The Complete Patents of Nikola Tesla

Edited by Jim Glenn

(This is a Must Have Book for Inventors !)
— Tommy C —

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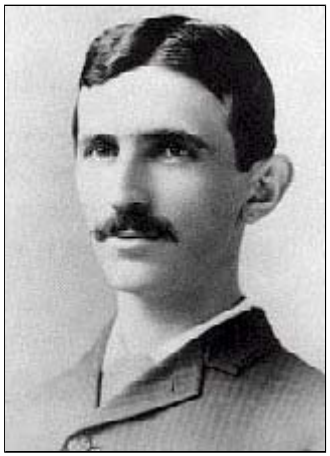
Nikola Tesla's Automobile



Nikola Tesla, the "man who invented the twentieth century," was born July 10, 1856, at Smiljan, Lika province (in modern Croatia), a part of the expiring Empire of Austro–Hungary. His father, Rev. Milutin Tesla of the Serbian Orthodox Church, intended Nikola for the priesthood, but did not insist–it must have been hard to make demands of the high–strung, fragile youth who was his son. On Nikola's evidence we know his mother, Duka Mandic, to have been an inventor, a maker of tools and devices for her weaving, carpentry, and other handiwork.

As a child Nikola manifested a full share of Duka's ingenuity, building among other things a bug–propelled engine. Much later he would mention that he had always the ability to see his ideas constructed in his mind, and in such detail that he could adjust and balance the parts. In school he absorbed languages quickly (English, French, Getman, Italian) and made an impressive showing in mathematics.

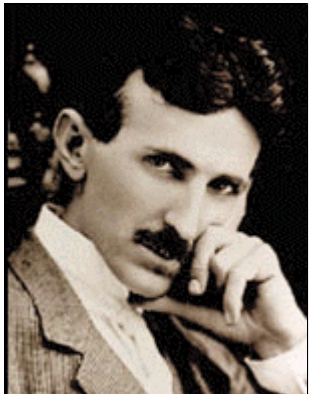
He entered the Polytechnic College of Graz in 1875, studied hungrily, but for lack of funds was unable to complete his second year. He took himself to Prague, immersing his restless mind in the university library there (and took up gambling as a means of support-with what success is uncertain); he returned

to Smiljan in 1879.

Already at Graz he knew that electricity would be his life's fascination. Indeed, this was the scientific frontier, where mystery and knowledge collided. When he learned in 1881 that a telephone exchange, one of Europe's first, was to be built in Budapest, he left at once. The Edison Tel. Co. (European subsidiary) in Budapest hired him, sent him to Paris in 1882 and to other cities. His standing and repute within the field were sufficient by 1884 that a colleague wrote a letter recommending him to Thomas Edison. Tesla fully appreciated that an inventor's prospects in America–to attract capital, to manufacture and sell, to reap rewards-greatly exceeded his opportunities in Europe.

He did emigrate and he did go to work for Edison, but for less than a year, until the fee promised for a particularly difficult project, redesign of an Edison dynamo, failed to materialize. Edison, it is recorded, made some mention of the Serb's failure to comprehend American humor. (Of course Tesla, who later formed a great friendship with Mark Twain, perfectly well understood American humor and Edison.)

Over the next ten years, free to make his own arrangements, Tesla consulted, invented, invested–forming with his backers a number of companies and producing the forty or so fundamental AC patents that revolutionized the running of industrial America. His name became synonymous in the press with electrical wizardry; he was seldom photographed without megavolt streamers playing around him, the apparatus afire with an eerie glow. All of which is a fair picture of the man: he relished the highvoltage drama of his public demonstrations but no less in the lab insisted on being first and closest in any chancy experiment.



Tesla was" in any case, a natural showman. Strikingly thin, six–foot–four, always whitegloved and well dressed, he lived at the Waldorf (when he could afford it), ate the best food, with the best people, and infallibly charmed his company. But that problematic, intense youth never disappeared: he counted things compulsively, calculated the volumes of bowls and cups before he could eat from them; his assorted phobias and fetishes perhaps denied him any close relationships. He wrote of recurrent visual sensations, bright and geometric, which occasionally overwhelmed his sight, actually blotting out scenes in front of him.

Among his business investors he would eventually number the likes of J. P. Morgan and John Jacob Astor, but the most important for his aspirations was an early association with George Westinghouse. Westinghouse purchased Tesla's basic AC patents in 1888 for cash and shares amounting to $60,000 and a royalty on electrical horsepower sold. (By agreement the two principals canceled the mostly unpaid royalty in 1897; the lump sum Westinghouse negotiated has never been firmly determined, though a check record for $216,000 does exist.) More importantly Tesla acquired a resourceful and tenacious champion in the Westinghouse Corporation.

A fierce, often underhanded competition raged for years between the General Electric Co. (a creature of Morgan) and Westinghouse. GE's strategy, when mere engineering would not avail, was to invent ghastly tales of AC hazards and misadventures. In 1890 the company went so far as to license, through an agent, the Westinghouse system in order to power a death contraption which they called an "electric chair." Sing Sing Prison, in upstate New York, was persuaded to use it, with the gratifying results for GE that the press for a while played headlines in which prisoners were "Westinghoused."

When the publicity battles were over, and the superiority of AC systems apparent, Westinghouse was kept constantly in the courts, defending the patents–which the company did with ferocity. For Tesla, now an eminence in the field, success brought little in the way of wealth. With consultant and contract work he lived comfortably enough and kept his lab busy; he sometimes wrote that genuine millions could not elude him for long.

Through the 1890s he absorbed himself (and his redoubtable chief assistant, George Scherff) in work with x–rays, with high–frequency, high–voltage phenomena, and with radio. By 1899 he had built in Colorado Springs an isolated laboratory in which he could unleash power at unheard–of levels. His "magnifying transmitter," which included a 52–foot Tesla coil, reached 12 Mv in the secondary-the arcs thrown from its antenna mast sounded a man–made thunder for miles around. As satisfying as were such spectacles for their creator, and tantalizing to his searching mind, any possible commercial value in energy at this scale lay far, far over the horizon.

A 1902 venture, with J. P. Morgan, to construct a transatlantic radio installation (at Wardenclyffe, Long Island) was abandoned by 1906. Troubled from the

outset by thinness of financing, the facility never became fully operational.

Now entering his fifties, Tesla received honors with regularity (including the Edison Medal) and stipends or fees enough to make ends meet, but clearly a decline had set in. Patent filings were fewer, lectures more seldom, his eccentricities more noticeable. Still, he seemed always able to find working capital, putting together the Tesla Ozone Co. in 1910 and later the Tesla Propulsion Co. (to produce his new and patented turbine).

His notes, letters, and patent filings bespeak a genius at work through his seventies, but a genius whose time is increasingly given over to feeding the pigeons of Manhattan, and to nursing the sick ones in his hotel room. When he died, January 7, 1943, in a world at war, the FBI showed up within hours to open his safe–though Tesla had become an American citizen in 1891, his many boxes and crates were put under seal and unaccountably turned over to the OAP (Office of Alien Property). Many were released in 1952 to the Tesla Museum in Belgrade, some have not resurfaced. His is a legacy of brilliance and enigma.

Remarkable by any standard, Tesla's 111 patents illuminate only his most purposive, practical work. As he often lamented, there just wasn't enough time to tame the racing of ideas in his head; so much had to be left incomplete. Some of the projects–for achieving ultra-high vacuum, a rocket engine design, experiments in directed beams and solar power–simply don't fit into the early twentieth century. His musings on ball lightning (he proposed an onionlike gaseous sphere of many charged layers) accord well with the most recent and satisfactory computer models. Frequently he was content to publish his findings without regard to priority or patentability: he introduced in this way the therapeutic method now called diathermy.

But the patent record is, as always, incontrovertible and precise. All inventors who wish to eat regularly must sooner or later become acquainted with the ordeals of the patent process. It will be useful to sketch the essentials of filing, using, and defending these peculiar grants.

To begin, a U.S. patent can be filed only by the inventor. Other nations, at different times in history, have allowed patents to whomever appeared first, treating the act of filing much like staking out a gold claim.

The application itself consists of five parts: petition (who is filing), oath (swearing to originality), specifications (how is it made, what it does), claims (what is new, important, and patentable about it), and drawings. A specialist, a patent examiner with expertise in one or several fields, studies the application and begins the often long, unpredictable process. The heart of the application lies in its specifications and claims.

Language describing a device's function or manufacture might later become crucial to making distinctions between it and a world of seemingly similar machines. Ordinary words (like "sever , "inclined," "adjacent") have judicial pedigrees and must not be used casually. And the result must be clear enough that a person skilled in the appropriate arts could construct a copy from the description.

Claims should be neither too broad nor too narrow-but they must stake out clearly the territory the inventor wants for his own. Up to twenty claims may be submitted with the basic filing fee; more claims mean more charges.

Tesla's patent claims, it will be noted, generally iterate one or two basic ideas but described in several ways: this is good patent form. There are no unusual requirements of the drawings, so long as they correspond well with the specifications. Tesla never sent actual models with any filing, though a skeptical examiner did visit once to have a look at his remote–controlled devices (No. 613,809). The Patent Office only occasionally insists upon working models, most famously for all applicants presenting perpetual motion machines. But then, the Patent Office for years used the same tactic to shoo away persons bearing drawings of flying machines.

Between the filing and the grant of a patent, a number of time – and paper–consuming things generally happen. The examiner will request clarifications, disallow various claims, point out errors, and give notice of "interference"–existence of applications by other inventors whose work and claims are very similar. (In the U.S. an interference may prompt an investigation to determine whose work has priority in actual fact, not merely in time of filing.)

Tesla and his lawyers submitted arguments to dissolve potential interferences in nearly every patent. Against an earlier radio patent by Wilson, for example, Tesla pointed out that his own four–circuit

transmitter / receiver (No. 725,605) operated with two distinct frequencies, while Wilson's used only one, polarized in two planes. Similar distinctions were made to challenges on behalf of Fessenden, Cardwell, MacKaye, Hogg, and DeForest.

When all the changes are made, claims language negotiated, objections answered, the sheaf of correspondence concerning a single Tesla patent, the "patent wrapper," might run to fifty or eighty pages and thousands of dollars in legal fees.

With all of these matters settled, and with the examiner satisfied that the patent can be reduced to "constructive practice"-that it can actually be built–a patent may finally be granted. (Tesla had a great deal of difficulty convincing the Patent Office about a balloon-supported conductor in No. 645,576. The inventor clearly didn't care how his antenna arrived at a great elevation, but the examiner did.)

In many ways the woes of an inventor only begin with the patent's issue. The patent is, legally, a "negative right"; it does not grant a right to manufacture (which might infringe in the process on other patents), it merely assures the right of its holder to bring infringement suits in court–a hazardous and expensive privilege.

The court might look into the patent and perhaps decide its novelty is a mere improvement upon some earlier design, the work of a skilled mechanic but not original or ingenious enough to merit a patent. Or it may conclude the patent covers something altogether obvious. Worse, the patent might describe a device patented earlier, a fatal case of "anticipation." It may be the inventor hasn't been vigilant, allowing general borrowing of the patent or, conversely, that the patent hasn't been put to any practical use-either way the court will detect "abandonment" of the patent. In all of these cases the patent will not be sustained. (In granting a patent, the Patent Office makes no guarantees about its legal durability.)

