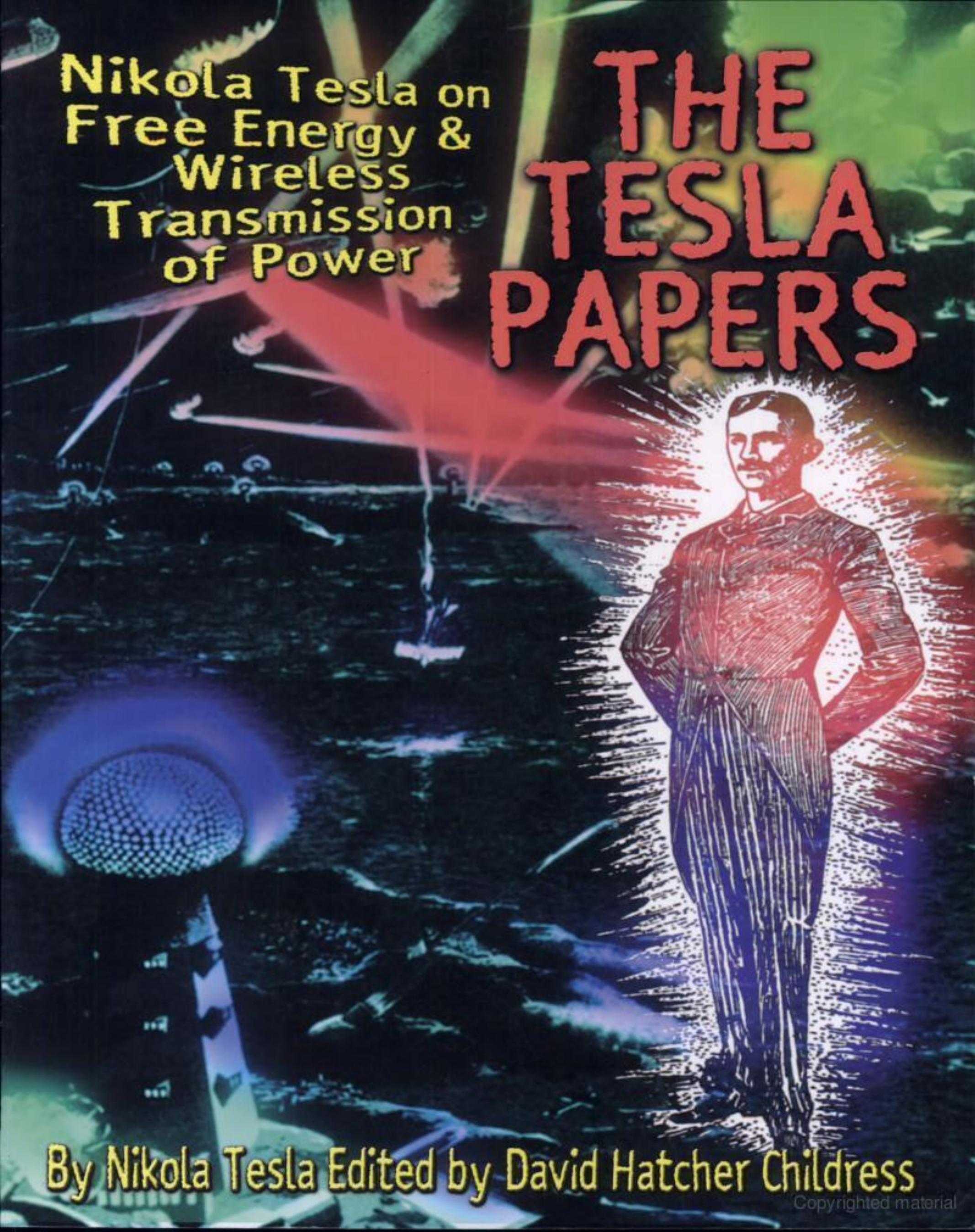
Nikola Tesla on Free Energy & Wireless Transmission of Power

THE TESLA PAPERS



By Nikola Tesla Edited by David Hatcher Childress

The Tesla Papers

edited by David Hatcher Childress

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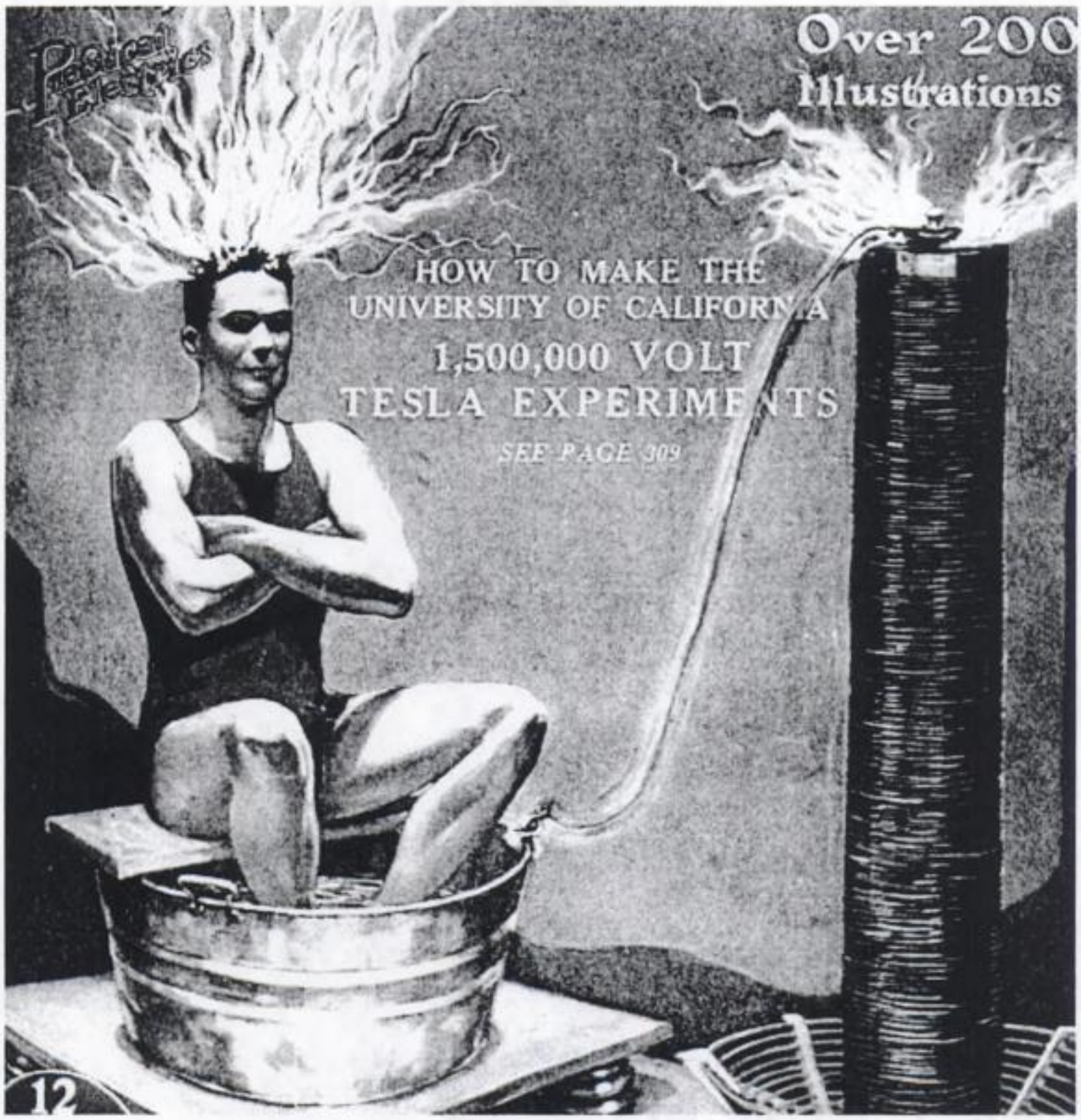


Part One
Tesla: Humanitarian

Nikola Tesla:
Humanitarian Genius

Excerpted from vol 6, no. 4, *Power and Resonance,* the "Journal of the International Tesla Society."
Author unknown

Ask any school kid: "who invented radio"? If you get an answer at all it will doubtless be Marconi—an answer with which all the encyclopedias and textbooks agree. Or ask most anyone: "who invented the stuff that makes your toaster, your stereo, the street lights, the factories and offices work?" Without hesitation, Thomas Edison, right? Wrong both times. The correct answer is Nikola Tesla, a person you have probably never heard of. there's more. He appears to have discovered x-rays a year before W. K. Roentgen did in Germany, he built a vacuum tube amplifier several years before Lee de Forest did, he was using fluorescent lights in his laboratory 40 years before the industry "invented" them, and he demonstrated the principles used in microwave ovens and radar decades before they became an integral part of our society. Yet we associate his name with none of them.

For about 20 years around the turn of the century, he was known and respected in academic circles world wide, corresponding with eminent physicists of his day, including Albert Einstein, quoted and conferred with on matters of electrical science, adopted by New York's high society, backed by such financial and industrial giants as J. P. Morgan, John Jacob Astor, and George Westinghouse. He counted as friends eminent artists such as Mark Twain and pianist Ignace Paderewski. His honorary degrees, major prizes, and other citations number in the dozens.

The house where Nikola Tesla was born in Smiljan, Croatia in 1856.

Tesla was born in Smiljan, Croatia in 1856, the son of a clergyman and an inventive mother. He had an extraordinary memory, one that made learning six languages easy for him. He entered the Polytechnic School at Gratz, where for four years he studied mathematics, physics and mechanics, confounding more than one professor by an understanding of electricity, an infant science in those days, that was greater than theirs. His practical career started in 1881 in Budapest, Hungary, where he made his first electrical invention, a telephone repeater (the ordinary loudspeaker) and conceived the idea of a rotating magnetic field, which later made him world famous in its form as the modern induction motor. The polyphase induction motor is what provides power to virtually every industrial application, from conveyer belts to winches to machine tools.

Milutin Tesla, Nikola's father.

Tesla's mental abilities require some mention, since, not only did he have a photographic memory, he was able to use creative visualization with an uncanny and practical intensity. He describes in his autobiography how he was able to visualize a particular apparatus and was then able to actually test run the apparatus, disassemble it and check for proper action and wear! During the manufacturing phase of his inventions, he would work with all blueprints and specifications in his head. The invention invariably assembled together without redesign and worked perfectly. Tesla slept one to 2 hours a day and worked continuously on his inventions and theories without benefit of ordinary relaxation or vacations. He could judge the dimension of an object to a hundredth of an inch and perform difficult computations in his head without benefit of slide rule or mathematical tables. Far from an ivory tower intellectual, he was very much aware of the issues in the world around him, made it a point to render his ideas accessable to the general public by frequent contributions to the popular press, and to his field by numerous lectures and scientific papers.

He decided to come to the USA in 1884. He brought with him the various models of the first induction motors, which, after a brief and unhappy period at the Edison works, were eventually shown to George Westinghouse. It was in the Westinghouse shops that the induction motor was perfected. Numerous patents were taken out on this prime invention, all under Tesla's name.

Tesla worked briefly for Thomas Edison when he first came to the United States, creating many improvements on Edison's dc motors and generators, but left under a cloud of controversy after Edison refused to live up to bonus and royalty commitments. This was the beginning of a rivalry which was to have ugly consequences later when Edison and his backers did everything in their power to stop the devel-

A young Nikola Tesla.

opment and installation of Tesla's far more efficient and practical ac current delivery system and urban power grid. Edison put together a traveling road show which attempted to portray ac current as dangerous, even to the point of electrocuting animals both small (puppies) and large (in one case an elephant) in front of large audiences. As a result of this propaganda crusade, the state of New York adopted ac electrocution as its method of executing convicts. Tesla won the battle by the demonstration of ac current's safety and usefulness when his apparatus illuminated and powered the entire New York World's Fair of 1899.

Tesla's most important work at the end of the nineteenth century was his original system of transmission of energy by wireless antenna. In 1900 Tesla obtained his two fundamental patents on the transmission of true wireless energy covering both methods and apparatus and involving he use of four tuned circuits. In 1943, the Supreme Court of the United States granted full patent rights to Nikola Tesla for the invention of the radio, superseding and nullifying any prior claim by marconi and others in regards to the "fundamental radio patent" It is interesting to note that Tesla, in 1898, described the transmission of not only the human voice, but images as well and later designed and patented devices that evolved into the power supplies that operate our present day TV picture tubes. The first primitive radar installations in 1934 were built following principles, mainly regarding frequency and power level, that were stated by Tesla in 1917.

In 1889 Tesla constructed an experimental station in Colorado Springs where he studied the characteristics of high frequency or radio frequency alternating currents. While there he developed a powerful radio transmitter of unique design and also a number of receivers "for individualizing and isolating the energy transmitted". He conducted experiments designed to establish the laws of radio propagation which are currently being "rediscovered" and verified amid some controversy in high energy quantum physics.

Tesla wrote in *Century Magazine* in 1900: "...that communication without wires to any point of the globe is practicable. My experiments showed that the air at the ordinary pressure became distinctly conducting, and this opened up the wonderful prospect of transmitting large amounts of electrical energy for industrial purposes to great distances without wires...its practical consummation would mean that energy would be available for the uses of man at any point of the globe. I can conceive of no technical advance which would tend to unite the various elements of humanity more effectively than this one, or of one which would more add to and more economize human energy..." This was written in 1900! After finishing preliminary testing, work was begun on a full sized broadcasting station at shoreham,

Long Island. Had it gone into operation, it would have been able to provide usable amounts of electrical power at the receiving circuits. After construction of a generator building (still standing) and a 180 foot broadcasting tower (dynamited in world war I on the dubious pretext of being a potential navigation reference for German U-boats), financial support for the project was suddenly withdrawn by J. P. Morgan when it became apparent that such a worldwide power project couldn't be metered and charged for.

Another one of Tesla's inventions that is familiar to anyone who has ever owned an automobile, was patented in 1898 under the name "electrical ignitor for gas engines". More commonly known as the automobile ignition system, its major component, the ignition coil, remains practically unchanged since its introduction into use at the turn of the century.

