the nobler path requires great sacrifice. Nikola Tesla is considered one of the greatest inventor's of all time. However, what exceeded his brilliance in creating, was his brilliance in envisioning- which is a mark of a noble man. Tesla is a hero because his focal point in life was creating, envisioning, and making a positive impact on the world. This was unlike his contemporaries who sought power, fame, and fortune (the marks of weak men). It is ironic that the things these men sought, were Tesla's barriers in life. In this respect, not only can it be shown that Tesla was a hero through his triumphs, but also through his struggles and impact on the world.

Tesla has been described as a modern Prometheus- just as Prometheus gave fire to man, Tesla gave alternating current to the world. However, to simply say that he gave AC to the world would be a grave error because he introduced so many other remarkable creations and visions. It is through his triumphs that he portrayed that virtue and honor could still prevail in a time when inventors sought fame, fortune, and power.”

Several students were very interested in Tesla's work on “death rays”, and discuss their findings in the following projects: Dan Kalmick and Thomas Shoujen Kuo: Web Page: *Wardencllyffe and Tunguska*; Renee Khuong, Essay: *Tesla's Death Ray*, and James Robert, Learned Bryon and Hideki Ross, Web Page: *Nikola Tesla: The Particle Beam Weapon*.

Anna M Melby, Essay: *Nicola Tesla: “The Personality Behind the Invento”* “In addition to being a brilliant man with an inherent knowledge for the workings of electricity, Tesla embodied other qualities without which he would have had many difficulties in overcoming all of the obstacles that he was faced with throughout his life. Because of his great memory, ability to visualize, and intelligence, he was able to dream up his inventions, but it is Tesla's other qualities - his unceasing optimism, confidence in his ideas, fearlessness, and ability to look to the big picture - which enabled him to bring the visions in his head to life, setting the stage for all technology after him.”

Eric Ostrem, Essay: *Nikola Tesla: “A Violin of Anonymity”* “Nikola Tesla was one of the most brilliant men ever to live. His mind was a finely tuned violin, vibrating and resonating, producing beautiful scientific music. He did not constrain his music to only one string, and played many different songs. He experimented in many different areas of science, however, mainly in the area of electrical science and engineering. He was fascinated not so much with what one could see, but more with what one could not see. He experimented with things built into the world that were not obvious or research oriented. He investigated electricity, radio transmission, frequencies,

waves, x-rays, magnetic fields, remote control . . . all intangibles to the normal mind. His experimentation led to the creation of Alternating Current (AC), which revolutionized electrification and provided the basis for today's electronic age. He was one of the firsts to develop radio, remote control and x-rays.

However, despite his enormous contributions to electrical science, he is virtually unknown to the general populous. Why, if his contributions were so large, does he to this day receive so little credit for them? The answers are many and ranging, however, I believe that three chief reasons lie behind this enigma. The products of his experimentation were either not marketable or he did not market them. His experimentation was largely scientific: he was less an inventor and more a scientist. Finally, he failed to specialize enough to gain an identity with a single production. These three factors combined to create his relative anonymity among those who fail to personally pursue learning about him. His name is not synonymous with a single invention. These reasons are why he wallows in an undeserved anonymity."

Samsophear Say, Essay: "Nikola Tesla- Is He Getting the Recognition that He Deserved?" "Our assignment for the freshmen seminar class was to do a web page or a five-page essay on anything relating to Nikola Tesla. I chose the essay project because I know nothing about making a web page. I have decided to write my essay on his contributions to the world and why I think these contributions is enough to make him be recognized. And yet, why is not getting that recognition.

Let me start by asking you, "What comes to your mind when I say Thomas Edison?" Probably something like "he invented the light bulb." And that would be correct. But what would have come to your mind if I had said Nikola Tesla instead of Thomas Edison? Probably nothing, right? You are not the only one. Not many people have heard of his name before or know what he did, including myself. Yet, I am learning more about him now in my freshmen seminar class called Engineering 24. Furthermore, the more I read and hear about him the more I think he should be known and recognized to the whole world for his tremendous achievements. Some of his inventions that we are still using today are only proof of his great achievements."