The pivotal patent case concerning priority in radio (Marconi Wireless Telegraph Co. v. U.S., 320 U.S. 1) didn't work its way up to the Supreme Court until 1943, when some of the issues in question were nearly thirty years old. Tesla, it must be understood, was not a party to this suit.

Marconi v. U.S. had begun as an action to recover licensing fees from the government for its use of

certain radio equipment during World War 1. Although Marconi Wireless had ceased to exist after 1919, its patents and other property having been absorbed by RCA, it reserved the right to pursue this litigation. The legal ghost that Marconi Wireless had become won a victory in the U.S. Court of Claims to the tune of $42,984.93, but only by the thinnest edge: survival of a single claim among the many in the patent. The government appealed to the Supreme Court.

In the course of its eighty–page decision, the Court found it necessary to rule on many points of law, procedure, and fact, including the facts, or history, of radio development. Its consideration relied heavily on what it named a radio communication system with "two tuned circuits each at the transmitter and receiver, all four tuned to the same frequency," by which it meant tuned antenna (output / input) and oscillator (signal / detector) circuits coupled by transformers in each piece of equipment. But this should not be confused with the four circuits of a later, more sophisticated Tesla patent (No. 723,188), in which two different frequencies are transmitted and received–to eliminate a degree of noise and (though the Patent Office contested the claim) to allow greater privacy of transmission.

A majority of the Court found, after tracing the lineage of radio through Maxwell, Hertz, Lodge, Tesla, and Crookes, the basic Marconi patent (No. 763,772, filed Nov. 1900) used nothing not already included in Tesla's earlier patent No. 645,576 (filed Sept. 1897), except for the presence in Marconi's design of an inductively tuneable antenna. (And the antenna element under discussion-Lodge's patent, No. 609,104-was bought from Lodge by Marconi.) The Court went on to note that Stone's radio patent (No. 714,756) completely anticipated Marconi's, antenna included. Stone, by the way, had always credited Tesla with the first basic, workable design, saying of his own patent it was "practically the same as that employed by Tesla" –but with the valuable refinements of a tuneable antenna and design adjustments to "swamp" parasitic oscillations in the transmitter.

Even the patent history of Marconi No. 763,772 showed serious blemishes: it had been rejected outright by the Patent Office and was only wrangled into being by persistent renewal and argument of Marconi's lawyers. With the facts thus marshalled, and observing that no amount of commercial success could save Marconi's patent, the Court held it invalid.

The decision was stunning, especially in view of the ease with which the Marconi patent had prevailed in

earlier suits. In a 1914 case one federal judge found singular value in Marconi's use of a ground connection, and heaped praises on him as the indubitable inventor of radio. Nearly thirty years later, writing in dissent of Marconi v. U.S., justice Frankfurter would credit only Marconi with having the "flash," the stroke of genius, that unites disparate elements into a fundamentally new process or device. Yet he could not identify wherein Marconi's patent differed from those that had come before.

More than one judge has lamented the court's role as scientific referee, for it often has little in resources or temperament to give the job an assured performance. Utterly specious notions persisted for years, in and out of court, over such things as a ground connection-chaff thrown into the proceedings by lawyers hoping to add technical mystery and confusion. (There is a ground in all of Tesla's patent specifications, and in everyone else's equipment, too.)

Slowly, perhaps a little grudgingly, writers of scientific history have enlarged their paragraphs on the development of radio, giving Tesla the credit he is due. Surely, as the patents show, if that all–unifying "flash" came to any man, it was Nikola Tesla.

TABLE OF CONTENTS

Nikola Tesla's Automobile

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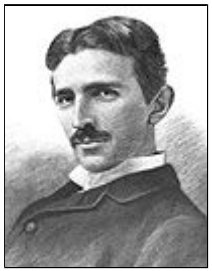


In well informed circles, it is occasionally mentioned that Nikola Tesla, even in retirement, built an automobile propelled by gravity stressing energy. At the age of 70, in a period of deep economic depression, Tesla had considerable financial means. While these means were not as ample as originally and contractually promised by Westinghouse, they made possible this extraordinarily interesting episode which is today fully documented. We say this also because, once again. the episode points out the enormous significance of this extraordinary experimental physicist. It took no less than 100 years of today's fast-moving events to fully grasp the importance of the man. There is no explanation for this. One can merely humorously assume that Tesla came from some other world, to be born on Earth. His results in experimental physics, which appeared to be perfectly obvious, still cause indigestion in orthodox theoretical physics circles.

In 1930, Nikola Tesla asked his nephew, Petar Savo, who was born in Yugoslavia in 1899, to come to New York. Petar was 43 years younger than his uncle. Up to that date, he had lived under stringent conditions in Yugoslavia, Tesla's country of birth. During the summer of 1931, Tesla took his nephew to Buffalo to unveil and test a new automobile. Tesla had developed it with his own personal funds.

It was a Pierce Arrow, one of the luxury cars of the period. The engine had been removed, leaving the clutch, gearbox and transmission to the rear wheels undisturbed. The gasoline engine had been replaced with a round, completely enclosed electric motor of approximately 1 meter in length and 65 cm in

diameter, with a cooling fan in front. Reputedly, it had no distributor. Tesla was not willing to say who had manufactured the engine. It was possibly one of the divisions of Westinghouse.

The "energy receiver" (gravitational energy converter) had been built by Nikola Tesla himself. The dimensions of the converter housing were approximately 60 X 25 X 15 cm. It was installed in front of the dashboard. Among other things, the converter contained 12 vacuum tubes, of which three were of the 70-L-7 type. A heavy antenna, approximately 1.8 meters long, came out of the converter. This antenna apparently had the same function as that on the Moray converter (see below). Furthermore, two thick rods protruded approximately 10 cm from the converter housing. Tesla pushed them in, saying "Now we have power." the motor achieved a maximum of 1,800 rpm. Tesla said it was fairly hot when operating, and therefore a cooling fan was required. For the rest, he said there was enough power in the converter to illuminate an entire house, besides running the car engine. The car was tested for a week, reaching a top speed of 90 miles per hour effortlessly. Its performance data were at least comparable to those of an automobile using gasoline. At a stop sign, a passerby remarked that there were no exhaust gases coming from the exhaust pipe. Petar answered "We have no motor."

The car was kept on a farm, perhaps 20 miles outside of Buffalo, not far from Niagara Falls.

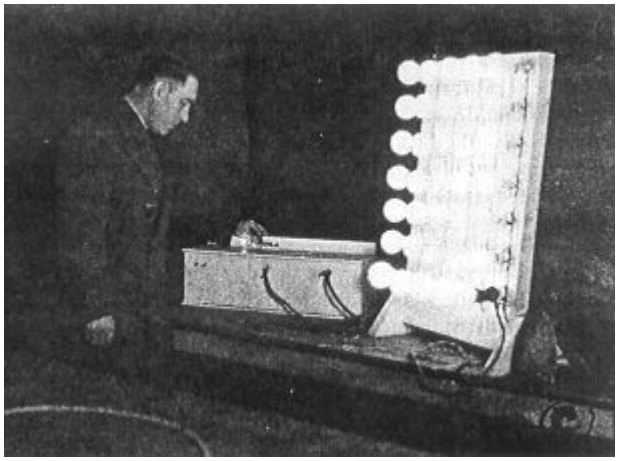
A few months after this automobile test, and because of the economic crisis at the time, Pierce Arrow had to stop production. It is very likely that the interconnection between the electric motor and the transmission had been performed there. Pierce Arrow's tools were taken over by Studebaker, in South Bend. Not quite 30 years later, that company also vanished to form American Motors, jointly with Nash. Later, some of its fans attempted to resuscitate the Pierce Arrow. Unfortunately, they were not successful.

Thus, today that company's name is in a mausoleum, together with others. such as Horch, Maybach, Hispano-Suiza, Bugatti and Isotta Fraschini.

Nikola Tesla apparently knew that this construction contradicted the technical concepts of the time. He thus avoided all discussions with engineers, theoretical scientists, or companies (with very few exceptions). It is obvious that this Pierce Arrow was built only as a private hobby. An inventory of all

available information – by aeronautical engineer Derek Ahlers – was completed on September 16, 1967, in New York. The complete documentation of all the information gathered by Ahlers is in our archives, The experimental car built by Nikola Tesla in 1931 already foreshadowed the cars of the future. Minimum operating costs and freedom from pollution are part of it also. The invention of super magnets, mentioned earlier. creates possibilities for unlimited conversion of gravity field energy anywhere on Earth, thus benefiting individualistic society.

Tesla's Electric Car - another version



Dr. T. Henry Moray with his resonate coil device. This device could output 80,000 watts.

This device was properly tested and documented.

After the Patent Office refused Henry Moray a patent on his device, he offered to give it to the goverment for free — They refused the offer.

(It appears from my studies on the subject, that Nikola Tesla had a chance to see Henry Moray's device after the Germanium detector was smashed by a malicious person.

Nikola Tesla was able to replace Henry Moray's "solid state component" with vacuum tubes in the resonate coil design he used for his car. —Tommy C—)

The Whispering Wheel — An In-wheel Electric Engine

The wheel is in fact the engine (motor), no axles or any other friction–producing and therefore energy–wasting mechanical parts are needed.

— The perfect mate for the above technology —

Chapter 4

"Broadcast Power" — Nikola Tesla

"Lost Science" by Gerry Vassilatos

ISBN 0-932813-75-5

POLYPHASE

The drama of Twentieth Century Science and its intriguing relationship with financiers and governments unfold together in the remarkable life of Nikola Tesla. His is a biography replete with all the elements of tragedy. Tesla, a great discoverer of unsurpassed force, became the focal point of old insidious forces intent on destroying the future for the selfish sake of the status quo. Tesla remains a focal point of wonderment, of dream, and of worlds, which yet should be to those who are familiar with his biography. For them, Tesla stands astride the quaint past century and the gleaming future. He is a technological Colossus, pointing the way to a new dawn.

The biography of Nikola Tesla should be the very first chapter in every child's science text. Yet, we find his name stricken from the record in every avenue of which he alone holds priority. This conspicuous absence prompts wonderment. What the world does with discoverers determines the world course. In the life of Nikola Tesla we see the portrayal of our own future, the fate of the world. The achievements of this researcher were lofty. The world has not yet implemented his greatest works. For a time, all the world's dramatis personae focused on Tesla. He remains the legend, the theme, the archetype of all Twentieth Century scientists.

But who was Nikola Tesla, and where was he from? How did he reach such a mighty stature, and what did

he actually invent? Tesla was born in 1856, the son of an illustrious Serbian family. His father, an Orthodox priest, his uncles noteworthy military heroes of highest rank. He was educated in Graz, and later moved to Budapest. Throughout his life he was blessed, or haunted, by vivid visions. In the terminology of Reichenbach he would be termed an extreme sensitive. It was through these remarkable visions that Nikola Tesla invented devices, which the Victorian world had never seen. Indeed, his visionary experiences produced the modern world, as we know it. He attended various Universities in Eastern Europe during his early adulthood. While delving into his studies, he became aware by the new and insidious scientific trends, which questioned the validity of human sense and reason. An impassioned soul, Tesla felt the pain of modern humanity in its intellectual search for a soul. Finding no solace in any of his classes, he sought refuge in a more romantic treatment of science and nature. None could be found. Professors dutifully promoted the "new view" by which it was declared that the natural world was "inert ... dead ... a mere collection of forces".