Nikola Tesla also designed and built prototypes of a unique fuel burning rotary engine based upon his earlier design for a rotary pump. Recent tests that have been carried out on the Tesla bladeless disk turbine indicate that, if constructed using newly developed high temperature ceramic materials, it will rank as the world's most efficient gas engine, out-performing our present day piston type internal combustion engines in fuel efficiency, longevity, adaptability to different fuels, cost and power to weight ratio.

Tesla's generosity eventually left him without adequate funds to pursue and realize his inventions. His idealism and humanism left him with little stomach for the world of industrial and financial intrigue. His New York laboratory was destroyed by a mysterious fire. References to his work and accomplishments were systematically purged from the scientific literature and textbooks. Driven into a Hermetic exile in a New York hotel during the period between the two wars, 20 years of his potentially rich and productive contribution were taken from us. The only occasions of public appearance were the yearly press interview on his birthday when he would describe amazing and far reaching inventions and technological possibilities. These were distorted and sensationalized in the popular press, particularly when he described advanced weapons systems on the eve of world war II. He died in obscurity in 1943. Only the FBI took note: they searched his papers (in vain) for the design of the "death-ray machine". It is interesting to note that the motivation for our "Star Wars" defense system was based upon fears that the soviets had begun deployment of weapons based upon Tesla high energy principles. Public reports of mysterious "blindings" of U.S. surveillance satellites, anomalous high altitude flashes and fireballs, elf wave radio interference, and other cases lend credence to this interpretation.

Credit must be given where credit is due for the labor saving and humanitarian inventions such as universal ac current that have been incorporated into the very fabric of our daily lives and also the devices who's design have been made available, but have not been utilized by society at large.

A Short History of Nikola Tesla

This is a file to straighten out misconception and disinformation that has occurred over the years, about how supposedly "great" Edison was, and how Nikola Tesla was brushed under the capitalist power rug.

Edison was a thief, employing all kinds of people for their brains, he stole their inventions, their ideas, so much so, that it is unclear today what Edison actually invented, and what was stolen from others.

The Edison Electric Institute was formed to perpetuate the notion that Edison was the inventor of record, and to make sure that school textbooks, etc., only mentioned HIM in connection with these many inventions. Much like Bell Labs does today.

Nikola Tesla was pretty much always a genius, after having made many improvements in the electric trolleys, and trains in his country, he came to America, sought employment, and eventually ended up working for Edison.

Edison had contracted with New York City to build Direct Current (D.C.) power plants every square mile or so, so as to power the lights that he supposedly invented. Street lights, hotel lighting etc. Having trenches dug throughout the city to lay the cables, copper, and as big around as a man's bicep, he told Tesla that if Tesla could save him money by redesigning certain aspects of the installation, that he would give Tesla a percentage of the savings. A verbal agreement. After approximately a year, Tesla went to Edison's office and showed him the savings that had occurred ($100,000 or so, which in those days was quite a piece of change) as a direct result of his (Tesla's) engineering, and Edison pretended ignorance of any agreement. Tesla quit. From that point on, the two men were enemies.

Tesla invented useable Alternating Current (A.C.) that we all use today, in a world where Edison and others already had a huge investment in D.C. power.

Tesla proselytized A.C. power and had some success building A.C. power plants, and providing A.C. power to various entities. One of these was Sing Sing prison, in upstate New York. Tesla provided A.C. power for the "electric chair" there. Edison had big articles printed in the New York newspapers, saying that A.C. power was dangerous "killing" power, and in general, gave a bad name to Tesla.

To contradict this jab, Tesla set out on his own positive marketing campaign, appearing at the 1893 World Exposition in Chicago passing high frequency "dangerous" A.C. power over his body to power light bulbs in front of the public. Shooting huge, long sparks from his "Tesla coil", and touching them, etc. "Proving" that A.C. power was safe for public consumption.

The advantage of A.C. power was that you could send it a long distance through reasonably sized wires with little loss, and if you touched the wires together, "shorted them", you got a lot of sparks, and only the place where they were touching melted until the two wires weren't touching anymore.

D.C. power, on the other hand, needed huge cables to go any distance at all,

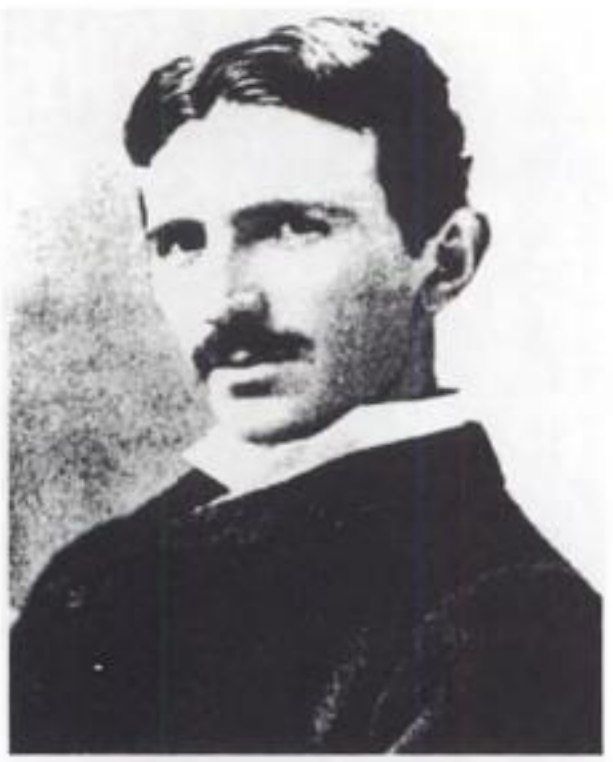
while using power, the cables heated up. When shorted, the cables melted all the way back to the power house, streets had to be dug up again and new cables laid. If a short occurred in a single light, it usually started a fire, and burned down the hotel or destroyed whatever it was in contact with! This was quite profitable for those in the D.C. power business, and quite good for those into ditch digging, construction, etc.

Tesla invented 2-phase, and 3-phase Alternating Current. He figured motors turned in a circle, so alternately driving separate, 180 degree, sections of the surrounding armature would build up less heat, and use less electricity. He was right.

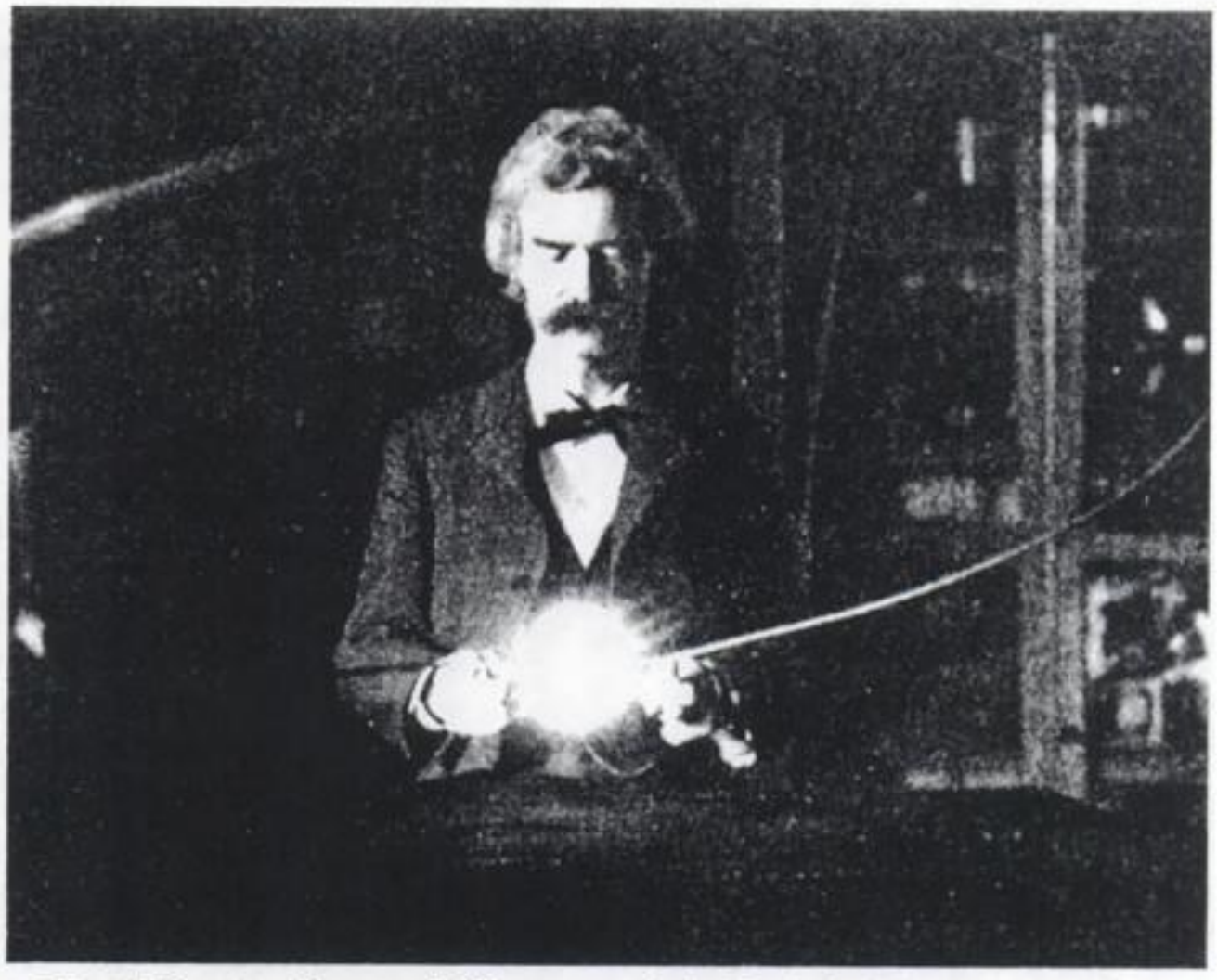
1929 came, the stock market crashed, bankers, lawyers, everyone who had lost their wealth and hadn't jumped out a window, sought work, many as common laborers if lucky, for a dollar a day. Tesla found himself digging ditches in the company of broke but influential ex-Wall-streeters. During the short lunch period, he would tell his buddies about phased A.C. electricity, and how it was efficient, etc. Along about 1932, he was working at a small generator rebuilding shop in New York, and one of the bankers that he used to dig ditches with, found him, and took him to Mr. Westinghouse, to whom he told his stories. Westinghouse bought 19 patents outright, and gave Tesla a dollar per horsepower for any electric motor produced by Westinghouse using the Tesla 3-phase system.

Tesla finally had the money with which to start building his laboratories, 5 and conducting the experiments with free earth energy. The idea that really made him unpopular.

Something free, that the masters of war and business couldn't control? They couldn't have that! So, the day after Tesla died in 1943, his huge laboratory on Long Island mysteriously burned down, no records saved, and the remnants were bulldozed the day after that to further eradicate any equipment still left. So much for "free energy.".




New Sources of Energy To Give the World
Unlimited Power, Noted Inventor Says

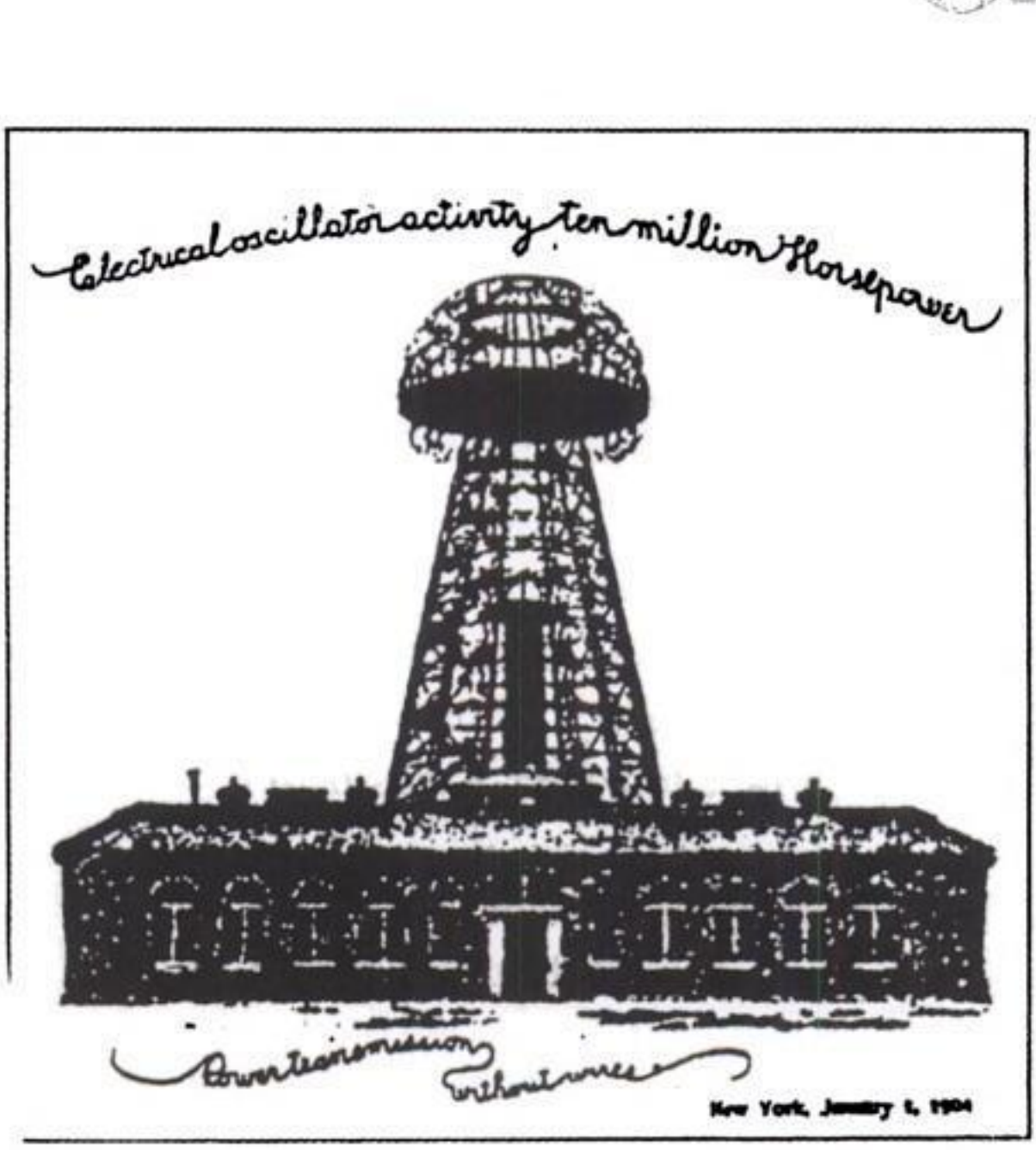


Mark Twain (Samuel Clemmens) in Tesla's laboratory, 1895.