EXCLUSIVE PRE-SCREENING OF A NEW PBS DOCUMENTARY

We were honored to get permission from producer/director Robert Uth to pre-screen his new documentary on life and legacy of Nikola Tesla on November 27, 2000, two weeks before it was shown for the first time on PBS [4]. From the press-release:

"TESLA, Master of Lightning, is a multi-media project that tells the complete story of the life and work of Nikola Tesla for the very first time. The project includes the PBS documentary special; the companion book written by Margaret Cheney and Robert Uth, published by Barnes & Noble in 1999; and an extensive educational website at

<http://www.pbs.org/tesla/>. This project is the result of years of research, in which many new and unknown details of Tesla's life have been uncovered. The documentary and the book contain a large and extremely rare collection of photographs documenting Tesla's life and inventions. A great deal of the story is told in Tesla's own words, drawn from his autobiographical and scientific writings, and performed by Stacy Keach."

We had about 50 students attending the pre-screening. The response was very positive, as well as the discussion that lasted long after the documentary was over.

CONCLUSIONS

There is a considerable and growing interest in Tesla's legacy today. A quick search on Internet (either on amazon.com or barnsandnoble.com) would produce close to 200 titles on Tesla, mostly published within the last 5 to 10 years. In my discussion with Dr. Finn after his lecture last year [5], I asked: "It seems that there is a growing interest in Tesla – how do you explain it?" His answer stunned me - he said something like: "Well, today only two types of people are interested in Tesla, the Serbs and the "lunatics". He did not say exactly "lunatics" but he implied it! Having in mind that Dr. Finn is responsible for bringing an exhibition about Tesla to the Smithsonian, we might have to wait for a long time to see any kind of credible Tesla exhibit. When asked by one of our students why so far Smithsonian did not have an exhibit on Tesla, Dr. Finn's answer was basically the same as the one he gave on the PBS Web site <http://www.pbs.org/tesla/>:

"We have, in fact, for several years been contemplating an exhibit on Tesla. Since we lack appropriate objects in the museum here, we contacted the Tesla Museum in Belgrade and began discussions about a joint project. We organized a conference of scholars and developed some core ideas. The situation in Yugoslavia has been such that further progress was not possible. However, with the recent political changes we expect that early next year we will have a small display of artifacts, in the hope that this will lead to full-scale exhibition."

In the mean time, while waiting on the Smithsonian Institution to prepare an exhibition on Tesla, we should do our best to popularize Tesla's legacy among the young people. We had excellent experience in organizing this course. There is no greater reward than to see the eyes and minds of our students lit by "the master of lightning". Tesla's life inspires the young students to believe that anything we can imagine can be accomplished. I will end this paper with the words of Maria Cheng, one of our students:

"This class has been an eye opening experience for me, allowing me to understand the mind and misfortunes of a man centuries ahead of his time. It reminds me that, as history displays, the lives of heroes aren't always fair. A positive initiative can be taken, however, by continuing to inform the people of the great advances this country (and the world) has been able to make, thanks to Nikola Tesla."



Figure 1: Prof. Vujic and her Eng-24 students (most of them).

REFERENCES

- [1] IEEE Power Engineering Society
<http://swww2.ieee.org/about/awards/sums/tesla.htm>
- [2] Margaret Cheney and Robert Uth, "Tesla: Master of Lightning," Barnes&Noble, 1999.
- [3] Nikola Tesla, "My inventions: the autobiography of Nikola Tesla" edited, with an introduction, by Ben Johnston. 1st Hart Bros. ed. Williston, Vt. : Hart Bros., 1982.
- [4] *TESLA, Master of Lightning*, premiered on PBS in the U.S. on Tuesday, December 12, 2000. It is a production of New Voyage Communications, Inc., Washington, D.C. Producer/Director : Robert Uth. Written by: Robert Uth, and Phylis Geller. Executive Producer : Phylis Geller. Senior Science Adviser: Leland I. Anderson. Funding is provided by PBS. e-mail: NPproducer@aol.com
- [5] Dr. Bernard S. Finn, Curator, National Museum of American History, Smithsonian Institution, Washington, D.C., private communication in Berkeley on October 23, 2000.