This quantitative regime was mounting force among academes, who were then attempting the total conversion of scientific method. Those who would not accept the new order were compelled to depart from academic pursuits. Tesla totally rejected these notions on the strongest of inner intuitions. Most of his instructors would have said that he was not University material. Tesla, sensitive to every such dogmatic wind, rejected their thesis and sought some better means for knowing nature. If he was to excel in engineering, there could only be cooperation with natural force, never violence. It was clear to him that the new scientific world-attack would ultimately lead to violent responses from nature itself.

His inner conflict expressed itself openly and candidly, bringing young Tesla into certain disrepute among rigid University authorities. Universities were more like military academies than places where original thinking was conducted in open forum. Tesla challenged too many persons of esteemed rank with probing questions for which he was given rebuke but no real answers.

A gifted researcher and voracious reader, he chanced upon some forgotten volumes of natural science written by Goethe. He had not been aware that Goethe, long before he chose poetry for the vehicle of his scientific themes, had written several magnificent tomes on the natural world. Tesla found to his wonder that Goethe had experienced the very same emotions. When the new scientific dogma was just in its infancy, Goethe caught wind of it and reacted violently, even as one who stands watch in the night.

Goethe was well aware of the new scientific trend and its implications. The reduction of nature to forces and mechanisms was utterly revolting to Goethe. Now, Tesla found a notable compatriot in his experience. He secured a thorough collection of Goethe's scientific texts and read these to the exclusion of all other philosophies. It was through this window that we may comprehend all of Tesla's scientific methods and later statements. For in Tesla we see the quest for communion with nature, one based on the faith that mind, sensation, consciousness, and ordained structure form the world-foundations. The sense-validating Qualitative Theme again appears in Nikola Tesla. Armed with this foundation, he was able to filter and qualify every other new study with which he was presented. In addition, he was irresistibly drawn into the study of electricity, the "new magick". In the following months, he absorbed the electrical engineering courses so rapidly that he no longer attended classes. He had taken a technical position in Budapest. Several new intuitions had seized him. Tesla became fascinated, obsessed with alternating current electricity. The problem he faced was considered insurmountable. Tesla was sure that he could devise an engine, which was turned, not by contact-currents, but by magnetic field actions alone.

The struggle toward designing such a device, begun as a puzzling amusement, was now completely consuming his strength. The answer, tantalizing and near, seemed elusive. Under-girding all these efforts was the strongest desire to achieve something original, and by this, to attain financial independence for the sake of pure research. His only dream was to have a laboratory facility of his own.

The excessive labors and mental exertions nearly drove him to the brink of madness. He was, for as time, seized with strange maladies and sensitivities which physicians could not address. Reichenbach accurately describes these symptoms, characteristic of extreme sensitives. There come times when the neurological sensitivity of these individuals literally transforms and processes through their being. The emergence of these rare sensitivities affects such persons for the remainder of their lives. Tesla found that his senses were amplified beyond reason. He was terribly frightened at first, nervous exhaustion permeating his frail being. Eventually learning to manage these rare faculties, he again resumed his life. But the visions, which began in his youth, were now more vivid and solid than ever before. When they came, unbidden, he could literally touch and walk around them. Now also, he was equal to receiving them. He was waiting for the revelation by which his alternating current motor would appear.

Tesla's life came into a new focus while walking in a park with some friends, the year 1881. It was late afternoon, and Tesla became entranced with the sight of a glorious sunset. Moved to indescribable emotions, he began quoting a verse from Goethe's "Faust";

"The glow retreats, done is our day of toil; it yonder hastes, new fields of life exploring, ah, can no wing lift me from this soil... upon his track to follow, follow soaring?"

As he reached this last line of verse, Tesla was suddenly seized by an overwhelming vision. In it, he beheld a great vortex, whirling eternally in the sun and driving across the earth with its infinite power. Completely absorbed in this glory, he became catatonic and irresponsive ... to the great fear of his companions. His mind and body buzzing with the power of the vision, he suddenly blurted out, "see my motor here ... watch me reverse it". They shook him, believing he had lost his mind completely.

Rigid and resisting all of their efforts, he would not move until the vision subsided. When he was finally led to a bench, he seemed completely transformed. The remainder of the day was spent in a grand and joyous celebration, Tesla's remaining funds supplying the feast. Throughout the long hours of that night he shared with his friends the great sight he had beheld. They spoke of the sure implications portended for the world's future, and departed with very great expectations.

Moving to Strassburg, he was employed as an engineer in a telephone subsidiary of the Continental Edison Company. It was in a small machine shop that he constructed the world's first brush less motors. He called them "magnetic vortex motors". Their whirling magnetic fields baffled electrical engineers. Now, Tesla's professors were studying his work. Goethe was absolute in his judgment of science and human nature: nature leads humanity to "follow, follow soaring".

Tesla's strange whirling devices worked on their very first trial. There were no connections between the rotors and stators, no sparking, lousy brushes. The motion was smooth and efficient. Numerous alternating current generators, transformers, and "brush less" motors, all were developed by Tesla in quick succession. The vision in material form. Himself a professional draftsman, he mapped out his entire Polyphase System. Tesla immigrated to America with a full portfolio of plans. America would be the place where his dreams would find fulfillment.

Continually attracted to engineering problems which none could master, his sudden visualization of the solutions became his normal mode of operation. In this respect, as well as others, he remained the wonder of all his technical assistants. He worked for Thomas Edison in New Jersey for a very short time period until securing a laboratory and financial supporters of his own.

In his first independent venture he developed arc lamps and lighting systems. When his financial supporters betrayed his trust, they left him bankrupt overnight. He became a ditch digger, suffering all the indignities, which immigrants faced in America during the 1880's. He learned the value of publicity after his incessant mention of polyphase and alternating current managed to attract the attention of certain new financial supporters. They drew him out of the ditch, but not before he demanded his own laboratory, a machine shop, and a sizable personal percentage "up front". The result was our present day electrical distribution system.

Tesla did not invent alternating current. Tesla reinvented alternating current in the form of Polyphase Current. His Polyphase System was a novel means for blending three identical alternating currents together simultaneously, but "out of step". The idea was similar to having three pistons on a crankshaft rather than one. Tesla's method had wonderful advantages, especially when motors were to be operated. Formally, no one could make an alternating current motor turn at all simply because no net motion could be derived from a current which just "shuttled" to and fro.

Polyphase applied a continuous series of separate "pushes" to rotors. Tesla's Polyphase System made brushless motors and brilliant lighting methods possible. Polyphase made it also possible to send electrical power to very great distances with little loss. Alternating electrical currents vibrated in the line. Current did not flow continuously from end to end, as in Edison's flawed system. Edison's direct current system could not supply electricity beyond a few city blocks before current virtually disappeared.

In efforts to discover a more efficient kind of Polyphase, Tesla explored higher frequency alternating currents. During this research, he built and patented several remarkable generators. Higher frequency Polyphase was found by Tesla to perform with far greater efficacy than the common sixty-cycle variety, which we still use. He fully intended on implementing these special generators in the system, which his patron and friend, George Westinghouse, had proliferated. The business arrangement rendered Tesla

fabulously wealthy at a young age.

Tesla extended his generator frequencies in multiples of sixty until reaching some thirty thousand cycles per second. These very high frequency alternating current generators became the marvel of all the academic and engineering world. They were copied and modified by several other subsequent inventors including Alexanderson. Remarkably driven at excessive speeds, they constituted Tesla's first belief that high frequency alternating current generators would supply the world's power.

High frequency current phenomena were new and exceedingly curious. A line of experimental research was conducted in order to evaluate new safe and possibly more efficient ways for transmitting power along long elevated lines. Tesla stated that the transmission of such safe currents across very long power line distances in the future would be a certainty, seeing their wonderful new qualities.

Tesla found that high frequency currents were harmless when contacted by the human body. Discharges from these generators traversed the outer surface of materials, never penetrating matter with depth. There was no danger when working with high frequency currents. He also observed their very curious and beautiful spark effects. They hissed and fizzled all over wire conductors, could stimulate luminescence in low pressure gas bulbs, seemed to traverse insulative barriers with ease, and made little pinwheels spin like delicate little fireworks displays.

Though curious, the effects were weak and furtive. They seemed to intimate some future technology which he was yet unable to penetrate. Tesla learned that his intuitions and visions were infallible. What he guessed usually proved true. This very personal revelation, he later claimed, was his greatest discovery.

As the safety of all personnel was his main concern, he was consumed with the idea of making his High Frequency Polyphase System completely safe for human operators and consumers alike. An extensive examination of each System component was undertaken with this aim in mind. Tesla was thorough and relentless in his quest for safety and efficiency.

But, his involvement with alternating currents would come to an abrupt and unexpected end. During a

series of experiments which followed these high frequency tests, an amazing seldom-mentioned accident occurred in which Tesla observed a phenomenon which forever altered his view of electricity and technology.

SHOCKING DISCOVERY

Tesla was an avid and professional experimenter throughout his life. His curiosity was of such an intense nature that he was able to plumb the mysteries of an electrical peculiarity with no regard for his own comfort. Whereas Edison would work and sleep for a few hours on the floor, Tesla would never sleep until he had achieved success in an experimental venture. This marathon could last for days. He was once observed to work through a seventy-two hour period without fatigue. His technicians were in awe of him.

The Victorian Era was flooding over with new electrical discoveries by the day. Keeping up with the sheer volume of strange electrical discoveries and curiosities was a task, which Tesla thoroughly enjoyed ... and preferred. His Polyphase System in perfect working order, the pleasurable occupation of studying new gazettes and scientific journals often fascinated his mind to the exclusion of all other responsibilities. A millionaire and world-heralded genius before the age of thirty, Tesla sought the pure kind of research he had so long craved.

Whenever he observed any intriguing electrical effect he immediately launched into experimental study with a hundred variations. Each study brought him such a wealth of new knowledge that, based on phenomena which he observed, he was immediately able to formulate new inventions and acquire new patents.

Tesla's New York laboratories had several sections. This complex was arranged as a multi-level gallery, providing a complete research and production facility. Tesla fabricated several of his large transformers and generators in the lower floors, where the machine shops of this building were housed. The upper floors contained his private research laboratories. He had attracted a loyal staff of technicians. Of all these, Kolman Czito was a trusted friend who would stand by Tesla for the remainder of his life. Czito was

the machine shop foreman in each of Tesla's New York laboratories.

Tesla observed that instantaneous applications of either direct or alternating current to lines often caused explosive effects. While these had obvious practical applications in improvement and safety, Tesla was seized by certain peculiar aspects of the phenomenon. He had observed these powerful blasts when knife-switches were quickly closed and opened in his Polyphase System. Switch terminals were often blasted to pieces when the speed of the switchman matched the current phase.

Tesla assessed the situation very accurately. Suddenly applied currents will stress conductors both electrically and mechanically. When the speed of the switch-action is brief enough, and the power reaches a sufficiently high crescendo, the effects are not unlike a miniature lightning stroke. Electricity initially heats the wire, bringing it to vapor point. The continual application of current then blasts the wire apart by electrostatic repulsion. But was this mechanistic explanation responsible for every part of the phenomenon?

The most refractory metals were said to be vaporized by such electrical blasts. Others had used this phenomenon to generate tiny granular diamonds. Yes, there were other aspects about this violent impulse phenomenon, which tantalized him. Sufficiently intrigued, he developed a small lightning "generator" consisting of a high voltage dynamo and small capacitor storage bank. His idea was to blast sections of wire with lightning-like currents. He wanted to observe the mechanically explosive effects, which wires sustain under sudden high-powered electrifications.