Part Two
The Problem of Increasing Human Energy

with special reference to the harnessing of the sun's energy.

by Nikola Tesla



THE ONWARD MOVEMENT OF MAN— THE ENERGY OF THE MOVEMENT— THE THREE WAYS OF INCREASING HUMAN ENERGY.

Of all the endless variety of phenomena which nature presents to our senses, there is none that fills our minds with greater wonder than that inconceivably complex movement which, in its entirety, we designate as human life. Its mysterious origin is veiled in the forever impenetrable mist of the past, its character is rendered incomprehensible by its infinite intricacy, and its destination is hidden in the unfathomable depths of the future. Whence does it come? What is it? Whither does it tend? are the great questions which the sages of all times have endeavored to answer.

Modern science says: The sun is the past, the earth is the present, the moon is the future. From an incandescent mass we have originated, and into frozen mass we shall turn. Merciless is the law of nature, and rapidly and irresistibly we are drawn to our doom. Lord Kelvin, in his profound meditations, allows us only a short span of life, something like six million years, after which time the sun's bright light will have ceased to shine, and its life-giving heat will have ebbed away, and our own earth will be a lump of ice, hurrying on through the eternal night. But do not let us despair. There will still be left on it a glimmering spark of life, and there will be a chance to kindle anew fire on some distant star. This wonderful possibility seems, indeed, to exist, judging from Professor Dewar's beautiful experiments with liquid air, which show that germs of organic life are not destroyed by cold, no matter how intense; consequently they may be transmitted through the interstellar space. Meanwhile the cheering lights of science and art, ever increasing in intensity, illuminate our path, and the marvels they disclose, and the enjoyments they offer, make us measurably forgetful of the gloomy future.

Though we may never be able to comprehend human life, we know certainly that it is movement, of whatever nature it be. The existence of a movement unavoidably implies a body which is being moved and a force which is moving it. Hence, wherever there is life, there is a mass moved by a force. All mass possesses inertia, all force tends to persist. Owing to this universal property and condition, a body, be it at rest or in motion, tends to remain in the same state, and a force, manifesting itself anywhere and through whatever cause, produces an equivalent opposing force, and as an absolute necessity of this it follows that every movement in nature must be rhythmical. Long ago this simple truth was clearly pointed out by Herbert Spencer, who arrived at it through a somewhat different process of reasoning. It is borne out in everything we perceive—in the movement of a planet, in the surging and ebbing of the tide, in the reverberations of the air, the swinging of a pendulum, the oscillations of an electric current, and in the infinitely varied phenomena of organic life. Does not the whole of human life attest it? Birth, growth, old age, and death of an individual, family, race, or nation, what is it all but a rhythm?

All life-manifestation, then, even in its most intricate form, as exemplified in man, however involved and inscrutable, is only a movement, to which the general laws of movement which govern throughout the physical universe must be applicable.

When we speak of man, we have a conception of humanity as a whole, and before applying scientific method to the investigation of his movement, we must accept this as a physical fact. But can anyone doubt today that all the millions of individuals and all the innumerable types and characters constitute an entity, a unit? Though free to think and act, we are held together, like the stars in the firmament, with ties inseparable. These ties we cannot see, but we can feel them. I cut myself in the finger, and it pains me: this finger is a part of me. I see a friend hurt, and it hurts me, too: my friend and I arc one. And now I see stricken down an enemy, a lump of matter which, of all the lumps of matter in the universe, I care least for, and still it grieves me. Does this not prove that each of us is only a part of a whole?

For ages this idea has been proclaimed in the consummately wise teachings of religion, probably not alone as a means of insuring peace and harmony among men, but as a deeply founded truth. The Buddhist expresses it in one way, the Christian in another, but both say the same: We are all one. Metaphysical proofs are, however, not the only ones which we are able to bring forth in support of this idea. Science, too, recognizes this connectedness of separate individuals, though not quite in the same sense as it admits that the suns, planets, and moons of a constellation are one body, and there can be no doubt that it will be experimentally confirmed in times to come, when our means and methods for investigating psychical and other states and phenomena shall have been brought to great perfection. Still more: this one human being lives on and on. The individual is ephemeral, races and nations come and pass away, but man remains. Therein lies the profound difference between the individual and the whole. Therein, too, is to be found the partial explanation of many of those marvelous phenomena of heredity which are the results of countless centuries of feeble but persistent influence.

Conceive, then, man as a mass urged on by a force. Though this movement is not of a translatory character, implying change of place, yet the general laws of mechanical movement are applicable to it, and the energy associated with this mass can be measured, in accordance with well-known principles, by half the product of the mass with the square of a certain velocity. So, for instance, a cannon ball which is at rest possesses a certain amount of energy in the form of heat, which we measure in a similar way. We imagine the ball to consist of innumerable minute particles, called atoms or molecules, which vibrate or whirl around one another. We determine their masses and velocities, and from them the energy of each of these minute systems, and adding them all together, we get an idea of the total heat-energy contained in the ball, which is only seemingly at rest. In this purely theoretical estimate this energy may then be calculated by multiplying half of the total mass—that is, half of the sum of all the small masses—with the square of a velocity

which is determined from the velocities of the separate particles. In like manner we may conceive of human energy being measured by half the human mass multiplied with the square of a velocity which we are not yet able to compute. But our deficiency in this knowledge will not vitiate the truth of the deductions I shall draw which rest on the firm basis that the same laws of mass and force govern throughout nature.

Man, however, is not an ordinary mass, consisting of spinning atoms and molecules, and containing merely heat-energy. He is a mass possessed of certain higher qualities by reason of the creative principle of life with which he is endowed. His mass, as the water in an ocean wave, is being continuously exchanged, new taking the place of the old. Not only this, but he grows, propagates, and dies, thus altering his mass independently, both in bulk and density. What is most wonderful of all, he is capable of increasing or diminishing his velocity of movement by the mysterious power he possesses of appropriating more or less energy from other substance, and turning it into motive energy. But in any given moment we may ignore these slow changes and assume that human energy is measured by half the product of man's mass with the square of a certain hypothetical velocity. However we may compute this velocity, and whatever we may take as the standard of its measure, we must, in harmony with this conception, come to the conclusion that the great problem of science is, and always will be, to increase the energy thus defined. Many years ago, stimulated by the perusal of that deeply interesting work, Draper's "History of the Intellectual Development of Europe," depicting so vividly human movement, I recognized that to solve this eternal problem must ever be the chief task of the man of science. Some results of my own efforts to this end I shall endeavor briefly to describe here.

Let, then, in *Diagram A*, M represent the mass of man. This mass is impelled in one direction by a force f, which is resisted by another partly frictional and partly negative force R, acting in a direction exactly opposite, and retarding the movement of the mass. Such an antagonistic force is present in every movement, and must be taken into consideration. The difference between these two forces is the effective force which imparts a velocity V to the mass M in the direction of the arrow on the line representing the force f. In accordance with the preceding, the human energy will then be given by the product $1/2\ MV^2=1/2\ MVxV$, in which M is the total mass of man in the ordinary interpretation of the term "mass," and V is a certain hypothetical velocity, which, in the present state of science, we are unable exactly to define and determine. To increase the human energy is, therefore, equivalent to increase this product, and there are, as will readily be seen, only three ways possible to attain this result, which are illustrated in the above diagram. The first way, shown in the top figure, is to increase the mass (as indicated by the dotted circle), leaving the two opposing forces the same. The second way is to reduce the retarding force R to a smaller value r, leaving the mass and the impelling force the same, as diagrammatically shown in the middle figure. The third way, which is

illustrated in the last figure, is to increase the impelling force f to a higher value F, while the mass and the retarding force R remain unaltered. Evidently fixed limits exist as regards increase of mass and reduction of retarding force, but the impelling force can be increased indefinitely. Each of these three possible solutions presents a different aspect of the main problem of increasing human energy, which is thus divided into three distinct problems, to be successively considered.

THE FIRST PROBLEM: HOW TO INCREASE THE HUMAN MASS— THE BURNING OF ATMOSPHERIC NITROGEN.

Viewed generally, there are obviously two ways of increasing the mass of mankind: first, by aiding and maintaining those forces and conditions which tend to increase it; and, second, by opposing and reducing those which tend to diminish it. The mass will be increased by careful attention to health, by substantial food, by moderation, by regularity of habits, by the promotion of marriage, by conscientious attention to the children, and, generally stated, by the observance of all the many precepts and laws of religion and hygiene. But in adding new mass to the old, three cases again present themselves. Either the mass added is of the same velocity as the old, or it is of a smaller or of a higher velocity. To gain an idea of the relative importance of these cases, imagine a train composed of, say, one hundred locomotives running on a track, and suppose that, to increase the energy of the moving mass, four more locomotives are added to the train. If these four move at the same velocity at which the train is going, the total energy will be increased four per cent.; if they are moving at only one half of that velocity, the increase will amount to only one per cent.; if they are moving at twice that velocity, the increase of energy will be sixteen per cent. This simple illustration shows that it is of the greatest importance to add mass of a higher velocity. Stated more to the point, if, for example, the children be of the same degree of enlightenment as the parents,—that is, mass of the "same velocity,"—the energy will simply increase proportionately to the number added. If they

DIAGRAM A

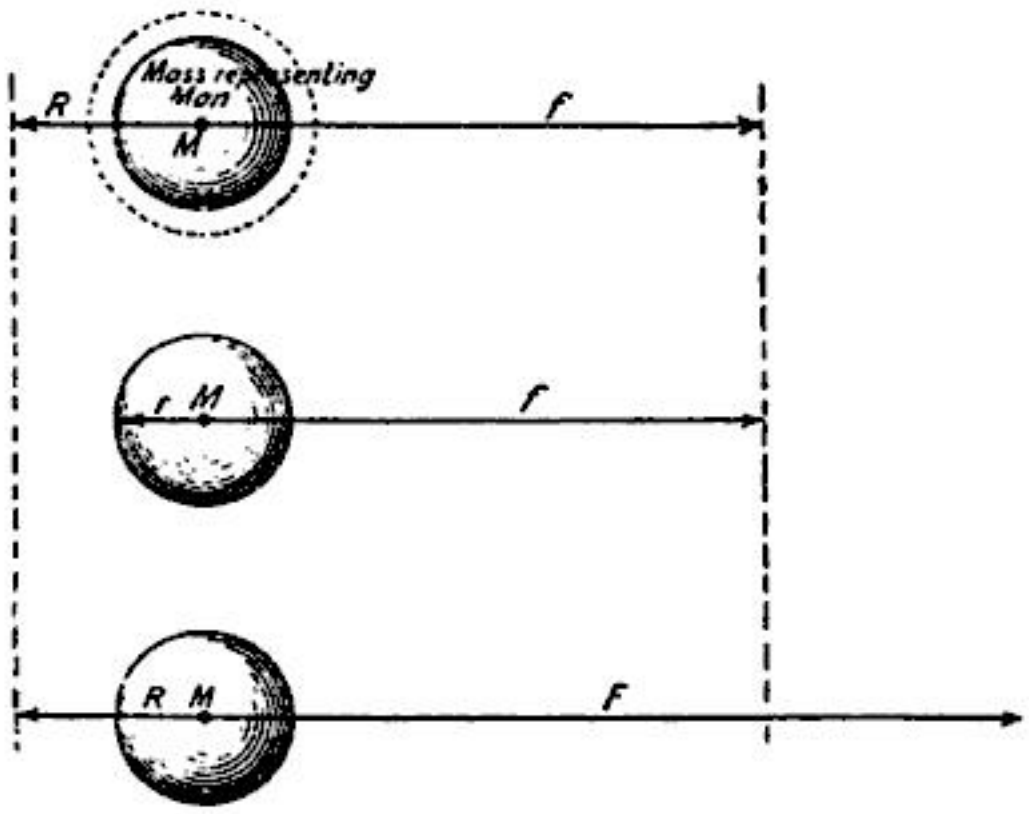


Diagram A. The three ways of increasing human energy.

are less intelligent or advanced, or mass of "smaller velocity," there will be a very slight gain in the energy; but if they are further advanced, or mass of "higher velocity," then the new generation will add considerably to the sum total of human energy. Any addition of mass of "smaller velocity," beyond that indispensable amount required by the law expressed in the proverb, "*Mens sana in corpore sano*,"[1] should be strenuously opposed. For instance, the mere development of muscle, as aimed at in some of our colleges, I consider equivalent to adding mass of "smaller velocity," and I would not commend it, although my views were different when I was a student myself. Moderate exercise, insuring the right balance between mind and body, and the highest efficiency of performance, is of course, a prime requirement. The above example shows that the most important result to be attained is the education, or the increase of the "velocity," of the mass newly added.

Conversely, it scarcely need be stated that everything that is against the teachings of religion and the laws of hygiene is tending to decrease the mass. Whisky, wine, tea, coffee, tobacco, and other such stimulants are responsible for the shortening of the lives of many, and ought to be used with moderation. But I do not think that rigorous measures of suppression of habits followed through many generations arc commendable. It is wiser to preach moderation than abstinence. We have become accustomed to these stimulants, and if such reforms are to be effected, they must be slow and gradual. Those who are devoting their energies to such ends could make themselves far more useful by turning their efforts in other directions, as, for instance, toward providing pure water.