Instantaneous applications of high current and high voltage could literally convert thin wires into vapor. Charged to high direct current potentials, his capacitors were allowed to discharge across a section of thin wire. Tesla configured his test apparatus to eliminate all possible current alternations. The application of a single switch contact would here produce a single, explosive electrical surge: a direct current impulse resembling lightning. At first Tesla hand-operated the system, manually snapping a heavy knife switch on and off. This became less favorable as the dynamo voltages were deliberately increased.

He quickly closed the large knife switch held in his gloved hand. Bang! The wire exploded. But as it did

so, Tesla was stung by a pressure blast of needle-like penetrations. Closing the dynamo down, he rubbed his face, neck, arms, chest, and hands. The irritation was distinct. He thought while the dynamo whirred down to a slow spin. The blast was powerful. He must have been sprayed by hot metal droplets as small as smoke particles. Though he examined his person, he fortunately found no wounds. No evidence of the stinging blast, which he so powerful felt.

Placing a large glass plate between himself and the exploding wire, he performed the test again. Bang! The wire again turned to vapor...but the pressured stinging effect was still felt. But, what was this? How were these stinging effects able to penetrate the glass plate? Now he was not sure whether he was experiencing a pressure effect or an electrical one. The glass would have screened any mechanical shrapnel, but would not appreciably shield any electrical effects.

Through careful isolation of each experimental component, Tesla gradually realized that he was observing a very rare electrical phenomenon. Each "bang" produced the same unexpected shock response in Tesla, while exploding small wire sections into vapor. The instantaneous burst produced strange effects never observed with alternating currents. The painful shocking sensation appeared each time he closed or opened the switch. These sudden shock currents were IMPULSES, not alternations. What surprised him was the fact that these needle-like shocks were able to reach him from a distance: he was standing almost ten feet from the discharge site!

These electrical irritations expanded out of the wire in all directions and filled the room in a mystifying manner. He had never before observed such an effect. He thought that the hot metal vapor might be acting as a "carrier" for the electrical charges. This would explain the strong pressure wave accompanied by the sensation of electrical shock. He utilized longer wires. When the discharge wire was resistive enough, no explosion could occur.

Wire in place, the dynamo whirred at a slower speed. He threw the switch for a brief instant, and was again caught off guard by the stinging pressure wave! The effect persisted despite the absence of an explosive conductor. Here was a genuine mystery. Hot vapor was not available to "carry" high voltage charges throughout the room. No charge carriers could be cited in this instance to explain the stinging nature of the pressure wave. So what was happening here?

The pressure wave was sharp and strong, like a miniature thunderclap. It felt strangely "electrical" when the dynamo voltage was sufficiently high. In fact, it was uncomfortably penetrating when the dynamo voltage was raised beyond certain thresholds. It became clear that these pressure waves might be electrified. Electrified sound waves. Such a phenomenon would not be unexpected when high voltages were used. Perhaps he was fortunate enough to observe the rare phenomenon for the first time.

He asked questions. How and why did the charge jump out of the line in this strange manner? Here was a phenomenon, which was not described in any of the texts with which he was familiar. And he knew every written thing on electricity. Thinking that he was the victim of some subtle, and possibly deadly short circuit, he rigorously examined the circuit design. Though he searched, he could find no electrical leakages. There were simply no paths for any possible corona effects to find their way back into the switching terminal, which he held.

Deciding to better insulate the arrangement in order that all possible line leakages could be eradicated, he again attempted the experiment. The knife switch rapidly closed and opened, he again felt the unpleasant shock just as painfully as before. Right through the glass shield! Now he was perplexed. Desiring total distance from the apparatus, he modified the system once more by making it "automatic".

He could freely walk around the room during the test. He could hold the shield or simply walk without it. A small rotary spark switch was arranged in place of the hand-held knife switch. The rotary switch was arranged to interrupt the dynamo current in slow, successive intervals. The system was actuated, the motor switch cranked it contacts slowly. Snap ... snap ... snap ... each contact produced the very same room-filling irritation.

This time it was most intense. Tesla could not get away from the shocks, regardless of his distance from the apparatus across his considerably large gallery hall. He scarcely could get near enough to deactivate the rotating switch. From what he was able to painfully observe, thin sparks of a bright blue-white color stood straight out of the line with each electrical contact.

The shock effects were felt far beyond the visible spark terminations. This seemed to indicate that their potential was far greater than the voltage applied to the line. A paradox! The dynamo charge was

supplied at a tension of fifteen thousand volts, yet the stinging sparks were characteristics of electro-static discharges exceeding some two hundred fifty thousand volts. Somehow this input current was being transformed into a much higher voltage by an unknown process. No natural explanation could be found. No scientific explanation sufficed. There was simply not enough data on the phenomenon for an answer. And Tesla knew that this was no ordinary phenomenon. Somewhere in the heart of this activity was a deep natural secret. Secrets of this kind always opened humanity into new revolutions.

Tesla considered this strange voltage multiplying effect from several viewpoints. The problem centered around the fact that there was no magnetic induction taking place. Transformers raise or lower voltage when current is changing. Here were impulses. Change was happening during the impulse. But there was no transformer in the circuit. No wires were close enough for magnetic inductions to take place. Without magnetic induction, there could theoretically be no transformation effect. No conversion from low to high voltage at all. Yet, each switch snap brought both the radiating blue-white sparks and their painful sting.

IMPULSES

Tesla noted that the strange sparks were more like electrostatic discharges. If the sparks had been direct current arcs reaching from the test line, he would surely have been killed with the very first close of the switch. The physical pressure and stinging pain of these sparks across such distances could not be explained. This phenomenon had never been reported by those who should have seen and felt its activities.

Tesla gradually came to the conclusion that the shock effect was something new, something never before observed. He further concluded that the effect was never seen before because no one had ever constructed such a powerful impulse generator. No one had ever reported the phenomenon be cause no one had ever generated the phenomenon. Tesla once envisioned a vortex of pure energy while looking into a sunset. The result of this great Providential vision was Polyphase current. A true revelation. But this, this was an original discovery found through an accident. It was an empirical discovery of enormous significance. Here was a new electrical force, an utterly new species of electrical force, which should have been incorporated into the electrical equations of James Clerk Maxwell. Surprisingly, it was not.

Tesla now questioned his own knowledge. He questioned the foundations on which he had placed so much confidence in the last several years. Maxwell was the "rule and measure" by which all of Tesla's Polyphase generators had been constructed. Tesla penetrated the validity of Maxwell's mathematical method. It was well known that Maxwell had derived his mathematical descriptions of electromagnetic induction from a great collection of available electrical phenomena. Perhaps he had not studied enough of the phenomena while doing so.

Perhaps newer phenomena had not been discovered, and were therefore unavailable to Maxwell for consideration. How was Maxwell justified in stating his equations as "final"? In deriving the laws of electromagnetic induction, Maxwell had imposed his own "selection process" when deciding which electrical effects were the "basic ones". There were innumerable electrical phenomena, which had been observed since the eighteenth century. Maxwell had difficulty selecting what he considered to be "the most fundamental" induction effects from the start. The selection process was purely arbitrary. After having "decided" which induction effects were "the most fundamental", Maxwell then reduced these selected cases and described them mathematically. His hope was to simplify matters for engineers who were designing new electrical machines. The results were producing "prejudicial" responses in engineers who could not bear the thought of any variations from the "standard". Tesla had experienced this kind of thematic propaganda before, when he was a student. The quantitative wave of blindness was catching up with him.

Tesla and others knew very well that there were strange and anomalous forms of electromagnetic induction, which were constantly, and accidentally being observed. These seemed to vary as the experimental apparatus varied. New electrical force discoveries were a regular feature of every Nature Magazine issue. Adamant in the confidence that all electrical phenomena had been both observed and mathematically described, academicians would be very slow to accept Tesla's claims.

But this academic sloth is not what bothered Tesla. He had already found adequate compensation for his superior knowledge in the world of industry. Tesla, now in possession of an effect, which was not predicted by Maxwell, began to question his own knowledge. Had he become a "mechanist", the very thing which he reviled when a student? Empirical fact contradicted what that upon he based his whole life's work. Goethe taught that nature leads humanity.

The choice was clear: accept the empirical evidence and reject the conventional theory. For a time he struggled with a way to "derive" the shock effect phenomenon by mathematically wrestling "validity" from Maxwell's equations ... but could not. A new electrical principle had been revealed. Tesla would take this, as he did the magnetic vortex, and from it weave a new world.

What had historically taken place was indeed unfortunate. Had Maxwell lived after Tesla's accidental discovery, then the effect might have been included in the laws. Of course, we have to assume that Maxwell would have "chosen" the phenomenon among those, which he considered "fundamental".

There was no other way to see his new discovery now. Empirical fact contradicted theoretical base. Tesla was compelled to follow. The result was an epiphany, which changed Tesla's inventive course. For the remainder of his life he would make scientific assertions, which few could believe, and fewer yet would reproduce. There yet exist several reproducible electrical phenomena, which cannot be predicted by Maxwell. They continually appear whenever adventuresome experimenters make accidental observations.

FOCUS

High voltage impulse currents produced a hitherto unknown radiant effect. In fact, here was an electrical "broadcast" effect whose implementation in a myriad of bizarre designs would set Tesla apart from all other inventors. This new electrical force effect was a preeminent discovery of great historical significance. Despite this fact, few academicians grasped its significance as such. Focused now on dogmatizing Maxwell's work, they could not accept Tesla's excited announcements. Academes argued that Tesla's effect could not exist. They insisted that Tesla revise his statements.

Tesla's mysterious effect could not have been predicted by Maxwell because Maxwell did not incorporate it when formulating his equations. How could he have done so, when the phenomenon was just discovered? Tesla now pondered the academic ramifications of this new effect. What then of his own and possibly other electrical phenomena, which were not incorporated into Maxwell's force laws? Would academes now ignore their existence? Would they now even dare to reject the possibility of such phenomena on the basis of an incomplete mathematical description?

Seeing that the effect could grant humanity enormous possibilities when once tamed, Tesla wished to study and implement the radiant electrical action under much safer conditions. The very first step, which he took before proceeding with this experimental line, was the construction of special grounded copper barriers: shields to block the electrical emanations from reaching him.

They were large, body-sized mantles of relatively thick copper. He grounded these to insure his own complete safety. In electrical terms, they formed a "Faraday Cage" around him. This assembly would block out all static discharges from ever reaching Tesla during the tests. Now he could both observe and write what he saw with confidence.

Positioned behind his copper mantle, Tesla initiated the action. ZZZZZZ ... the motorized switch whirring, dynamo voltage interrupted several hundred times per second, the shock action was now continuous. He felt a steady rhythm of electrostatic irritations right through the barrier accompanied by a pressure wave, which kept expanding. An impossibility. No electrical influence should have passed through the amount of copper, which composed the shield. Yet this energetic effect was penetrating, electrically shocking, and pressured. He had no words to describe this aspect of the new phenomenon. The shocks really stung.

Tesla was sure that this new discovery would produce a completely new breed of inventions, once tamed and regulated. Its effects differed completely from those observed in high frequency alternating current. These special radiant sparks were the result of non-reversing impulses. In fact, this effect relied on the non-reversing nature of each applied burst for its appearance. A quick contact charge by a powerful high voltage dynamo was performing a feat of which no alternating generator was capable. Here was a demonstration of "broadcast electricity".