For every person who perishes from the effects of a stimulant, at least a thousand die from the consequences of drinking impure water. This precious fluid, which daily infuses new life into us, is likewise the chief vehicle through which disease and death enter our bodies. The germs of destruction it conveys are enemies all the more terrible as they perform their fatal work unperceived. They seal our doom while we live and enjoy. The majority of people are so ignorant or careless in drinking water, and the consequences of this are so disastrous, that a philanthropist can scarcely use his efforts better than by endeavoring to enlighten those who are thus injuring themselves. By systematic purification and sterilization of the drinking water the human mass would be very considerably increased. It should be made a rigid rule—which might be enforced by law—to boil or to sterilize otherwise the drinking-water in every household and public place. The mere filtering does not afford sufficient security against infection. All ice for internal uses should be artificially prepared from water thoroughly sterilized. The importance of eliminating germs of disease from the city water is generally recognized, but little is being done to improve the existing conditions, as no satisfactory method of sterilizing great quantities of water has as yet been brought forward. By improved electrical appliances we are now enabled to produce ozone cheaply and in large amounts, and this ideal disinfectant seems to offer a happy solution of the important question.

[1] Sound mind in a sound body

Gambling, business rush, and excitement, particularly on the exchanges, are causes of much mass-reduction, all the more so because the individuals concerned represent units of higher value. Incapacity of observing the first symptoms of an illness, and careless neglect of the same, are important factors of mortality. In noting carefully every new sign of approaching danger, and making conscientiously every possible effort to avert it, we are not only following wise laws of hygiene in the interest of our well being and the success of our labors, but we are also complying with a higher moral duty. Everyone should consider his body as a priceless gift from one whom he loves above all, as a marvelous work of art, of indescribable beauty and mastery beyond human conception, and so delicate and frail that a word, a breath, a look, nay, a thought, may injure it. Uncleanliness, which breeds disease and death, is not only self destructive but a highly immoral habit. In keeping our bodies free from infection, healthful, and pure, we are expressing our reverence for the high principle with which they are endowed. He who follows the precepts of hygiene in this spirit is proving himself, so far, truly religious. Laxity of morals is a terrible evil, which poisons both mind and body, and which is responsible for a great reduction of the human mass in some countries. Many of the present customs and tendencies are productive of similar hurtful results. For example, the society life, modern education and pursuits of women, tending to draw away from their household duties and make men out of them, must needs detract from the elevating ideal they represent, diminish the artistic creative power, and cause sterility and a general weakening of the race. A thousand other evils might be mentioned, but all put together, in their bearing upon the Problem under discussion, they would not equal a single one, the want of food, brought on by poverty, destitution, and famine. Millions of individuals die yearly for want of food, thus keeping down the mass. Even in our enlightened communities, and notwithstand-

ing the many charitable efforts, this is still, in all probability, the chief evil. I do not mean her absolute want of food, but want of healthful nutriment.

How to provide good and plentiful food is, therefore, a most important question of the day. On general principles the raising of cattle as a means of providing food is objectionable, because, in the sense interpreted above, it must undoubtedly tend to the addition of mass of a smaller velocity." It is certainly preferable to raise vegetables, and I think, therefore, that vegetarianism is a commendable departure from the established barbarous habit. That we can subsist on plant food and perform our work even to advantage is not a theory, but a demonstrated fact. Many races living almost exclusively on vegetables are of superior physique and strength. There is no doubt that some plant food, such as oatmeal, is more economical than meat, and superior to it in regard to both mechanical and mental performance. Such food, moreover, taxes our digestive organs decidedly less, and, in making us more contented and sociable, produces an amount of good difficult to estimate. In view of these facts every effort should be made to stop the wanton and cruel slaughter of animals, which must be destructive to our morals. To free ourselves from animal instincts and appetites, which keep us down, we should begin at the very root from which they spring: we should effect a radical reform in the character of the food.

There seems to be no philosophical necessity for food. We can conceive of organized beings living without nourishment, and deriving all the energy they need for the performance of their life-functions from the ambient medium. In a crystal we have the clear evidence of the existence of a formative life-principle, and though we cannot understand the life of a crystal, it is nonetheless a living being. There may be, besides crystals, other such individualized, material systems of beings, perhaps of gaseous constitution, or composed of substance still more tenuous. In view of this possibility, —nay, probability, —we cannot apodictically deny the existence of organized beings on a planet merely because the conditions on the same are unsuitable for the existence of life as we conceive it. We cannot even with positive assurance, assert that some of them might not be present here, in this our world, in the very midst of us, for their constitution and life-manifestation may be such that we are unable to perceive them.

The production of artificial food as a means for causing an increase of the human mass naturally suggests itself, but a direct attempt of this kind to provide nourishment does not appear to me rational, at least not for the present. Whether we could thrive on such food is very doubtful. We are the result of ages of continuous adaptation, and we cannot radically change without unforeseen and, in all probability, disastrous consequences. So uncertain an experiment should not be tried. By far the best way, it seems to me, to meet the ravages of the evil would be to find ways of increasing the productivity of the soil. With this object the preservation of forests is of an importance which cannot be overestimated, and in this connection, also, the utilization of water-power for purposes of electrical transmission, dispensing in many ways with the necessity of burning wood, and tending thereby to forest pres-

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of the electrical pressure of the current impulses, of their wave-form and other characteristic features, were investigated. Then the influence of the atmospheric pressure and temperature and of the presence of water and other bodies was studied, and thus the best conditions for causing the most intense chemical action of the discharge and securing the highest efficiency of the process were gradually ascertained. Naturally, the improvements were not quick in coming; still, little by little, I advanced. The flame grew larger and larger, and its oxidizing action more and more intense. From an insignificant brush-discharge a few inches long it developed into a marvelous electrical phenomenon, a roaring blaze, devouring the nitrogen of the atmosphere and measuring sixty or seventy feet across. Thus slowly, almost imperceptibly, possibility became accomplishment. All is not yet done, by any means, but to what a degree my efforts have been rewarded an idea may be gained from the inspection of *Figure 1*, which, with its title, is self explanatory. The flame-like discharge visible is produced by the intense electrical oscillations which pass through the coil shown, and violently agitate the electrified molecules of the air. By this means a strong affinity is created between the two normally indifferent constitu-

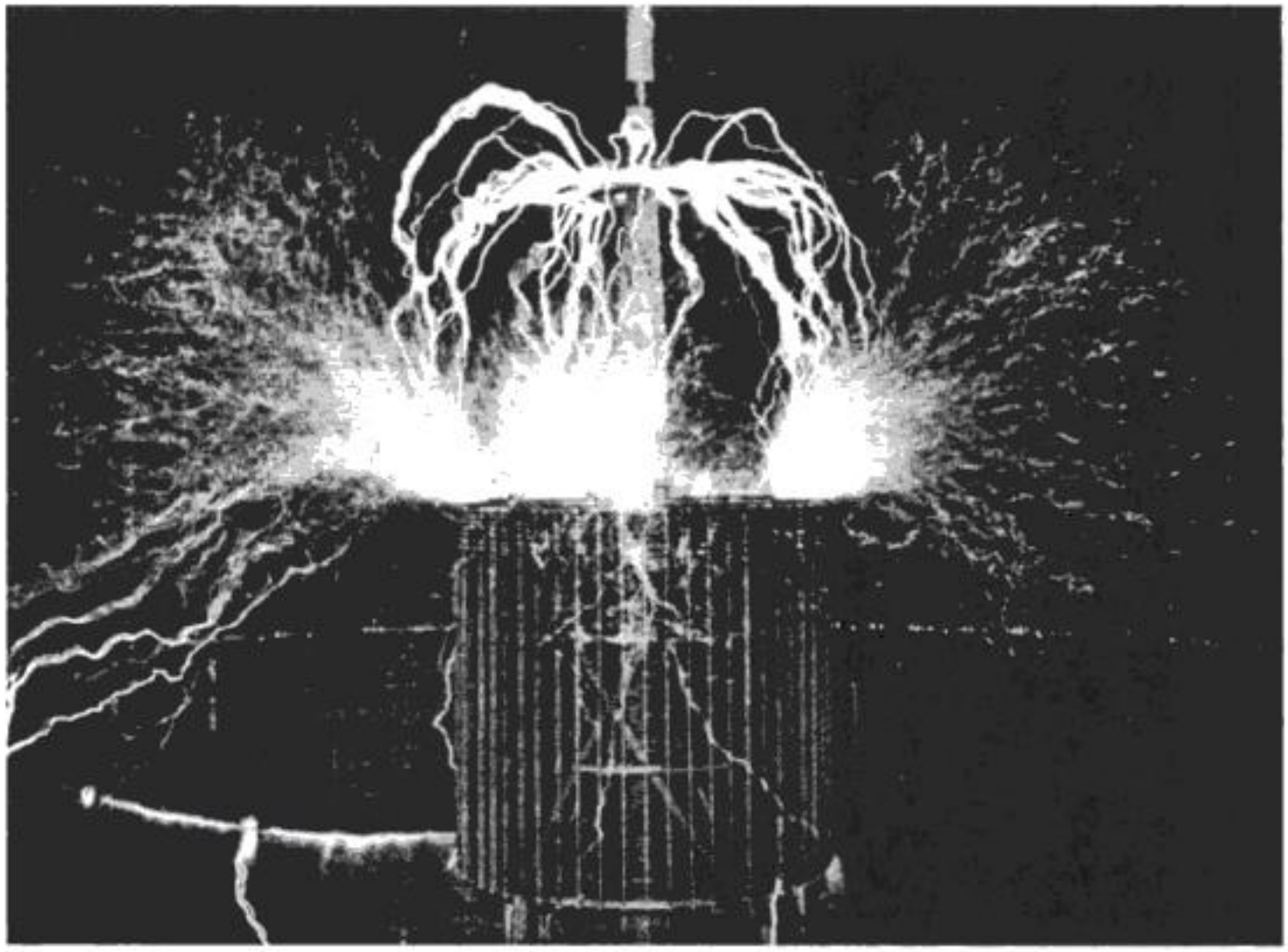

Figure 1. Burning the Nitrogen of the atmosphere. This result is produced by the discharge of an electrical oscillator giving twelve million volts. The electrical pressure, alternating one hundred thousand times per second, excites the normally inert nitrogen, causing it to combine with the oxygen. The flame-like discharge shown in the photograph measures sixty-five feet across.

ents of the atmosphere, and they combine readily, even if no further provision is made for intensifying the chemical action of the discharge. In the manufacture of nitrogen compounds by this method, of course, every possible means bearing upon the intensity of this action and the efficiency of the process will be taken advantage of, and, besides, special arrangements will be provided for the fixation of the compounds formed, as they are generally unstable, the nitrogen becoming again inert after a little lapse of time. Steam is a simple and effective means for fixing permanently the compounds. The result illustrated makes it practicable to oxidize the atmospheric nitrogen in unlimited quantities, merely by the use of cheap mechanical power and simple electrical apparatus. In this manner many compounds of nitrogen may be manufactured all over the world, at a small cost, and in any desired amount, and by means of these compounds the soil can be fertilized and its productiveness indefinitely increased. An abundance of cheap and healthful food, not artificial, but such as we are accustomed to, may thus be obtained. This new and inexhaustible source of food supply will be of incalculable benefit to mankind, for it will enormously contribute to the increase of the human mass, and thus add immensely to human energy. Soon, I hope, the world will see the beginning of an industry which, in time to come, will, I believe, be in importance next to that of iron.

THE SECOND PROBLEM: HOW TO REDUCE THE FORCE RETARDING THE HUMAN MASS— THE ART OF TELAUTOMATICS.

As before stated, the force which retards the onward movement of man is partly frictional and partly negative. To illustrate this distinction I may name, for example, ignorance, stupidity, and imbecility as some of the purely frictional forces, or resistances devoid of any directive tendency. On the other hand, visionariness, insanity, self-destructive tendency, religious fanaticism, and the like, are all forces of a negative character, acting in definite directions. To reduce or entirely to overcome these dissimilar retarding forces, radically different methods must be employed. One knows, for instance, what a fanatic may do, and one can take preventive measures, can enlighten, convince, and possibly direct him, turn his vice into virtue; but one does not know, and never can know, what a brute or an imbecile may do, and one must deal with him as with a mass, inert, without mind, let loose by the mad elements. A negative force always implies some quality, not infrequently a high one, though badly directed, which it is possible to turn to good advantage; but a directionless, frictional force involves unavoidable loss. Evidently, then, the first and general answer to the above question is: turn all negative force in the right direction and reduce all frictional force.

There can be no doubt that, of all the frictional resistances, the one that most retards human movement is ignorance. Not without reason said that man of wisdom, Buddha: "Ignorance is the greatest evil in the world." The friction which re-

sults from ignorance, and which is greatly increased owing to the numerous languages and nationalities, can be reduced only by the spread of knowledge and the unification of the heterogeneous elements of humanity. No effort could be better spent. But however ignorance may have retarded the onward movement of man in times past, it is certain that, nowadays, negative forces have become of greater importance. Among these there is one of far greater moment than any other. It is called organized warfare. When we consider the millions of individuals, often the ablest in mind and body, the flower of humanity, who are compelled to a life of inactivity