Most researchers and engineers are fixed in their view of Nikola Tesla and his discoveries. They seem curiously rigidified in the thought that his only realm of experimental developments laid in alternating current electricity. This is an erroneous conception which careful patent study reveals. Few recognize the documented facts that, after his work with alternating currents was completed, Tesla switched over completely to the study of impulse currents. His patents from this period to the end of his career are filled with the terminology equated with electrical impulses alone.

The secret lay principally in the direct current application in a small time interval. Tesla studied this time increment, believing that it might be possible to eliminate the pain field by shortening the length of time during which the switch contact is made. In a daring series of experiments, he developed rapid mechanical rotary switches, which handled very high direct voltage potentials. Each contact lasted an average of one ten-thousandth second.

Exposing himself to such impulses of very low power, he discovered to his joy and amazement that the pain field was nearly absent. In its place was a strange pressure effect, which could be felt right through the copper barriers. Increasing the power levels of this device produced no pain increase, but did produce an intriguing increased pressure field. The result of simple interrupted high voltage DC, the phenomenon was never before reported except by witnesses of close lightning strokes. This was erroneously attributed however to pressure effects in air.

Not able to properly comprehend their nature at first, Tesla also conservatively approached the pressure phenomenon as due to air pressure. He had first stated that the pressure field effect was due to sharp sound waves, which proceeded outward from the suddenly charged line. In fact, he reported this in a little-known publication where he first announced the discovery. Calling the pressure effects "electrified sound waves", he described their penetrating nature in acoustic terms.

Further experimentation however, gradually brought the new awareness that both the observed pressure effect and electrical shock fields were not taking place in air at all. He demonstrated that these actions could take place in oil immersions. Impulse charged lines were placed in mineral oil and carefully watched. Strong pressure projections emerged from sharp wire ends in the oil, as if air were streaming out under high pressure.

Tesla first believed that this stream was wire-absorbed air driven off by electrical pressure. Continual operation of the phenomenon convinced him that the projected stream was not air at all. Furthermore, he was not at a loss to explain the effect, but was reluctant to mention his own theory of what had been generated by high voltage direct current impulses.

Tesla made electrical measurements of this projective stream. One lead of a galvanometer was connected

to a copper plate, the other grounded. When impulses were applied to wire line, the unattached and distant meter registered a continual direct current. Current through space without wires! Now here was something which impulses achieved, never observed with alternating currents of any frequency.

Analysis of this situation proved that electrical energy or electrically productive energies were being projected from the impulse device as rays, not waves. Tesla was amazed to find these rays absolutely longitudinal in their action through space, describing them in a patent as "light-like rays". These observations conformed with theoretical expectations described in 1854 by Kelvin.

In another article Tesla calls them "dark-rays", and "rays which are more light-like in character". The rays neither diminished with the inverse square of the distance nor the inverse of the distance from their source. They seemed to stretch out in a progressive shock-shell to great distances without any apparent loss.

MAGNETIC ARCS

Nikola Tesla now required greater power levels than those provided by his mechanical rotary switch system. He also saw the need for controlling ultra-rapid current interruptions of high repetition ("succession") rates. No mechanical switch could perform in this manner. He had to envision and devise some new means by which ultra-rapid interruptions could be obtained. In his best and most efficient system, highly charged capacitors were allowed to impulsively discharge across special heavy-duty magnetic arcs.

The magnetic arc gap was capable of handling the large currents required by Tesla. In achieving powerful, sudden impulses of one polarity, these were the most durable. Horn shaped electrodes were positioned with a powerful permanent magnetic field. Placed at right angles to the arc itself, the currents, which suddenly formed in this magnetic space, were accelerated along the horns until they were extinguished. Rapidly extinguished!

Arcs were thus completely extinguished within a specified time increment. Tesla configured the circuit

parameters so as to prevent capacitor alternations from occurring through the arc space. Each arc discharge represented a pure unidirectional impulse of very great power. No "contaminating current reversals" were possible or permissible.

Reversals ... alternations ... would ruin the "shock broadcast". The effect was never observed when alternating currents were engaged. High voltage was supplied by a large dynamo. Tesla could speed or slow this dynamo with a hand operated rheostat. Power was applied in parallel across the capacitor. The magnetic arc was linked almost directly to one side of this capacitor, a long and thick copper strap connecting the magnetic arc and the far capacitor plate.

This simple asymmetric positioning of the magnetic arc discharger to one side of the dynamo supply produced pure unidirectional electropositive or electronegative impulses as desired. Tesla designed this very simple and powerfully effective automatic switching system for achieving ultra-rapid impulses of a single polarity. Capacitor values, arc distances, magnetic fields and dynamo voltages were all balanced and adjusted to yield a repetitive train of ultra-short singular impulses without "fly back" effects.

The system is not really well understood by engineers, the exceptional activities of the arc plasma introducing numerous additional features to the overall system. While the effects, which Tesla claimed, can be reproduced with electron tube impulse circuitry, these produce decidedly inferior effects. The overall power of the basic arc discharge is difficult to equal. Tesla eventually enclosed the magnetic arc, immersing the gap space in mineral oil. This blocked premature arcing, while very greatly increasing the system output.

Most imagine that the Tesla impulse system is merely a "very high frequency alternator". This is a completely erroneous notion, resulting in effects, which can never equal those to which Tesla referred. The magnetic discharge device was a true stroke of genius. It rapidly extinguishes capacitor charge in a single disruptive blast. This rapid current rise and decline formed an impulse of extraordinary power. Tesla called this form of automatic arc switching a "disruptive discharge" circuit, distinguishing it from numerous other kinds of arc discharge systems. It is very simply a means for interrupting a high voltage direct current without allowing any backward current alternations. When these conditions are satisfied, the Tesla Effect is then observed.

The asymmetrical positioning of the capacitor and the magnetic arc determines the polarity of the impulse train. If the magnetic arc device is placed near the positive charging side, then the strap is charged negative and the resultant current discharge is decidedly negative.

Tesla approached the testing of his more powerful systems with certain fear. Each step of the testing process was necessarily a dangerous one. But he discovered that when the discharges exceeded ten thousand per second, the painful shock effect was absent. Nerves of the body were obviously incapable of registering the separate impulses. But this insensitivity could lead to a most seductive death. The deadly aspects of electricity might remain. Tesla was therefore all the more wary of the experiments.

He noticed that, though the pain field was gone, the familiar pressure effect remained. In its place came a defined and penetrating heat. Tesla was well aware that such heat could signal internal electrocution. He had already made a thorough study of these processes, recognizing that such heating precedes the formation of electrical arcs through the body. Nevertheless, he applied power to the dynamo in small but steady intervals.

Each increase brought increase in the internal heating effects. He remained poised at each power level, sensing and scoping his own physiology for danger signs. He continued raising the power level until the magnetic arc reached its full buzzing roar. Tesla found that this heat could be adjusted and, when not extreme, was completely enjoyable. So soothing, relaxing, and comfortable was this manifestation that Tesla daily exposed himself to the energies. An electrical "sauna".

He later reported these findings in medical journals, freely offering the discovery to the medical world for its therapeutic benefits. Tesla was a notorious user of all such therapies from this time on, often falling into a deep sleep in the warm and penetrating influences. Once, having overindulged the electro-sauna therapy, he fell into a profoundly deep sleep from which he emerged a day later! He reported that this experience was not unpleasant, but realized that proper "electro-dosages" would necessarily have to be determined by medical personnel.

During this time, Tesla found shorter impulse lengths where the heating effect disappeared altogether, rendering the radiance absolutely harmless. These impulse trains were so very high that the deepest

nerves of one's body could not sense the permeating radiant energy field. Now he could pursue his vision of broadcast energy systems without fear of rendering to humanity a technological curse, rather than a true blessing.

TRANSFORMERS

Tesla operated the magnetic arc system at higher power levels, experimenting with various impulse lengths and repetition rates. He measured the mysterious electrical current, which apparently flowed through space from this system. These radiant fields operated at far greater power than before. Strange effects were suddenly appearing at certain distances from the magnetic impulser.

For one thing, Tesla noticed that metallic surfaces near the impulser became covered with white brush-like corona discharges. While the sparks played in trails across the metal surfaces, Tesla observed physical movement among the metal objects. Tensions and rocking motions. Both phenomena occurring simultaneously, he was utterly fascinated. The sparks themselves seemed alive. The moving metal objects seemed to suggest new motor effects. What was this strange coalition, this synchronicity of phenomena?

Brilliant white coronas came forth with a gaseous "hissing" sound from metal points and edges. Metal plates were soon poised all around the device for observation. Tesla recognized at once that these effects were not identical with those obtained earlier while using high frequency alternating currents. These new discharges were white, energetic, and strong.

The electrical behavior of copper plates, rods, cylinders, and spheres near his primary impulser brought forth a great variety of white fluidic discharges. Strong discharge brushes appeared from the ends of copper plates. These came in prodigious volumes, hissing and arcing wildly in all directions, especially from sharp points. Tesla tried copper discs. These seemed to produce more stable discharges. He observed the curious manner in which these white discharges seemed to "race" around the disc edge at times, blending and separating with all the other sparks. Here was a greatly magnified example of Reichenbach's Od force perhaps!

He noted the manner in which white brush discharges appeared from copper conductors of different shapes. Each form, poised near his impulser, gave a characteristic corona distribution. This coronal correspondence with specific geometric form greatly impressed him. With certain metal forms the discharges were very fluidic in appearance. Smooth, fluidic sheaths covered copper cylinders of specific size. This absolutely fascinated Tesla. There was an aerodynamic nature inherent in radiant electricity.

Copper cylinders produced remarkable volumes of white discharges. The discharges from certain sized cylinders were actually larger than those being applied. This inferred that an energy transformation effect was taking place within the cylinder. This reminded him of his initial observation with the shock-excited wires. Those which did not explode gave forth far greater voltages than were initially used. He had never understood why this was occurring. Here was another instance in which applied energy was seemingly magnified by a conductor. Why was this happening?

The key to understanding this bizarre phenomenon might be found here, he thought. He observed the discharges from copper cylinders of various diameters. Each became edged with white brush discharges when held near or actually placed within the conductive copper strap of the impulser. The discharge effect was most pronounced when cylinders were placed within the periphery of the copper strap.

Tesla noticed that white corona sheaths were actually covering the outer cylinder wall at times. These would appear, build in strength, and disappear on sudden discharge with a surprising length. The sheathing action was repetitive when the cylinder had a critically small volume. Very small cylinders behaved like rods, where discharges only appeared at their edges. The stability of these strange sheath discharges varied with cylinder diameter and length. Tesla noticed that not every cylinder performed well near the impulser. Only cylinders of specific volume produced stable and continuous white electrical sheaths. If the cylinders were too small, then the sheaths were intermittent and unstable. There was an obvious connection between the supplied impulse train and the cylinder volume. But what was it?

Tesla surveyed the entire range of his recent discoveries. Impulses produced a radiant electrical effect. Radiant electricity was mysteriously flowing through space. As it flowed, it focused over metal conductors as a white fluidic corona. When the shape and volume of the metal conductors were just right, the energy appeared as a stable white corona of far greater voltage than the impulse generator

supplied. More questions. More discoveries.