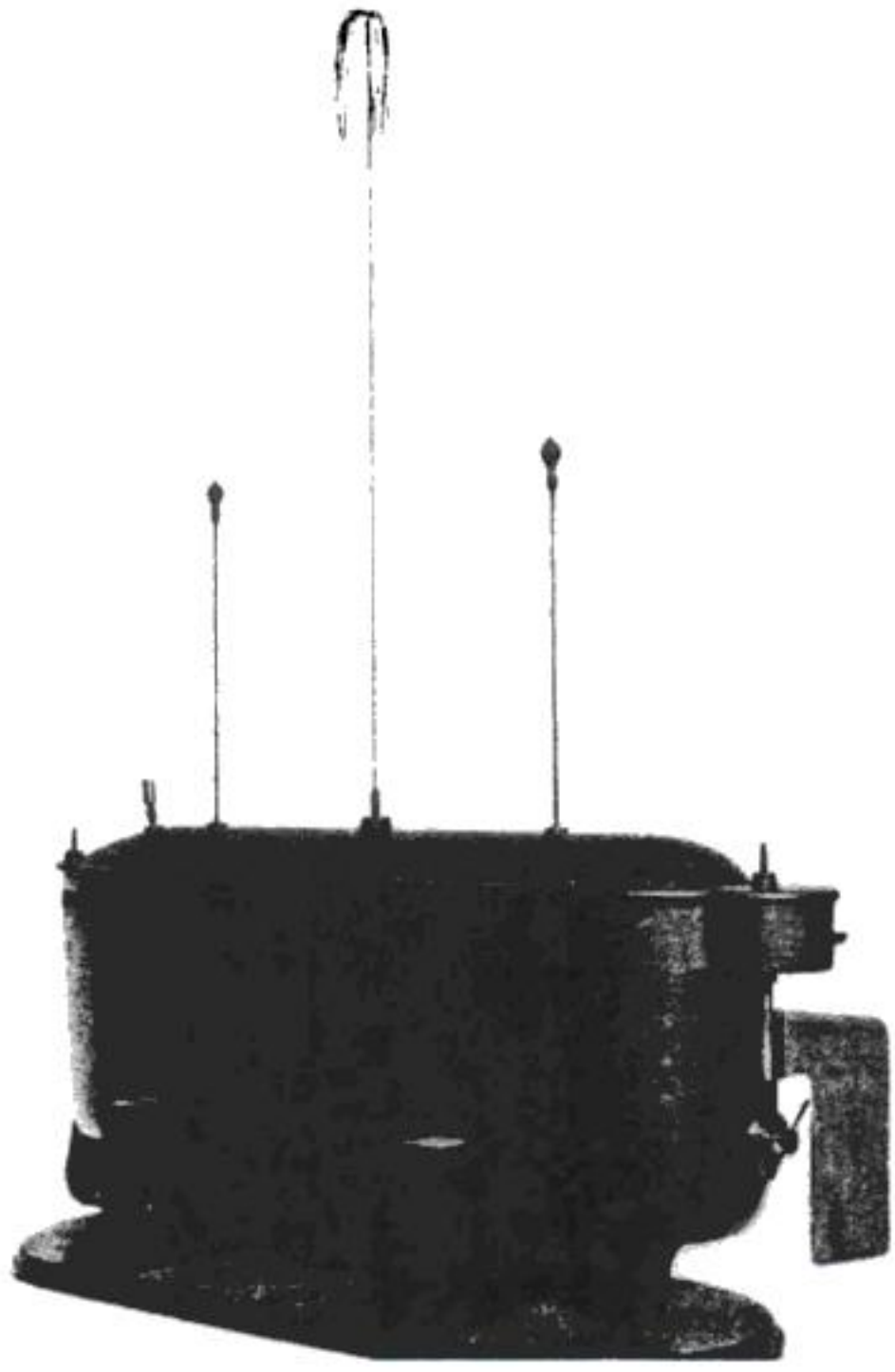

Figure 2. The first practical Telautomaton. A machine having all its bodily or translatory movements and the operation of the interior mechanism controlled from a distance without wires. The crewless boat shown in the photograph contains its own motive power, propelling and steering machinery, and numerous other accessories, all of which are controlled by transmitting from a distance, without wires, electrical oscillations to a circuit carried by the boat and adjusted to respond only to these oscillations.

and unproductiveness, the immense sums of money daily required for the maintenance of armies and war apparatus, representing ever so much of human energy, all the effort uselessly spent in the production of arms and implements of destruction, the loss of life and the fostering of a barbarous spirit, we are appalled at the inestimable loss to mankind which the existence of these deplorable conditions must involve. What can we do to combat best this great evil?

Law and order absolutely require the maintenance of organized force. No community can exist and prosper without rigid discipline. Every country must be able to defend itself, should the necessity arise. The conditions of today are not the result of yesterday, and a radical change cannot be effected tomorrow. If the nations would at once disarm, it is more than likely that a state of things worse than war itself would follow. Universal peace is a beautiful peace is a beautiful dream, but not at once realizable. We have seen recently that even the noble effort of the man invested with the greatest worldly power has been virtually without effect. And no wonder, for the establishment of universal peace is, for the time being, a physical impossibility. War is a negative force, and cannot be turned in a positive direction without passing through the intermediate phases. It is the problem of making a wheel, rotating one way, turn in the opposite direction without slowing it down, stopping it, and speeding it up again the other way.

It has been argued that the perfection of guns of great destructive power Will stop warfare. So I myself thought for a long time, but now I believe this to be a profound mistake. Such developments will greatly modify, but not arrest it. On the contrary, I think that every new arm that is invented, every new departure that is made in this direction, merely invites new talent and skill, engages new effort, offers a new incentive, and so only gives a fresh impetus to further development. Think of the discovery of gun powder. Can we conceive of any more radical departure than was effected by this innovation? Let us imagine ourselves living in that period: would we not have thought then that warfare was at an end, when the armor of the knight became an object of ridicule, when bodily strength and skill, meaning so much before, became of comparatively little value? Yet gunpowder did not stop warfare; quite the opposite—it acted as a most powerful incentive. Nor do I believe that warfare can ever be arrested by any scientific or ideal development, so long as similar conditions to those now prevailing exist, because war has itself become a science, and because war involves some of the most sacred sentiments of which man is capable. In fact, it is doubtful whether men who would not be ready to fight for a high principle would be good for anything at all. It is not the mind which makes man, nor is it the body; it is mind and body. Our virtues and our failings are inseparable, like force and matter. When they separate, man is no more.

Another argument, which carries considerable force, is frequently made, namely, that war must soon become impossible because the means of defense are outstripping the means of attack. This is only in accordance with a fundamental law which may be expressed by the statement that it is easier to destroy than to build. This law

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of the strong. The weak individual then began to learn how to defend him self. He made use of a club, stone, spear, sling, or bow and arrow, and in the course of time, instead of physical strength, intelligence became the chief deciding factor in the battle. The wild character was gradually softened by the awakening of noble sentiments, and so Imperceptibly, after ages of continued progress, we have come from the brutal fight of the unreasoning animal to what we call the "civilized warfare" of today, in which the combatants shake hands, talk in a friendly way, and smoke cigars in the *entr'actes,* ready to engage again in deadly conflict at a signal. Let pessimists say what they like, here is an absolute evidence of great and gratifying advance.

But now, what is the next phase in this evolution? Not peace as yet, by any means. The next change which should naturally follow from modern developments should be the continuous diminution of the number of individuals engaged in battle. The apparatus will be one of specifically great power, but only a few individuals will be required to operate it. This evolution will bring more and more into prominence a machine or mechanism with the fewest individuals as an element of warfare, and the absolutely unavoidable consequence of this will be the abandonment of large, clumsy, slowly moving, and unmanageable units. Greatest possible speed and maximum rate of energy-delivery by the war apparatus will be the main object. The loss of life will become smaller and smaller, and finally, the number of the individuals continuously diminishing, merely machines will meet in a contest without bloodshed, the nations being simply interested, ambitious spectators. When this happy condition is realized, peace will be assured. But, no matter to what degree of perfection rapid fire guns, high power cannon, explosive projectiles, torpedo-boats, or other implements of war may be brought, no matter how destructive they may be made, that condition can never be reached through any such development. All such implements require men for their operation; men are indispensable parts of the machinery. Their object is to kill and to destroy. Their power resides in their capacity for doing evil. So long as men meet in battle, there will be bloodshed. Bloodshed will ever keep up barbarous passion. To break this fierce spirit, a radical departure must be made, an entirely new principle must be introduced, something that never existed before in warfare—a principle which will forcibly, unavoidably, turn the battle into a mere spectacle, a play, a contest without loss of blood. To bring on this result men must be dispensed with: machine must fight machine. But how accomplish that which seems impossible? The answer is simple enough: produce a machine capable of acting as though it were part of a human being—no mere mechanical contrivance, comprising levers, screws, wheels, clutches, and nothing more, but a machine embodying a higher principle, which will enable it to perform its duties as though it had intelligence, experience, reason, judgment, a mind! This conclusion is the result of my thoughts and observations which have extended through virtually my whole life, and I shall now briefly describe how I came to accomplish that which at first seemed an unrealizable dream.

A long time ago, when I was a boy, I was afflicted with a singular trouble, which seems to have been due to an extraordinary excitability of the retina. It was the appearance of images which, by their persistence, marred the vision of real objects and interfered with thought. When a word was said to me, the image of the object which it designated would appear vividly before my eyes, and many times it was impossible for me to tell whether the object I saw was real or not. This caused me great discomfort and anxiety, and I tried hard to free myself of the spell. But for a long time I tried in vain, and it was not, as I still clearly recollect, until I was about twelve years old that I succeeded for the first time, by an effort of the will, in banishing an image which presented itself. My happiness will never be as complete as it was then, but, unfortunately (as I thought at that time), the old trouble returned, and with it my anxiety. Here it was that the observations to which I refer began. I noted, namely, that whenever the image of an object appeared before my eyes I had seen something which reminded me of it. In the first instances I thought this to be purely accidental, but soon I convinced myself that it was not so. A visual impression, consciously or unconsciously received, invariably preceded the appearance of the image. Gradually the desire arose in me to find out, every time, what caused the images to appear, and the satisfaction of this desire soon became a necessity. The next observation I made was that, just as these images followed as a result of something I had seen, so also the thoughts which I conceived were suggested in like manner. Again, I experienced the same desire to locate the image which caused the thought, and this search for the original visual impression soon grew to be a second nature. My mind became automatic, as it were, and in the course of years of continued, almost unconscious performance, I acquired the ability of locating every time and, as a rule, instantly the visual impression which started the thought. Nor is this all. It was not long before I was aware that also all my movements were prompted in the same way, and so, searching, observing, and verifying continuously, year after year, I have, by every thought and every act of mine, demonstrated, and do so daily, to my absolute satisfaction, that I am an automaton endowed with power of movement, which merely responds to external stimuli beating upon my sense organs, and thinks and acts and moves accordingly. I remember only one or two cases in all my life in which I unable to locate the first impression which prompted a movement or a thought, or a dream.

With these experiences it was only natural that long ago, I conceived the idea of constructing an automaton which would mechanically represent me, and which would respond, as I do myself, but of course, in a much more primitive manner, to external influences. Such an automaton evidently had to have motive power, organs for locomotion, directive organs, and one or more sensitive organs so adapted as to be excited by external stimuli. This machine would, I reasoned, perform its movements in the manner of a living being, for it would have all the chief mechanical characteristics or elements of the same. There was still the capacity for growth, propagation, and, above all, the mind which would be wanting to make the model

complete. But growth was not necessary in this case, since a machine could be manufactured full-grown, so to speak. As to the capacity for propagation, it could likewise be left out of consideration, for in the mechanical model it merely signified a process of manufacture. Whether the automaton be of flesh and bone, or wood and steel, it mattered little, provided it could perform all the duties required of it like an intelligent being. To do so, it had to have an element corresponding to the mind, which would effect the control of all its movements and operations, and cause it to act, in my unforeseen case that might present itself, with knowledge, reason, judgment, and experience. But this element I could easily embody in it by conveying to it my own intelligence, my own understanding. So this invention was evolved, and so a new art came into existence, for which the name "telautomatics" has been suggested, which means the art of controlling the movements and operations of distant automatons.

This principle evidently was applicable to any kind of machine that moves on land or in the water or in the air. In applying it practically for the first time, I selected a boat (see *Figure* 2). A storage battery placed within it furnished the motive power. The propeller, driven by a motor, represented the locomotive organs. The rudder, controlled by another motor likewise driven by the battery, took the place of the directive organs. As to the sensitive organ, obviously the first thought was to utilize a device responsive to rays of light, like a selenium cell, to represent the human eye. But upon closer inquiry I found that, owing to experimental and other difficulties, no thoroughly satisfactory control of the automaton could be effected by light, radiant heat, Hertzian radiations, or by rays in general, that is, disturbances which pass in straight lines through space. One of the reasons was that any obstacle coming between the operator and the distant automaton would place it beyond his control. Another reason was that the sensitive device representing the eye would have to be in a definite position with respect to the distant controlling apparatus, and this necessity would impose great limitations in the control. Still another and very important reason was that, in using rays, it would be difficult if not impossible, to give to the automaton individual features or characteristics distinguishing it from other machines of this kind. Evidently the automatons should respond only to an individual call, as a person responds to a name. Such considerations led me to conclude that the sensitive device of the machine should correspond to the ear rather than to the eye of a human being, for in this case its actions could be controlled irrespective of intervening obstacles, regardless of its position relative to the distant controlling apparatus, and last, but not least, it would remain deaf and unresponsive, like a faithful servant, to all calls but that of its master. These requirements made it imperative to use, in the control of the automaton, instead of light or other rays, waves or disturbances which propagate in all directions through space, like sound, or which follow a path of least resistance, however curved. I attained the result aimed by means of an electric circuit placed within the boat, and adjusted, or "tuned," exactly to electrical vibrations of the proper kind trans-

mitted to it from a distant "electrical oscillator." This circuit in responding, however feebly, to the transmitted vibrations, affected magnets and other contrivances, through the medium of which were controlled the movements of the propeller and rudder, and also the operations of numerous other appliances.

By the simple means described the knowledge, experience, judgment—the mind, so to speak—of the distant operator were embodied in that machine, which was thus enabled to move and to perform all its operations with reason and intelligence. It behaved just like a blindfolded person obeying directions received through the ear.

The automatons so far constructed had "borrowed minds," so to speak, as each merely formed part of the distant operator who conveyed to it his intelligent orders; but this an is only in the beginning. I purpose to show that, however impossible it may now seem, an automaton may be contrived which will have its "own mind," and by this I mean that it will be able, independent of any operator, left entirely to itself, to perform, in response to external influences affecting its sensitive organs, a great variety of acts and operations as if it had intelligence. It will be able to follow a course laid out or to obey orders given far in advance; it will be capable of distinguishing between what it ought and what it ought not to do, and of making experiences or, otherwise stated, of recording impressions which will definitely affect its subsequent actions. In fact, I have already conceived such a plan.