Rods produced sparks from their edges, but not as long as copper cylinders did. Tesla selected a cylinder, which worked very well, and placed several horizontal "cuts" all around its surface. He was totally surprised when, on testing, the spark discharge from the cut cylinder was notably larger than before. Increased spark length means increased voltage. But why did this diminished conductivity force the voltage up?

The cuts diminished conductivity in the cylinder by forcing the energy into a tighter "squeeze". He had noted that electrical impulses displayed a tendency to traverse the outer surface of metal conductors. Certain cylinders were often ensheathed in a fluidic white discharge, which smoothly traveled between coil ends in a tightly constricted layer. Here was something truly notable. His input voltage was far less than that produced from the upper coil terminal. But why from end to end?

The essential reason why current preferred outer surface conduction was precisely because they were impulsing. The sudden shock, which any conductor experienced, produced an expansive effect, where the electrical charge was rejected by the conductive interior. This "skin effect" was a function of impulse time and conductor resistance. Highly resistant objects forced all of the impulse energy to the surface.

Now he was getting somewhere. Frustrated radiant electricity constricted into a tighter surface volume when encountering metal surfaces. This intense surface focusing effect brought the voltage up to tremendous values. Here was a new transformer effect! He believed it was an electrostatic transformation. Impulse currents each possessed an electrostatic nature. The bunching of charge in the impulser brings this electrostatic field to a peak in a small instant of time.

Constricting this field volume produces a greatly magnified voltage. Placement of any conductor in the field space alters the field by constricting its shape. When symmetrical conductors of special shape, volume, and resistance are placed in this space, the field is greatly constricted. Because the impulsing electrostatic field is very abrupt, it "snaps" over the conductor from end to end.

Tesla knew that here is where the secret lies. If resistance in the conductor is great enough, the snapping

electrostatic force cannot move any charges. It is forced to "grow" over the conductor surface until it discharges at the end point, where greatly magnified voltages are obtained. When the wire diameter is small enough, the wire explodes under electrostatic pressures, which exceed those seen in dynamite.

In effect, Tesla had managed to interrupt a high voltage direct current several thousand times per second. In doing so, he had discovered a way to completely separate electrostatic energy from current impulses. Tesla pondered these facts, wondering if it was possible to force the magnification effect beyond the limits of standard electromagnetic transformers. In other words, how high could voltage be raised? Was there a limit to the process?

In order to achieve such enormous voltage levels, he needed a conductive shape, which offered so much resistance to charge movement, that all the applied energy would become electrostatic. In effect, Tesla wanted to convert a quantity of supply power into a pure electrostatic voltage. This phenomenon suggested that his goal was not impossible.

Tesla extended his idea of the cut copper cylinder to coils. From the viewpoint of electrostatic impulses, flat copper coils appear to be "continuously cut" cylinders. The electrostatic field focuses over the coil as it did with the cylinders, from end to end. A simple magnet coil of specific volume would offer so much resistance that it would be difficult to predict the actual resultant voltage, which results without an empirical test.

WHITEFIRE

Constructing several of these, he was ready for the test. When each copper magnet coil was impulsed, Tesla saw tremendous white brushes leaping from their free ends: discharges approaching one million volts! But his supply power was nowhere near these voltages, and the coil was not wrapped in thousands of windings. These previously unexpected voltage magnifications were the result of an energy transformation, one that took electrical power and converted it completely into pressure. Watts into Volts, an unheard thing. It was the key to a new and explosive technology.

Tesla also found that such coils required very thin coil forms. He ceased using cellulose and cardboard forms, preferring "squirrel cage" type forms made of thin end-braced wooden rods. Wire was wound about these cylindrically disposed rods, producing the very best effects. Spacings were also tried between successive coil windings with excellent results. Spaced windings reduced sparking to a minimum.

Tesla remarked that the electrostatic potentials along the coil surface (from end to end) could be as much as ten thousand volts per inch of winding! A ten-inch coil of proper volume could produce one hundred thousand volt discharges. In addition, and in confirmation of his suspicions, no current was ever measured at the free terminals of these coils. A "zero coil current" condition! It was simply another paradox, which would occupy the academicians for several more argumentative decades. Tesla suddenly realized that coils represented a truly special and valuable component in his quest. The instantaneous resistance which any coil offered to an applied impulse was so immense that current could not flow through the wire length. As a phenomenal consequence, no current flowed through the coil windings at all! But sparking was observed, traveling from coil end to end. Here was yet another anomaly!

He began placing these "secondary" coils within his "primary" impulser circuit. The strap, which connected his magnetic arc to the capacitors, formed the "primary". He made necessary distinctions among his Transformer components. Few engineers actually appreciate these distinctions. The "primary" and "secondary" of Tesla Transformers are not magnetic inductors. They are resistive capacitors. Coil-shaped capacitors! Tesla Transformer action is electrostatic induction.

There were conditions for the most efficient manifestation of the effect. Maxwell could not predict these values. Tesla empirically discovered most of the rules for impulse behavior. He found that the transformative abilities of these smooth copper coils were maximum when the coil mass equaled the mass of the impulser's conductive copper strap. It did not matter how thin the coil windings were. The equality of copper masses brought maximum transformative effects. When this equal mass condition was fulfilled, Tesla said that the coil-capacitors were "in resonance". Electrostatic resonance.

Tesla found it possible to produce millions of electrostatic volts by this method. His first Transformers were horizontal in orientation, both free ends of the secondary coil-capacitor producing unidirectional

impulses of great power. White discharges from each of these free ends had very different characteristics, indicating the unidirectional flow. Electropositive terminals always appeared brush-like and broad. Electronegative terminals always appeared constricted and dart-like.

His next Transformer series employed vertical cylinders with the base connected directly to ground. Free terminals stood quite a distance above the primary capacitor strap, spouting a brilliant white crown. These marked a turning point in his theories concerning electricity, since it was possible for him to develop well over one million volts impulse power in a device scarcely taller than a child.

These discharges were of an intense white coloration. White-fire. Very sudden impulses color discharge channels with the brilliant white-fire because Tesla Transformers separate the effusive Aether from electrons. Tesla Transformer conduct Aether, not electrons. The white-fire brilliance is the distinctive Aetheric trademark of Tesla Transformers.

During this time, Tesla discovered the peculiar necessity for streamlining his Transformers. Cylindrical secondary capacitors suddenly became conical forms. These presented the most bizarre appearance of all. Tesla used cone-shaped secondaries to focus the impulses. White-fire discharges from these forms evidenced real focusing effects, the discharges themselves assuming inverted conical shapes. Their greatly intensified nature is seen in photographs, which were taken under his own intrigued supervision. The magnified voltages were reaching those thresholds in which his laboratory enclosures were far too small to continue making industrial scale progress on radiant energy systems.

The fact that white-fire discharges pass through all matter, notably insulators, revealed the Aetheric nature. Tesla saw that white-fire discharges could permeate all materials in a strangely gaseous manner. This penetration scarcely heated matter. In fact, the white-fire brushes often had a cooling effect. The sparks themselves, though violent in appearance, were "soft" when compared to all other forms of electricity. He had successfully removed the hazard from electricity. In blocking the slow and dense charges, he had freed the mysterious effusive Aether streams inherent in electricity. Because of this, new and intensified radiant effects were constantly making their appearance across his laboratory space.

Tesla found that as these new "Impulse Transformers" greatly magnified power supplied to them, so also

their radiant electric effects were equally magnified. He found it possible to wirelessly project electrostatic power to very great distances, lighting special lamps to full candlepower at hundreds of feet. In these experiments, he also conceived of signaling systems. It would be possible to switch radiant effects in telegraphic fashion. Distant vacuum tube receivers would then light or dim in corresponding manner. Tesla experimented with a special breed of telegraphic wireless in 1890.

He also found it possible to wirelessly operate specially constructed motors by properly intercepting this space-flowing energy stream. He had made his own Polyphase system obsolete! The new vision was vastly more enthralling. The world would be transformed. He discovered ways to beam the energy out to any focus, even to the zenith. His plan to illuminate the night sky with a radiant energy beacon captured the minds of all who listened.

Tesla now possessed the means by which the radiant electricity could be greatly magnified and transmitted. He could now transform the very nature of the radiance so that it could carry increasingly greater power. Now he could begin developing a new technology, which would completely revitalize the world order. Power could be broadcast to any location without wire connections. Radiant electricity could be utilized in completely new appliances. A new world was about to be released!

SPACE FLOWING CURRENT

Understanding the analogue between these electrical impulse effects and the behavior of high-pressure gases was of paramount importance. This gaseous aspect of impulse electrical radiance was perhaps the most mystifying aspect of these newfound energies. Those who sought out Tesla's every lecture were very aware that a new electrical species had been discovered.

While yet a student, Tesla had became aware of certain scientific imperatives enunciated by Johann von Goethe. One of these was the preservation and extension of all activities-natural. Goethe implied that when natural conditions were preserved during experimentation, then nature itself was in the best configuration to reveal more unified phenomenal exhibitions to qualitative observers.

Tesla recognized that his new discovery of impulse, the result of an accident, was a total departure from Polyphase alternating current. While his original vision of the vortex was applied by him to the designing of motors and generators, Tesla now realized that this was not its primary message. In fact, taken from the viewpoint, which Goethe expressed, Polyphase was a most unnatural form of energy.

Natural activity is suffused with impulses, not alternations. Natural activity is initiated as a primary impulse. Nature is flooded with impulses of all kinds. From lightning to nervous activities, all natural energy movements occur as impulses. Impulses were now seen by Tesla to fill the natural world. But, more fundamentally, Tesla saw that impulses flood the metaphysical world.

The mysterious flow of meanings during conversation occurs as a sequence of directed impulses in space. Though inert air vibrates in alternations with sounds uttered, the flow of meaning remains unidirectional. Intentions are also impulses. The unidirectional flow of intentions appear as impulses. Motivations proceed from the manifestation of sudden desires. Overtly expressed as actions, the initiating impulses are then fulfilled.

Tesla wished to comprehend where this "motivating force" came from, and where it went during the expressed actions. In all of this, he was very much the wonderful stereotype of the Victorian natural philosopher. His scientific pursuits followed these considerations until the last. Those who study his announcements recognize his metaphysical foundations, the basis of all his subsequent scientific quests.

Tesla observed the amazing "coordination" of new phenomena which daily seemed to bring new technological potentials before him. This wonderful synchronicity, this vortex, revealed his new and fortunate position in nature. Having somehow "broken" his fixation with the unnatural ... with Polyphase ... he reentered the natural once again. Impulses. Could it be that the induction of electrical impulses summoned the other impulse characteristics of nature? Was he producing a metaphysical vortex, into which all the impulse phenomena of nature would now flow? Was this the real sunset message, which seized him in Budapest, so many years ago? Was electricity the fundamental natural energy ... the motivator?

Victorian Science was not exactly sure what electricity was, there being so very many attributes associated with the term. Seventeenth and Eighteenth Century natural philosophers conjectured on the nature of both electric and magnetic forces. Gilbert and Descartes shared the belief that these forces were a special kind of "flowing charge", a space radiant stream which took place in tightly constricted lines. Some equated the electromagnetic forces with a "dark light", which Karl von Reichenbach later proved in part.

Faraday adopted and modified the view that electromagnetic forces acted through space because they were a special flow of charge. This effusive charge movement changed when traveling through conductors, becoming more densified and retarded in velocity. Faraday's "lines of force" were not conceived by him to be mere static tensions as modernists view them. Faraday envisioned these force lines as radiant, streaming lines. They were mobile, moving longitudinally into space.