Although I evolved this invention many years ago and explained it to my visitors very frequently in my laboratory demonstrations, it was not until much later, long after I had perfected it, that it became known, when, naturally enough, it gave rise to much discussion and to sensational reports. But the true significance of this new art was not grasped by the majority, nor was the great force of the underlying principle recognized. As nearly as I could judge from the numerous comments which then appeared, the results I had obtained were considered as entirely impossible. Even the few who were disposed to admit the practicability of the invention saw in it merely an automobile torpedo, which was to be used for the purpose of blowing up battle-ships, with doubtful success. The general impression was that I contemplated simply the steering of such a vessel by means of Hertzian or other rays, There are torpedoes steered electrically by wires, and there are means of communicating without wires, and the above was, of course, an obvious inference. Had I accomplished nothing more than this, I should have made a small advance indeed. But the art I have evolved does not contemplate merely the change of direction of a moving vessel; it affords a means of absolutely controlling, in every respect, all the innumerable translatory movements, as well as the operations of all the internal organs, no matter how many, of an individual automaton. Criticism to the effect that the control of the automaton could be interfered with were made by people who do not even dream of the wonderful results which can be accomplished by the use of electrical vibrations. The world moves slowly, and new truths are difficult to see. Certainly, by the use of this principle, an arm for attack as well as defense may

be provided, of a destructiveness all the greater as the principle is applicable to submarine and aerial vessels. There is virtually no restriction as to the amount of explosive it can carry, or as to the distance at which it can strike, and failure is almost impossible. But the force of this new principle does not wholly reside in its destructiveness. Its advent introduces into warfare an element which never existed before—a fighting machine without men as a means of attack and defense. The continuous development in this direction must ultimately make war a mere contest of machines without men and without loss of life—a condition which would have been impossible without this new departure, and which, in my opinion, must be reached as preliminary to permanent peace. The future will either bear out or disprove these views. My ideas on this subject have been put forth with deep conviction, but in a humble spirit.

The establishment of permanent peaceful relations between nations would most effectively reduce the force retarding the human mass, and would be the best solution of this great human problem. But will the dream of universal peace ever be realized? Let us hope that it will. When all darkness shall be dissipated by the light of science, when all nations shall be merged into one, and patriotism shall be identical with religion, when there shall be one language, one country, one end, then the dream will have become reality.

THE THIRD PROBLEM: HOW TO INCREASE THE FORCE ACCELERATING THE HUMAN MASS—THE HARNESSING OF THE SUN'S ENERGY.

Of the three possible solutions of the main problem of increasing human energy, this is by far the most important to consider, not only because of its intrinsic significance, but also because of its intimate bearing on all the many elements and conditions which determine the movement of humanity. In order to proceed systematically, it would be necessary for me to dwell on all those considerations which have guided me from the outset in my efforts to arrive at a solution, and which have led me, step by step, to the results I shall now describe. As a preliminary study of the problem an analytical investigation, such as I have made, of the chief forces which determine the onward movement, would be of advantage, particularly in conveying an idea of that hypothetical "velocity" which, as explained in the beginning, is a measure of human energy; but to deal with this specifically here, as I would desire, would lead me far beyond the scope of the present subject. Suffice it to state that the resultant of all these forces is always in the direction of reason, which, therefore, determines, at any time, the direction of human movement. This is to say that every effort which is scientifically applied, rational, useful, or practical, must be in the direction in which the mass is moving. The practical, rational man, the observer, the man of business, he who reasons, calculates, or determines in advance, carefully applies his effort so that when coming into effect it will be in

the direction of the movement, making it thus most efficient, and in this knowledge and ability lies the secret of his success. Every new fact discovered, every new experience or new element added to our knowledge and entering into the domain of reason, affects the same and, therefore, changes the direction of the movement, which, however, must always take place along the resultant of all those efforts which, at that time, we designate as reasonable, that is, self-preserving, useful, profitable, or practical. These efforts concern our daily life, our necessities and comforts, our work and business, and it is these which drive man onward.

But looking at all this busy world about us, on all this complex mass as it daily throbs and moves, what is it but an immense clock work driven by a spring? In the morning, when we rise, we cannot fail to note that all the objects about us are manufactured by machinery: the water we use is lifted by steam-power; the trains bring our breakfast from distant localities; the elevators in our dwelling and in our office building, the cars that carry us there, are all driven by power, in all our daily errands, and in our very life pursuit, we depend upon it; all the objects we see tell us of it; and when we return to our machine-made dwelling at night, lest we should forget it, all the material comforts of our home, our cheering stove and lamp, remind us how much we depend on power. And when there is an accidental stoppage of the machinery, when the city is snow-bound, or the life-sustaining movement otherwise temporarily arrested, we are affrighted to realize how impossible it would be for us to live the life we live without motive power. Motive power means work. To increase the force accelerating human movement means, therefore, to perform more work.

So we find that the three possible solutions of the great problem of increasing

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GREAT POSSIBILITIES OFFERED BY IRON FOR INCREASING HUMAN PERFORMANCE—
ENORMOUS WASTE IN IRON MANUFACTURE.

Iron is by far the most important factor in modern progress. Its contributes more than any other industrial product to the force accelerating human movement. So general is the use of this metal, and so intimately is it connected with all that concerns life, that it has become as indispensable to us as the very air we breathe. Its name is synonymous with usefulness, But, however great the influence of iron may be on the present human development, it does not add to the force urging man onward nearly as much as it might. First of all, its manufacture as now carried on is connected with an appalling waste of fuel—that is, waste of energy. Then, again, only a pan of all the iron produced is applied for useful purposes. A good part of it goes to create frictional resistances, while still another large part is the means of developing negative forces greatly retarding human movement. Thus the negative force of war is almost wholly represented in iron. It is impossible to estimate with any degree of accuracy the magnitude of this greatest of all retarding forces, but it is certainly very considerable. If the present positive impelling force due to all useful applications of iron be represented by ten, for instance, I should not think it exaggeration to estimate the negative force of war, with due consideration of all its retarding influences and results, at, say, six. On the basis of this estimate the effective impelling force of iron in the positive direction would be measured by the difference of these two numbers, which is four. But if, through the establishment of universal peace, the manufacture of war machinery should cease, and all struggle for supremacy between nations should be turned into healthful, ever active and productive commercial competition, then the positive impelling force due to iron would be measured by the sum of those two numbers, which is sixteen—that is, this force would have four times its present value. This example is, of course, merely intended to give an idea of the immense increase in the useful performance of mankind which would result from a radical reform of the iron industries supplying the implements of warfare.

A similar inestimable advantage in the saving of energy available to man would be secured by obviating the great waste of coal which is inseparably connected with the present methods of manufacturing iron. In some countries, as in Great Britain, the hurtful effects of this squandering of fuel are beginning to be felt. The price of coal is constantly rising, and the poor are made to suffer more and more. Though we are still far from the dreaded "exhaustion of the coal-fields," philanthropy commands us to invent novel methods of manufacturing iron, which will not involve such barbarous waste of this valuable material from which we derive at present most of our energy. It is our duty to coming generations to leave this store of energy intact for them, or at least not to touch it until we shall have perfected processes for burning coal more efficiently. Those who are to come after us will need fuel more

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sured by its cheapness and its unrivaled mechanical and magnetic qualities. These are such that no other product can compete with it now. But there can be no doubt that, at a time not very distant, iron, in many of its now uncontested domains, will have to pass the scepter to another: the coming age will be the age of aluminum. It is only seventy years since this wonderful metal was discovered by Wochler, and the aluminum industry, scarcely forty years old, commands already the attention of the entire world. Such rapid growth has not been recorded in the history of civilization before. Not long ago aluminum was sold at the fanciful price of thirty or forty dollars per pound; today it can be had in any desired amount for as many cents. What is more, the time is not far off when this price, too, will be considered fanciful, for great improvements are possible in the methods of its manufacture. Most of the metal is now produced in the electric furnace by a process combining fusion and electrolysis, which offers a number of advantageous features, but involves naturally a great waste of the electrical energy of the current. My estimates show that the price of aluminum could be considerably reduced by adopting in its manufacture a method similar to that proposed by me for the production of iron. A pound of aluminum requires for fusion only about seventy per cent of the heat needed for melting a pound of iron, and inasmuch as its weight is only about one third of that of the latter, a volume of aluminum four times that of iron could be obtained from a given amount of heat-energy. But a cold electrolytic process of manufacture is the ideal solution, and on this I have placed my hope.

The absolutely unavoidable consequence of the advance of the aluminum industry will be the annihilation of the copper industry. They cannot exist and prosper together, and the latter is doomed beyond any hope of recovery. Even now it is cheaper to convey an electric current through aluminum wires than through copper wires; aluminum castings cost less, and in many domestic and other uses copper has no chance of successfully competing. A further material reduction of the price of aluminum cannot but be fatal to copper. But the progress of the former will not go on unchecked, for, as it ever happens in such cases, the larger industry will absorb the smaller, one: the giant copper interests will control the pygmy aluminum interests, and the slow-pacing copper will reduce the lively gait of aluminum. This will only delay, not avoid, the impending catastrophe.

Aluminum, however, will not stop at downing copper. Before many year's have passed it will be engaged in a fierce struggle with iron, and in the latter it will find an adversary not easy to conquer. The issue of the contest will largely depend on

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spot or elsewhere, to generate electricity for industrial uses in dynamos driven by gas-engines. The commercial success of such a plant is largely dependent upon the production of gas-engines of great nominal horse-power, which, judging from the keen activity in this field, will soon be forthcoming. Instead of consuming coal directly, as usual, gas should be manufactured from it and burned to economize energy.

But all such improvements cannot be more than passing phases in the evolution toward something far more perfect, for ultimately we must succeed in obtaining electricity from coal in a more direct way, involving no great loss of its heat-energy. Whether coal can be oxidized by a cold process is still a question. Its combination with oxygen always evolves heat, and whether the energy of the combination of the carbon with another element can be turned directly into electrical energy has not yet been determined. Under certain conditions nitric acid will burn the carbon, generating an electric current, but the solution does not remain cold. Other means of oxidizing coal have been proposed, but they have offered no promise of leading to an efficient process. My own lack of success has been complete, though perhaps not quite so complete as that of some who have "perfected" the cold-coal battery. This problem is essentially one for the chemist to solve. It is not for the physicist, who determines all his results in advance, so that, when the experiment is tried, it cannot fail. Chemistry, though a positive science, does not yet admit of a solution by such positive methods as those which are available in the treatment of many physical problems. The result, if possible, will be arrived at through patient trying rather than through deduction or calculation. The time will soon come, however, when the chemist will be able to follow a course clearly mapped out beforehand, and when the process of his arriving at a desired result will be purely constructive. The cold-coal battery would give a great impetus to electrical development; it would lead very shortly to a practical flying machine, and would enormously enhance the introduction of the automobile. But these and many other problems will be better solved, and in a more scientific manner, by a light-storage battery.

ENERGY FROM THE MEDIUM— THE WINDMILL AND THE SOLAR ENGINE— MOTIVE POWER FROM TERRESTRIAL HEAT— ELECTRICITY FROM NATURAL SOURCES.

Besides fuel, there is abundant material from which we might eventually derive power. An immense amount of energy is locked up in limestone, for instance, and machines can be driven by liberating the carbonic acid through sulfuric acid or otherwise. I once constructed such an engine, and it operated satisfactorily.

But, whatever our resources of primary energy may be in the future, we must, to be rational, obtain it without consumption of any material. Long ago I came to this conclusion, and to arrive at this result only two ways, as before indicated, appeared

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rounding, and operate by heat abstracted. These statements interested me intensely. Evidently a living being could do this very thing, and since the experiences of my early life which I have related had convinced me that a living being is only an automaton, or, otherwise stated, a "self-acting engine," I came to the conclusion that it was possible to construct a machine which would do the same. As the first step toward this realization I conceived the following mechanism. Imagine a thermopile consisting of a number of bars of metal extending from the earth to the outer space beyond the atmosphere. The heat from below, conducted upward along these metal bars, would cool the earth or the sea or the air, according to the location of the lower parts of the bars, and the result, as is well known, would be an electric current circulating in these bars. The two terminals of the thermopile could now be joined through an electric motor, and, theoretically, this motor would run on and on, until the media below would be cooled down to the temperature of the outer space. This would be an inanimate engine which, to all evidence, would be cooling a portion of the medium below the temperature of the surrounding, and operating by the heat abstracted.

But was it not possible to realize a similar condition without necessarily going to a height? Conceive, for the sake of illustration, an enclosure T, as illustrated in *diagram b*, such that energy could not be transferred across it except through a channel or path O, and that, by some means or other, in this enclosure a medium were maintained which would have little energy, and that on the outer side of the same there would be the ordinary ambient medium with much energy. Under these assumptions the energy would flow through the path O, as indicated by the arrow, and might then be converted on its passage into some other form of energy. The question was, Could such a condition be attained? Could we produce artificially such a "sink" for the energy of the ambient medium to flow in? Suppose that an extremely low temperature could be maintained by some process in a given space; the surrounding medium would then be compelled to give off heat, which could be converted into mechanical or other form of energy, and utilized. By realizing such a plan, we

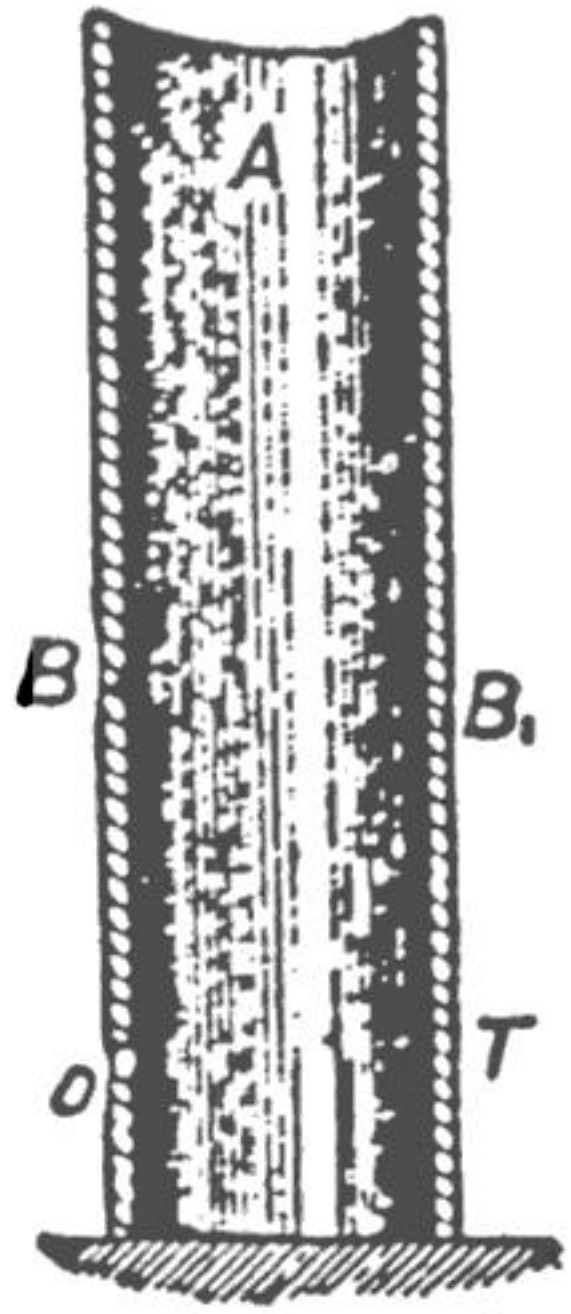

Diagram B. Obtaining energy from the ambient medium. A: Medium with little energy; B and B_1: ambient medum with much energy; O: path of energy.