Others would change the names, referring to electric force lines as "diaelectric" or dielectric flux, but the view remained essentially as conceived by Faraday. Young James Clerk Maxwell also believed that force lines were dynamic, longitudinal lines of flow. But flow-lines of what substance? Here lay the principle problem, which occupied physicists throughout the Victorian Era.

Victorian researchers and natural philosophers wished to discover the exact nature of the "flowing charge" of which force lines were composed. Most agreed that the mysterious flowing "substance" had to be an effusive, ultra-gaseous flux. This flux was composed of infinitesimal energy particles, which affected the various pressures and inductions, observed.

Henry and Faraday struggled with the idea of deriving usable electric power from static charges. The notions was that, since force-lines were made of a "flowing charge substance", then fixed contacts placed on charged masses would supply electrical power forever. No one was able, however, to derive this flowing charge. Lossy discharges preceded every contact. Most researchers, whose attempts with highly charged Leyden Jars failed, sought a more benign source of concentrated charge. The quest shifted to magnets, but the attempt remained as futile as ever. There remained no available way to derive power from the individual flowing charges of a force-line.

J.J. Thomson discovered electrons in vacuum discharges; assuming that these "electric particles" operated in all instances where electrical activity was observed. Victorian researchers did not accept this view completely. Thomson's "electrons" were viewed as the result of violent collisions across a vacuum acceleration space. It was not possible to ascertain whether these same "Thomson currents" were active within electrical conductors operating at small voltages.

Very reputable experimenters besides Tesla continued claiming that "space flowing electricity" is the real electricity. Tesla's classic demonstrations proved that rapid electrical impulses actually exceed the ability of fixed charges to transmit the applied forces. Charges lag where electrostatic forces continue propagating. One is compelled to see that electrostatic forces precede the movement of charges.

Tesla saw that electrostatic impulses could flow without line charges. His "zero current coils" operated simply because the charges themselves were immobilized. Electricity was shown to be more in the nature of a flowing force rather than a stream of massive particles. But what then was this "flowing current"?

In Tesla's view, radiant electricity is a space flowing current, which is NOT made of electrons. Later Victorians believed that there was a substance, which both filled all space and permeated all matter. Several serious researchers claimed to have identified this gas. Notables, such as Mendeleev predicted the existence of several ultra-rare gases, which preceded hydrogen. These, he claimed, were inert gases. This is why they were rarely detected. The inert gases, which Mendeleev predicted, formed an atmosphere, which flooded all of space. These gaseous mixtures composed the Aether.

Tesla and others believed that both electrical and magnetic forces were actually streams of Aether gas, which had been fixated in matter. Materials were somehow "polarized" by various "frictive" treatments by which an Aether gas flow was induced in them. Most materials could maintain the flow indefinitely, since no work was required on their part. Matter had only to remain polarized, transducing the Aether flow. The Aether gas contained all the power. Unlimited power.

This Aether gas power manifested as the electromagnetic forces themselves, adequate reason to pursue the development of an Aether gas engine. Such an engine could run forever on the eternal kinetic energies of the Aether itself, it being both generated and driven by the stars.

Tesla believed that radiant electricity is composed of Aether gas. He based this belief on the fact that his zero current coils were not conducting the "slow and dense" charges usually observed in ordinary electrical circuits. Abrupt impulses produced distinctive and different effects ... fluidic effects. The qualities ascribed by Tesla to "electricity" or things "electrical" in his numerous patent texts and press interviews are those, which refer to the Aether gas. Tesla did not refer to electron currents as "electricity". He did not equate "electricity" with electron flow. Whenever Tesla spoke of "electrical" effects he always described their effusive, gaseous quality.

Tesla referred to space as the "ambient or natural medium". Space, he claimed, was that which "conducts electricity". He had found a means by which this gaseous electrical flow could be greatly concentrated, magnified, and directed. He saw that this radiant electricity was, in reality, a gaseous emanation. An Aetheric emanation. This is why he made constant reference to fluidic terminology throughout his lectures.

Resistance, volume, capacity, reservoir, surface area, tension, pressure, pressure release: these were the terms upon which Tesla relied throughout his presentations. The terminology of hydraulics. Tesla also recognized that because Aether was a gas, it had aerodynamic requirements.

Aether, in Tesla's lexicon, was space flowing electricity: a gas of superlative and transcendent qualities. Aether was the electricity, which filled all of space, a vast reservoir of unsurpassable power. Motive, dynamic, and free for the taking. Aether gas technology would revolutionize the world. Aether gas engines would provide an eternal power source for the world. Science, industry, corporations, financial alignments, social orders, nations ... everything would change.

INTRIGUES

Completing a tour of the major scientific institutes in America, Tesla expected to retire for a season of rest in New York once again. News of his advancements however, flooded every technical trade journal. The name Tesla was everywhere once again. First polyphase and now radiant electricity. He was the "darling" of the press. Tesla captured the public eye once again. People everywhere were thrilled with the

projected future visions, which Tesla freely provided. He was a model European immigrant, suave and debonair. These are probably the qualities which first attracted Anne Morgan. Irresistible, wealthy, unattached, and warm. Tesla was her obsession.

Despite his great personal charm and magnetic personality, he maintained his serious tone and poise wherever he went. The vision of the future was far more important than the attentions of a young and flirtatious lady. In anticipation of these forthcoming events, Tesla often invited other socially esteemed guests to his laboratory for special demonstrations. In this manner, it was noised abroad that what he claimed was in fact real. Anne often attended these gatherings, breathing silently in the shadows of his large loft laboratory.

There were others who, although not attending these demonstrations, were equally watchful of Tesla's newest radiant energy developments. Several of these persons, shall we say, were interested in his new discovery and its implications...because their fortunes were threatened. Tesla had swept the world once with polyphase. He wiped out Edison's Direct Current System overnight.

J.P. Morgan, Edison's recent "patron", had lost a considerable sum during that fiasco. It was certain that Tesla would soon sweep the world again with broadcast electricity. This destabilizing influence would not be tolerated. Anne complicated the affair considerably. She was in love with Tesla. Obsessed in fact. Too obsessed and desperate to let go.

ROYAL SOCIETY LECTURES

In the very midst of all these national attentions, Tesla received an invitation from Lord Kelvin. He was formally requested to address the Royal Society; his latest findings were earnestly desired. The English, usually extremely conservative, were sure that Tesla would change the course of world history. Tesla, adjourning from his daily researches now prepared himself for the lectures, which would start the world-change. He packed nearly every piece of delicate equipment one can imagine. Vacuum tubes, Transformers, strange motors, and equally strange wireless apparatus. All were carefully crated and personally brought to Europe by Tesla himself. His beloved elder and personal mentor, Sir William

Crookes, greeted him.

In the opening portions of his Royal Society lectures Tesla first described his preliminary work with high voltage high frequency alternating currents in some length. He explained that these devices embodied the very last investigations and improvements of his Polyphase System. He demonstrated several of the first small high frequency alternators and iron-core induction coils in order to prepare his audience for a final announcement.

In this very last dramatic demonstration Tesla revealed to British Academia the disruptive electric discharge and the properties of electric rays. Tesla made a rare and complete "full disclosure" of the electric ray effect at the very end of his lecture. It was the very last time he would ever do so again in academic circles.

Tesla showed that the new radiant electricity was distinctive, having been openly proclaimed during the London Royal Society lectures. Tesla deliberately compared and contrasted the potent impulse radiance to his previous weak effects produced by alternating currents (February 1892). Fluorescent lamps and other luminous wonders held his audience spellbound. All the while his voice, tenor-like by excitement, rang throughout the silent awestruck hall.

He demonstrated wireless lamps, lit to full brilliance by radiant electricity. He ran small motors at sizable distances for his audiences to see. This last lecture represents the only recorded instance in which Tesla openly announced his discovery of the electro-radiant impulse. He tells the personally revolutionizing aspect of his discovery and how it virtually eradicates his previous work. He went to great detail verbally describing and disclosing the exact means for eliciting the phenomenon.

In his closing time Tesla quickly demonstrates special "electrostatic" motors and lamps made to utilize the radiant effect. Examination of these first lamp and vane-motor devices reveals their primitive and initial state. Tesla modeled the motor after the Crookes radiometer, stating this fact publicly for the benefit of his revered mentor. Tesla finally stated the vast implications of the discovery. He pointed their minds toward the establishment of true power transmission.

He prophetically announced the new civilization, which would emerge from these first devices and systems. The world would be completely revolutionized by this new principle. Tesla described beam-transmission of electrical energy, and the possibility of harnessing the radiant energies of space itself. Those who had witnessed Tesla's entire demonstration were completely enthralled at his results, but misunderstood his new announcement completely. This became apparent to Tesla a short while after he, highly decorated and honored, departed for his Parisian tour. British Science was yet delving into Teslian high frequency alternations. Tesla had already disposed of these discoveries as mere preparatory introductions to impulses.

Tesla showed by way of comparison that disruptive field impulse transcendently exceeds all other electro-inductive effects by several orders. He expressed difficulty in discerning whether the effects were electrostatic or electrodynamic in nature, preferring to associate them more with electrostatic effects. We deduce that he had only recently begun developing the electric impulse effect because of his hesitance in identifying the phenomena properly.

Tesla was stringently exact in all his statements. This seems uncharacteristic of his scientific nature. But he did this in true scientific openness. Tesla did not know exactly what was occurring in the electric impulse at that time, desiring only to share the discovery openly and candidly. Academic disapproval of his personal semantics came swiftly in journal after journal.

It is clear that Sir William Crookes completely grasped the significance of Tesla's entire demonstration and realized the closing formal announcement of the new electric force. Crookes could not contain the thrilling implications. He was also sure that the new force would completely revolutionize the scientific world.

Crookes upheld Tesla thereafter as the true discoverer of an unrecognized electrical force. Tesla continued correspondence with his mentor after his departure from England. He had hoped that his dramatic announcement and demonstration would produce a new regime of electrical engineering, and that others would now reproduce the radiant electric effects as described. His hopes would be strangely dashed to pieces in the coming years when the derisive academic attacks began.

To European academes, the lecture series was astounding. It was a glimpse of the future, so clear that few could find time to argue with Tesla at all. Tesla concluded his tour of England and France, everywhere heralded in typical Victorian heroic style. One night, while in Paris, a telegram informed him that his mother was on point of death. Rushing to her bedside, he managed a few hours of final conversation.

He always referred to her as the one who completely understood his strange abilities. Was she not the woman who had encouraged him when he first remarked about his childhood visions? When siblings and friends derided him, she was his support. Early the next morning, in an adjacent house, he was abruptly awaken by a vision. What he beheld changed his life. A seraphic host surrounded his mother. She was ascending into bright clouds. Several minutes after that, the announcement came. His mother had quietly passed away. He spent a torturous week in his native land for her funeral, and fled back again to New York.

REVERSALS

When English engineers wrote, asking the means for generating his impulse effects, Tesla gave them very strict descriptive parameters. He never failed to openly disclose the secret by which his spectacular effects were obtained. He had learned to freely share what he knew with all. He was surprised to discover that the academic societies who so warmly addressed him in Europe, were gradually losing interest in his discovery. Being utterly incapable of duplicating his specified parameters, most believed the effects to be "dubious".