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acted as an immense stimulus to contemporary electrical research, but it has likewise, in a measure, by its fascination, paralyzed the scientific mind, and thus hampered independent inquiry. Every new phenomenon which was discovered was made to fit the theory, and so very often the truth has been unconsciously distorted.

When I advanced this system of telegraphy, my mind was dominated by the idea of effecting communication to any distance through the earth or environing medium, the practical consummation of which I considered of transcendent importance, chiefly on account of the moral effect which it could not fail to produce universally. As the first effort to this end I proposed, at that time, to employ relay-stations with tuned circuits, in the hope of making thus practicable signaling over vast distances, even with apparatus of very moderate power then at my command.

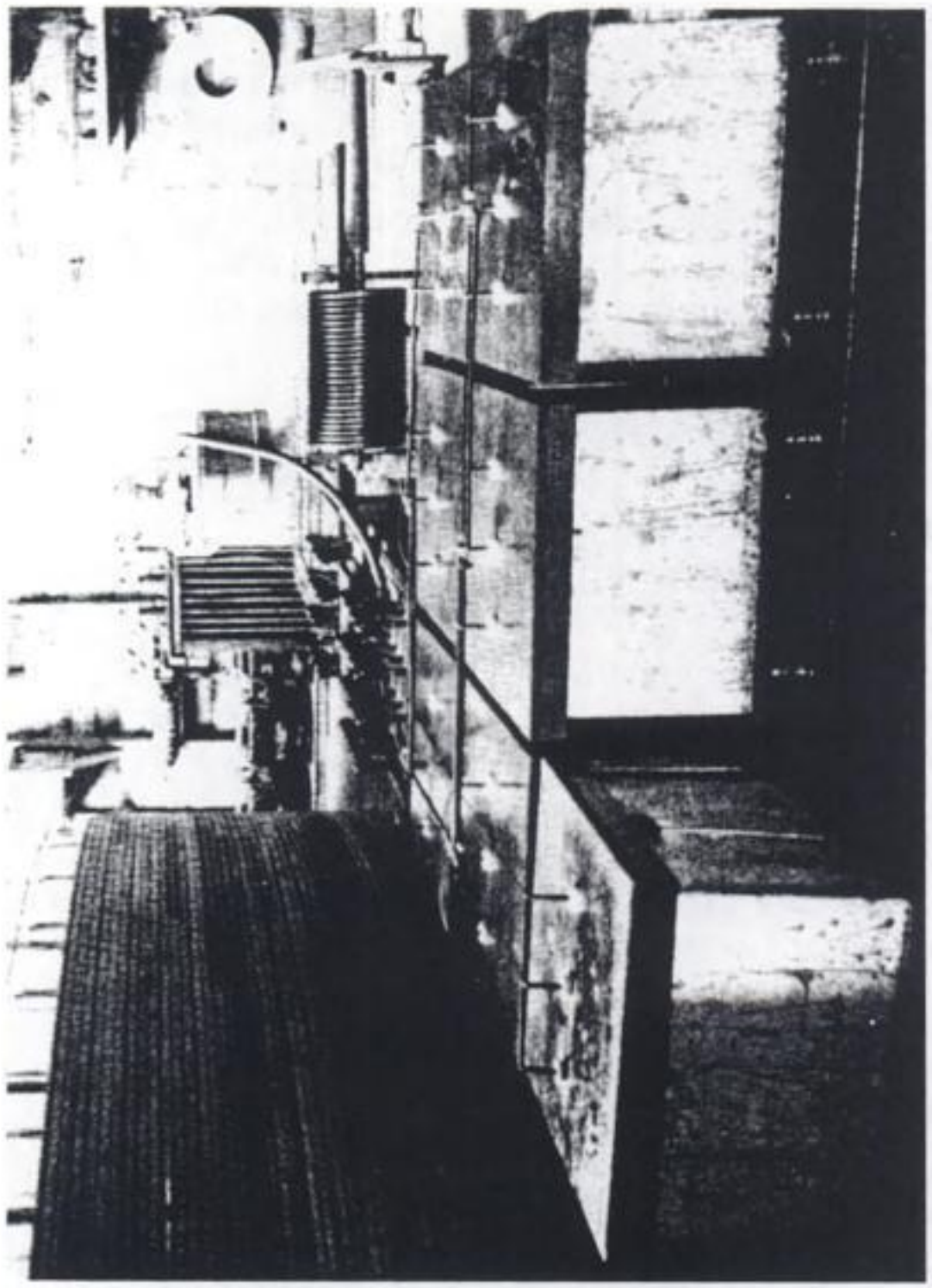

Figure 6. Photographic view of the essential parts of electrical oscillator used in the experiments described.

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Part Three
The Wireless
Transmission of Electricity

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lightning discharges in a thunderstorm which passed over his Colorado Springs laboratory and then moved more than 200 miles eastward across the plains. In his Colorado Springs Notes, Tesla noted that these stationary waves "... can be produced with an oscillator," and added in parenthesis, "This is of immense importance."6 The importance of his observations is due to the support they lend to the prime objective of the Colorado Springs laboratory. The intent of the experiments and the laboratory Tesla had constructed was to prove that wireless transmission of electrical power was possible.

Schumann Resonance is analogous to pushing a pendulum. The intent of Project Tesla is to create pulses or electrical disturbances that would travel in all directions around the Earth in the thin membrane of non- conductive air between the ground and the ionosphere. The pulses or waves would follow the surface of the Earth in all directions expanding outward to the maximum circumference of the Earth and contracting inward until meeting at a point opposite to that of the transmitter. This point is called the anti-pode. The traveling waves would be reflected back from the anti-pode to the transmitter to be reinforced and sent out again.

At the time of his measurements Tesla was experimenting with and researching methods for "...power transmission and transmission of intelligible messages to any point on the globe." Although Tesla was not able to commercially market a system to transmit power around the globe, modern scientific theory and mathematical calculations support his contention that the wireless propagation of electrical power is possible and a feasible alternative to the extensive and costly grid of electrical transmission lines used today for electrical power distribution.

The Need for a Wireless System of Energy Transmission

A great concern has been voiced in recent years over the extensive use of energy, the limited supply of resources, and the pollution of the environment from the use of present energy conversion systems. Electrical power accounts for much of the energy consumed. Much of this power is wasted during transmission from power plant generators to the consumer. The resistance of the wire used in the electrical grid distribution system causes a loss of 26-30% of the energy generated. This loss implies that our present system of electrical distribution is only 70-74% efficient.

A system of power distribution with little or no loss would conserve energy. It would reduce pollution and expenses resulting from the need to generate power to overcome and compensate for losses in the present grid system.

The proposed project would demonstrate a method of energy distribution calculated to be 90-94% efficient. An electrical distribution system, based on this method would eliminate the need for an inefficient, costly, and capital intensive grid of cables, towers, and

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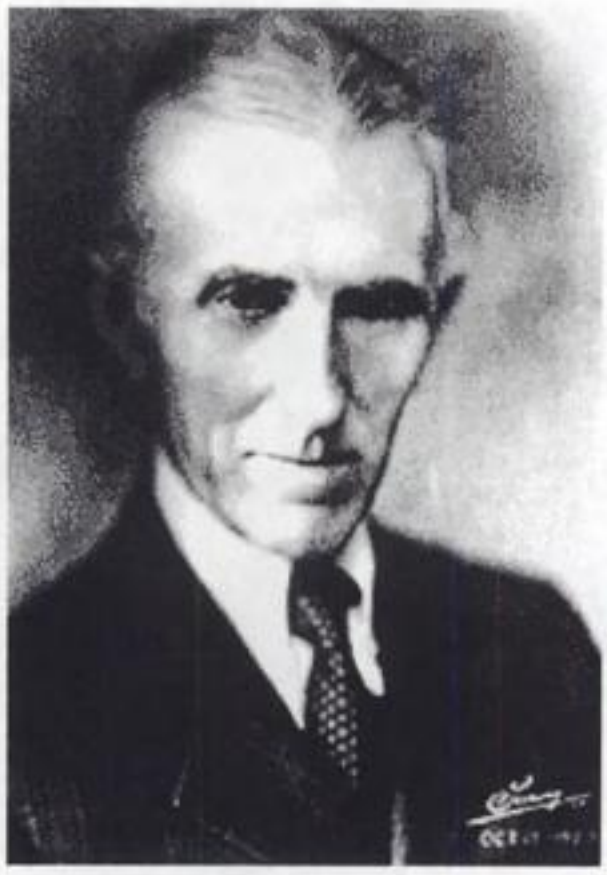
was the sole source of electricity!



While in the process of commercializing electricity, Thomas Edison hired men who knew of the new scientific gift to the world and were capable of new applications for electricity. One such man was a foreigner named Nikola Tesla. This man, although not known to many of us today, was without a doubt the greatest scientific mind that has ever lived. His accomplishments dwarfed even Thomas Edison's! Whereas Mr. Edison was a great experimenter, Mr. Tesla was a great theoretician. Nikola Tesla became frustrated and very much annoyed at the procedures Edison followed.

Tesla would rather calculate the possibility of something working (i.e. mathematical investigation) than the hit and miss technique of constant experimentation. So in the heat of an argument, he quit one day and stormed out of Edison's laboratory in West Orange, New Jersey.

Working on his own, Tesla conceived and built the first working alternating current generator. He, and he alone, is responsible for all of the advantages we enjoy today because of A.C. electric power.

Angered by Edison, Tesla sold his new patents to George Westinghouse for 15 million dollars in the very early 1900's. Tesla became totally independent and proceeded to carry on his investigative research in his laboratory on 5th Avenue in New York City.

George Westinghouse began to market this new system of electric generators and was in competition with Edison. Westinghouse prevailed because of the greater superiority of the A.C. generators over the less efficient D.C. power supplies of Thomas Edison. Today, A.C. power is the only source of electricity the world uses. And, please remember, Nikola Tesla is the man who developed it.

Now specifically dealing with automobiles in the infant days of their development, electric propulsion was considered and used. An electric powered automobile possessed many advantages that the noisy, cantankerous, smoke-belching gasoline cars could not offer.

First and foremost is the absolute silence one experiences when riding in an electrically powered vehicle. There is not even a hint of noise. One simply turns a key and steps on the accelerator—the vehicle moves instantly! No cranking from the start, no crank to turn (this was before electric starters), no pumping of the accelerator, no spark control to advance and no throttle linkage to pre-set before starting. One simply turned the ignition switch to on!

Second, is a sense of power. If one wants to increase speed, you simply depress the accelerator further—there is never any hesitation. Releasing the accelerator causes the vehicle to slow down immediately—you are always in complete control. It is not difficult to understand why these vehicles were so very popular around the turn of the century and until 1912 or so.

The big disadvantage to these cars was their range and need for re-charging every single night. All of these electric vehicles used a series of batteries and a D.C. motor to move itself about. The batteries require recharging every night and the range of travel was restricted to about 100 miles. Understand that this restriction was not a serious one in the early part of this century. Doctors began making house calls with electric cars (do you remember doctors making house calls?) because he no longer needed to tend to the horse at night time—

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The Tesla Howitzer

(anonymous, from the Internet)

Before the turn of the century, Nikola Tesla had discovered and was utilizing a new type of electric wave. Tesla repeatedly stated his waves were non-Hertzian, and his wireless transmissions did not fall off as the square of the distance.

His discovery was apparently so fundamental (and his intent to provide free energy to all humankind was so clear) that it was responsible for the withdrawal of his financial backing, his deliberate isolation, and the gradual removal of his name from the history books.

By 1914 or so, Tesla had been successfully isolated and was already nearly a "nonperson." Thereafter Tesla lived in nearly total seclusion, occasionally surfacing (at his annual birthday party for members of the press) to announce the discovery of an enormous new source of free energy, the perfection of wireless transmission of energy without losses, fireball weapons to destroy whole armies and thousands of airplanes at hundreds of miles distance, and a weapon (the "Tesla Shield," I've dubbed it) that could provide an impenetrable defense and thus render war obsolete.

In my pursuit of Tesla's secret, it gradually became apparent to me that present orthodox electromagnetic theory is seriously flawed in some fundamental respects. One of these is in the definition and use of THETA, the scalar electrostatic potential. It is this error which has hidden the long-sought Unified Field Theory from the theorists.

In the theory of the scalar electrostatic potential (SEP), the idea is introduced of work accomplished on a charge brought in from a distance against the scalar field.

The SEP is not a vector field, but is a scalar field. Indeed, scalar potential cannot of itself perform work on a charged mass due to the extremely high SEP of the vacuum itself.

Only a differential of SEP between two spatial points can produce force or accomplish work. (Rigorously, a differential of scalar potential between two spatial points constitutes a vector. Only a vector can produce force and do work.)

Also, work can only be done on a mass. Further, it takes TIME to move an electron or other charged mass between two spatial points, and so the work performed by a spatial differential of the THETA-FIELD requires TIME. Rigorously, the delta SEP is voltage, not SEP per se, and is directly related to the voltage or "E" field.

The entire voltage concept depends on the work performed in moving a mass, after that mass has moved. The idea of "voltage" always implies the existence of a steady differential of THETA between two spatial points for a finite length of time, and it also involves the assumption of a flow of actual mass having occurred.

SEP, on the one hand, is always a single-point function; on the other hand, difference in potential (i.e., V) is always a two point function, as is any vector.

Yet many graduate level physics and electromagnetics papers and texts erroneously confuse THETA and V in the static case! Such an interpretation is of course quite incorrect.