The impulse effect had very stringent requirements before its manifestation. Care in constructing impulse generators was the basic requirement. Engineers wanted equations. Tesla gave them descriptions. A few experimenters succeeded in later duplicating Tesla's broadcast electricity effects. But these systems were direct descendants of Tesla's earliest and less efficient designs.

It is often in the nature of academes to forgo empirically evident facts and argue personal differences, especially when foreign personalities are given excessive adulation. Fixated on issues having to do with

words and personal poise, Tesla's audiences found several acrid voices whose equally vile publications dared tamper with Tesla's character.

New critics were everywhere, even at home. Dolbear, Thomson, and even Pupin found time to criticize and deride Tesla. Because most younger academes relied entirely on schooling and less on empirical method, they were easily swayed by academic opinion. Tesla underestimated the power of media and of opinions in underrating his abilities. He quickly found that public opinion could actually sway scientific opinion. He failed to see who was behind the media campaign.

Tesla disregarded his antagonistic colleagues. Crookes always deferred to Tesla, whom he admired and loved as a younger protégé. Tesla revered the aged Crookes, upon whose confidence he came to rely during more difficult years. Crookes had been given a true Tesla Transformer when Tesla had given his lectures. The small device was potent, giving the uncharacteristic effects, which Tesla had always claimed. This single piece of evidence was left in England for all to see. Remarkably, this evidence did not silence the critics.

Tesla could see no reason in all of this. Something did not quite "add up". Even Tesla could see that there was a missing part of the "equation". Discovering this part would explain his own reversals. As if these personally devastating events were not enough for him, the insolent young Anne continued haunting him at his every turn. He continued being "polite" to her, but never more than this.

Crookes wrote many times to the Royal Society and to Tesla concerning this fact. Sure that Tesla was a modern Faraday, Crookes continued espousing the belief that Tesla had discovered the next historically important electrical advancement. He was encouraged to continue research despite his protagonists. Few academes trusted Tesla's methods now. Fewer yet listened any longer to his statements.

Losing credibility as quickly as he had found it, financiers were slow to trust investing in his new systems. His inventions continued their steady march into electrical history. Each new device chronicles a new step in the technology, which should have changed the world. He plunged himself headlong into work. Only work would vindicate him. Opinion would fade when others gradually saw the astounding developments, which he would produce. In these actions, Tesla revealed his noble and naive nature. The

world had changed, but changed toward a more brutish rule.

BROADCAST POWER

He set to work developing more powerful embodiments of his initial Transformers. In order to make a Broadcast Electrical System possible it would be necessary to devise more efficient transformers. He set to work on this very task, examining and dissecting every fundamental part of his existing Transformers.

Tesla discovered that excessive sparking, though impressive to observers, were actually "lossy instabilities". The distant radiant effects he desired were interrupted and distorted whenever sparking occurred. Both sparking and brush discharges actually ruined the distant broadcast effects of radiant electricity, a situation that had to be remedied. Tesla sought elimination of the discharges now. Tesla had already found that metals could focus radiant electrical effects. Additional stability in his Transformers could be achieved with the addition of large copper spheres to the active terminals. Tesla considered copper spheres to be "Aether gas reservoirs", providing his transmitters with an additional Aether gas supply.

Copper spheres attached to Transformer terminals reduced the required electrical levels for an efficient electric radiance. Copper spheres significantly reduced the injurious instabilities of visually spectacular brush discharges, but did not eliminate them entirely. What Tesla required was a new means for transmitting the radiant electricity without loss.

Tests with elevated copper spheres facilitated efficient transfer of radiant power between the Transformer and surrounding space. Now, Tesla Transformers became true Tesla Transmitters. Tesla found it possible to broadcast harmless radiant electricity with great power to very great distances. Numerous subsequent patents recorded his progressive conquest of the broadcast power principle.

He succeeded in making radiant electricity safe for human use. It would simply travel around conductors if made to impulse quickly enough. Only specially entuned receivers could properly intercept the radiant power for utility. Not three years before he had accidentally discovered the radiant electrical effect. He

dreamt of safely sending electrical power without wires in 1892. Now, in 1895, he had realized his dream. Would the system work across the vast distances, which he envisioned?

He took his more portable Transmitters outdoors, away from the confines of his South Fifth Street laboratory. Both in northern Manhattan and Long Island, Tesla tested his radiant broadcast systems without restriction. He measured the distant radiant electric effects of these designs in electrostatic volts. Broadcast power could be converted back into current electricity if so desired, the harmless high voltage becoming current in appropriate low resistance transformer coils.

He found to his very great surprise that very distantly positioned vacuum tubes could be lit to great white brilliance when the primary system was operating. The requirement for this action was twofold. First both the system and the receivers had to be grounded. Second, specific volumes of copper had to be connected to the receivers. When these two requirements were satisfied, lamps maximized their brilliance, and motors operated with power. Copper in the receiver had to "match" the copper mass of the transmitter in a very special equivalence, otherwise radiant transfer would not be efficient. The requirements differed very much from those of ordinary radio antennas. He also found that elevated copper spheres more powerfully enhanced the broadcast radiant power from his transmitters. This was Tesla's means by which his transmitters and receivers could be better "connected" despite their distance.

Tesla believed that these electrical beams invisibly linked both his transmitter and receivers together. He considered each as "disconnected terminals" to ground. Electrical radiance spread out in all directions from the elevated copper sphere of his transmitter. The secret in receiving a maximum signal was to match the transmitter's copper mass with the receiver mass. Then, the Aether streams would actually focus into the matched receiver. This affinity would take time, the transmitter energy "searching" for better ground sites. Radiant electricity evidenced curiously vegetative "growth characteristics".

Receivers now were outfitted with small copper spheres. These provided a more efficient affinity and absorption for the radiated power. The additional copper spheres, which surmounted Tesla transmitters effectively, lowered the input electrical power for the production of focused Aether discharges.

Tesla took the gas dynamic analogy to another level when he found that both low pressure gaseous and vacuum tubes could replace copper. Electro-radiant effects from gas-filled globes were projected with less electrical loss and even greater power. Large low-pressure argon gas filled globes were empirically found to broadcast tremendous radiance when used atop his transmitters. Additionally, he found that argon gas at low pressures could serve as an equivalent receiver as pure copper spheres.

The gas filled globes would be less costly than copper spheres to disseminate in public use. He was approaching a totally efficient system. Numerous personages were invited to observe these historic tests. J.H. Hammond Jr. was one such individual. Enthralled with Tesla's developments, he and his wife invited Tesla repeatedly to their home in later years. Tesla was their honored guest for months at a time. Later in years, after World War I, both Tesla and Hammond worked on robotics and remote control.

Tesla envisioned small power units for both home and industrial use. The installation and maintenance of these units would require a small monthly fee. Through these wireless units one could draw sufficient power to operate factories and homes alike. Electrical usage could be metered. The superiority of this new broadcast power system was obvious to all who observed it in operation.

Tesla also described the use of these power units for transportation. Transatlantic ships could simply draw their motive power from continental power broadcast stations. Trains and automobiles could be operated by drawing their power. The potential fortunes would soon stimulate financiers to invest heavily in the "coming activity".

In keeping with his publicity-mindedness, several investors were always invited to Tesla's private demonstrations. Tesla knew that their urge to support his new world-shaking venture would become irresistible when once each had beheld his small broadcast power system. The demonstrations were deemed by these individuals as "entertaining", in their typical dry tone. But, he rarely heard from these people again.

Here was a new change. Shy moneymen. A true contradiction. Their reticence left Tesla in a state of bewilderment. Once, in a ditch, his conversation alone was sufficient perfume to attract the bees. Now? None would dare leap into the new world sea. Why? What sharks were there besides themselves? Tesla

could simply not understand this new "dearth", this incredulous conservatism and lack of imagination on the part of New York investors.

Eager to begin, Tesla patiently waited for the messengers to call. Had he known more of the world around him, however, he would have stopped waiting. Shortly after Tesla's private demonstrations were concluded, Morgan's agent approached Tesla with a "business proposition". The bribe being sizable, contracts would have placed Morgan in control of Tesla's new system. Tesla laughed at the pale little Mr. Brown in his pinching-tight tails, informing him that he himself was already a millionaire. Why should he need such an affiliation at all? He was escorted very graciously by the amused Tesla.

While dining in the Waldorf several hours later, a rude interruption informed him that his laboratories were ablaze. The connection between his refusal to bow and the flames, which now reached skyward, was not made until all was consumed. That night, the world changed completely for Nikola Tesla. He lost everything of his past. Everything. The totality of his technological achievements were burned into vapor. Books, priceless souvenirs, delicate equipment, patents, models, drawings, new pieces of apparatus. Everything was burned. He read the message well.

There was a two-week period where he simply vanished. No one could find him. Kolman Czito, his trusted technical foreman and machinist feared for Tesla's life. Katherine Underwood Johnson was beside herself with anguish. She was the wife of a close friend, the only real love of Tesla's life. The fire was meant to kill. It was a message as clear as anyone would need. The assassination attempt failed to kill the intended victim. It certainly did not kill his dreams.

Wherever he was for those two weeks, the dreams were with him. But a part of Nikola Tesla died in the fire. It was the part, which was tied to the past. His eyes on the future, Tesla developed his discovery into a major technology, which the world seems to have forgotten. Of all those who prayed and wept over Tesla's disappearance, one person was no longer concerned. Never again would Anne need to be troubled by the thought of Nikola Tesla. His love was already sealed. Tesla recovered from the flames.

His subsequent discoveries and inventions surpassed his former works for forty more years; special radiation projectors, self-acting heat engines, power transmitters, remote control and robotics, the

"World Broadcast System", Beam Broadcast transmitters, "Aetheric reactors and Aetheric engines", cosmic ray motors, psychotronic television ... the list of astounding inventions is truly awe-inspiring. Tesla demonstrated each of these systems for a select group of witnesses.

Furthermore, despite rumors of his public and scientific demise, Tesla maintained two penthouse suites atop the Hotel New Yorker in a time when such extravagance was otherwise unobtainable. One of these suites was converted into a complete radio laboratory, several accoutrements of which having been retrieved by antique radio enthusiasts. Tesla was an indefatigable researcher. The biography of Nikola Tesla is replete with truly mysterious designs and developments. But these are parts of his biography, which must be told in other volumes.

Margaret Cheney has written an easy to read "people book" about Nikola Tesla's life and times.

"Tesla – Man Out Of Time".

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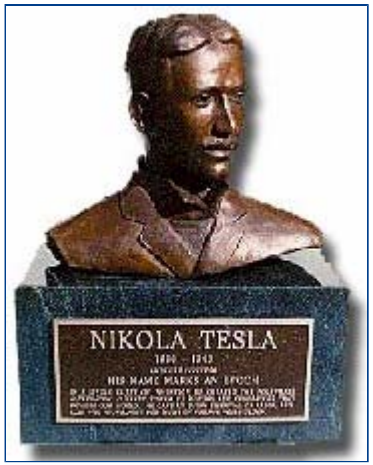
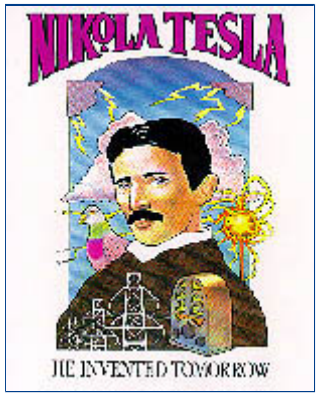
— Tommy C —





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