Another common assumption in present EM theory—that the electrostatic potential (0,O) of the normal vacuum is zero—has no legitimate basis.

In fact, we know (0,O) is nonzero because the vacuum is filled with enormous amounts of fluctuating virtual state activity, including incredible charge fluctuations. And by virtue of its point definition, (0,O) must be the "instantaneous stress" on spacetime itself, and a measure of the intensity of the virtual state flux though a 4-dimensional spacetime point.

Potential theory was largely developed in the 1800's before the theory of relativity. Time flowrate was then regarded as immutable.

Accordingly, electrostatic "intensity" was chosen as "spatial intensity," with the conno-

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The Tesla lectures which were given in America, England, France and Germany, were motivated to a great extent by the wish to counteract Tom Edison's attack on Tesla's invention of the alternating current polyphase system recently purchased by the Westinghouse Corporation of Pittsburgh. At the same time, Tesla displayed lights without filaments (i.e., fluorescent and neon lights), the principles to wireless communication, the means by which to create tuned circuits (patents no. 462,418 filed 2/4/1891), and the idea behind the radio tube. Where Edison had electrocuted dogs and cows with the Tesla AC currents in a negative propaganda campaign to demonstrate the viability of using the current in the electric chair, Tesla conceived of a way to send electricity through his own body to show that AC, when utilized correctly, was perfectly safe, and further, that electricity could even promote healing. This last invention quickly influenced the French medical doctor D'Arsonval, the father of electrotherapy [30, p. 286].

Referring to the Tesla lectures, Harpers Weekly, concluded, "*At one bound [Tesla] placed himself abreast ... such men as Edison, Brush, Elihu Thomson and Alexander Graham Bell*" [54, p. 524]. After describing the work of his predecessors and colleagues in the field of luminescence of vacuum tubes and Leyden jars by electromagnetic induction (i.e. William Crookes, Oliver Lodge, JJ Thomson, Elihu Thomson), Tesla proceeded to explain the real reason why commercial light bulbs gave off light. In essence, he stated that the air or lack of air had more to do with the phenomena than the filament. In a veiled attack against Edison's invention of the light bulb, Tesla showed that the action of the air was more important than the seemingly essential filament.

> *Two incandescent lamps exactly alike, one exhausted, the other not... were attached... [to] a current vibrating about one million times a second.... [These] passed through the filament.... The lamp which was exhausted glowed brightly, whereas the other one in which the filament was surrounded by air, at ordinary pressure, did not glow. This showed the great importance of the rarefied gas in the heating of a conductor, and it was pointed out that in incandescent lighting a high resistance filament [Edison's invention] does not at all constitute the really essential element of illumination.* [43, p. 249]

Tesla showed that the filament was superfluous for electric lights and thus he out 'Edisoned' Edison. However, the world (and also the lighting industry) would forget this fairly quickly while resurrecting time and again the "Edison sending men to the Amazon to look for the best filament" story.

In response, Edison said

> *[Tesla] has made no new discovery, but has shown considerable ingenuity in increasing vibrations. He gets his results from the induction coil and the Geissler tube. One great trouble is in the quality of the light if it is produced by that means. It is of a ghastly color... You cannot get a pleasant mellow light.* [12]

This last comment is as true today as then in terms of the inferiority of the quality of fluorescent lighting as compared to incandescent lamps. However, Tesla appears to have invented additional techniques to offset this common complaint, his laboratory having been described as "*flow[ing] with warmth of color.... Dazzling, pulsating clots of purple-violet light... sent out wave after wave of a strange, unearthly rich... hue that is not listed in the spectrum*" [20].

As a finale to the Tesla lectures, and as the coup de grace to Edison and the electric chair enthusiasts, Tesla sent hundreds of thousands of volts through his body to light various colored lamps, melt metal strips, and explode small globes. He also issued Svengali-like streams of lighting from his fingertips! Describing the experience, of subjecting his body to "the rapidly alternating pressure of an electrical oscillator of two and one half million volts," Tesla wrote:

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discharged. Developed from single terminal light bulbs, by 1897, Tesla was remotely discharging isolated capacitors at considerable distances and directing them to targets [9].

In articles beginning twenty years later in the New York Times and continuing for a period which spanned both world wars [30, 46, 47, 48], Tesla referred to various kinds of gross electrical manifestations which could be used in a variety of ways to protect a city or country from incoming invasions. His weaponry included defensive radar-like protective grids of light as well as offensive laser-like artillery.

TESLA'S NEW DEVICE LIKE BOLTS OF THOR
He Seeks to Patent Wireless Engine
For Destroying Navies by Pulling a Lever
-- To Shatter Armies Also --

"Impractical," he says of Westerner's plan to circle country with electrical fire
....

Nikola Tesla, the inventor, winner of the 1915 Nobel Prize, has filed patent applications on the essential parts of a machine the possibilities of which test a layman's imagination and promise a parallel of Thor's shooting thunderbolts from the sky to punish those who have angered the gods. Dr. Tesla insists there is nothing sensational about it but the fruition of many years of work and study.

Suffice it to say that the destructive invention will go through space with a speed of 300 miles/second, a manless airship without propelling engines or wings, sent by electricity to any desired point of the globe on its errand of destruction, if destruction its manipulator wishes to effect. Ten miles or a thousand miles, it will be all the same to the machine, the inventor says....

"It is perfectly practical to transmit electrical energy without wires and produce destructive effects at a distance... with precision." A man in a tower on Long Island could shield New York against ships or army by working a lever, if the inventor's anticipations become realized. [44]

At this same time, during World War I, while Tesla's partner John Hays Hammond Jr. was displaying remote controlled torpedo inventions to the U.S. Navy, at his coastal laboratory in Gloucester, Massachusetts, [18], in Great Britain, another Teslarian, Harry Grindell-Mathews [16], was provided with £25,000 by the British government for the creation of a search-light like beam which he said could control air craft. Grindell-Mathews, who had been wounded in the South African Wars while serving for the British Army a number of years earlier, eventually refined this invention and changed it into a "diabolical ray" which he said could destroy not only Zeppelins and aeroplanes, but immobilize marching armies and nautical fleets. Although he would not divulge the specifics of his creation, he made no secret of his admiration for Tesla, whose technologies had "inspired" the groundwork for this weapon. In July of 1924 he travelled to America to see an eye specialist. He probably met with electronics and science fiction publisher Hugo Gernsback [15] at this time, and thus may have also visited Tesla [17]. Staying at the Hotel Vanderbilt in New York, the British inventor was interviewed by a number of the local dailies:

Let me recall to you the air attacks on London during the [world] war. Searchlights picked up the German raiders and illuminated them while guns fired, hitting some but more often missing them. But suppose instead of a searchlight you direct my ray? So soon as it touches the plane this bursts into flame and crashes to the earth. [16]

Grindell-Mathews was also convinced that the Germans had such a ray. They were using a high frequency current of 200 kilowatts which as of yet they were "unable to control."

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University, and wife murderer, walked into Jack Morgan's Long Island home toting a six gun in each hand. He wanted Morgan to stop the flow of arms to Europe. With his wife and daughter leaping at the assailant, Morgan charged forward. Shot twice in the groin, Morgan and his wife were able to wrestle the guns from the man, and get him arrested. Tesla sent the overnight hero a get well letter,[29] as Holt committed suicide in a Long Island jail cell.

The Fifth Column had emerged. German spies were everywhere. Reports started filtering in that the Germans were creating a secret submarine base around islands off the coast of Maine. It was also alleged that the broadcasting station out at Sayville was not merely sending neutral dispatches to Berlin, but rather coded messages to battleships and submarines. The front pages of the papers were saturated with alarming headlines:

20 OR MORE AMERICANS LOST WHEN GERMANS SINK [PEACEFUL FREIGHTER]

NAVY MAY SEIZE SAYVILLE WIRELESS

Plant Under Suspicion Officers Think German Station May Send Messages to Submarines

Evidence Before Congress

Wilson Hears of New Disaster

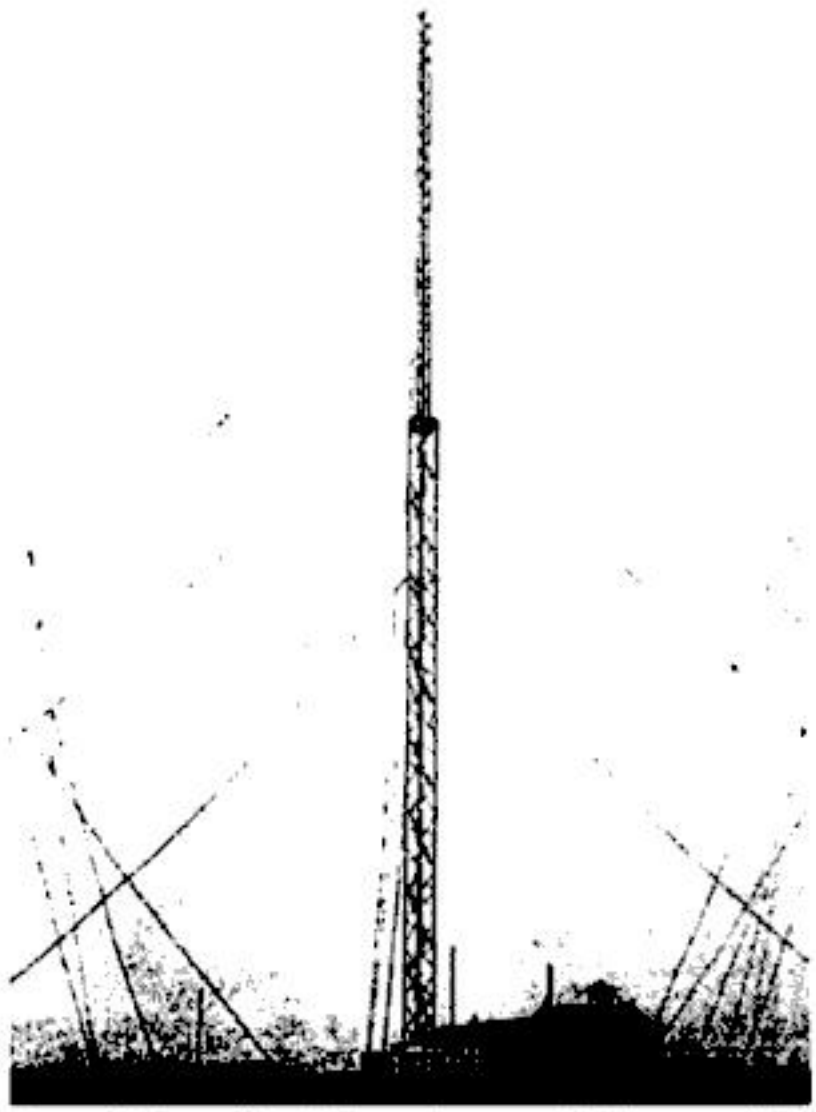
New Submarine Attack, However a Surprise in View of Hope from Berlin

Base for German Submarines Here?

Von Tirpitz Said to be Launching a New Campaign to Sink Munitions Ships

With Tesla, just a few months earlier, boasting to Morgan that he was working for the Germans, and "Grand Admiral von Tirpitz contemplat[ing] a more vigorous campaign against freight ships... [and planning] a secret base on this side of the Atlantic"[30] it is quite possible that the inventor's name became tainted in some inner circles.

A week later, on Tesla's 59th birthday, the **TIMES** reported that not only were the Germans dropping bombs over London from Zeppelins, they were also "controlling air torpedoes" by means of radio dynamics. Fired from Zeppelins, the supposed "German aerial torpedo[es] can theoretically remain in the air three hours, and can be controlled from a distance of two miles.... Undoubtedly, this is the



One of Marconi's wireless towers which resembled **Telefunken's towers at** Tuckertown, NJ **and Sayville, NY.**
Credit: MetaScience Foundation

secret invention of which we have heard so many whispers that the Germans have held in reserve for the British fleet."[31] Although it seemed as if Tesla's telautomatic nightmare prognostication of 1898 had come to be, Tesla himself announced to the press that "the news of these... magic bombs... cannot be accepted as true, [though] they reveal just so many startling possibilities."

"Aghast at the pernicious existing regime of the Germans," Tesla accused Germany of being an "unfeeling automaton, a diabolic contrivance for scientific, pitiless, wholesale destruction the like of which was not dreamed of before." No doubt, Tesla stopped doing business with von Tirpitz, although he probably continued his relationship with Professor Slaby, who may have been morally opposed to the war.

Tesla's solution to war was twofold: (1) a better defense, through an electronic star-wars type shield he was working on, and (2) "the eradication from our hearts of nationalism." If blind patriotism could

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mine such things as the proper timing of the spark gap opening and closing. Proper operation would indicate a strong fundamental component and a barely detectable second harmonic. A double humped waveform indicates a strong second harmonic and improper operation. This can happen easily when using both a secondary and an extra coil. Both the secondary and the extra coil are tuned to their quarter wave resonant frequencies. When connected together, we have two quarter wave sections in series, and presumably a large voltage increase in each section. However, unless very careful attention is paid to relative coil sizes and impedances, what we actually have is a half wave structure at the driving frequency and therefore a quarter wave structure at half the driving frequency. There is much greater voltage increase in a quarter wave system, so relatively small subharmonics in the driving voltage will appear as a large voltage at the top. The waveform will be double humped. There are many such subtle problems in Tesla coils, and one is strictly groping in the dark without knowing the waveform at the top.

The relative magnitude is important in tuning the coil. We can change the primary inductance or capacitance, the height, size, and shape of the top loading element (toroid or sphere), the quality of the grounding system, and other parameters in order to get the highest possible voltage out of the coil. This can be done at tuning voltages rather than full operating voltages, and is more accurate than trying to estimate spark lengths.

The fiber optic system to be described does not measure the absolute voltage directly. A separate measurement must be made to determine the calibration factor. This is not easy to do, and hopefully will be the subject of another paper. Of course, knowing that a particular coil operates at 1.4 MV rather than 1.2 MV, for example, has its major application in boosting our egos, rather like bragging about the speed and memory size of our computer. There has not been any method of measuring this voltage in the past, so we have extrapolated from data collected at lower voltages. If voltage breakdown occurs at 30 kV between two clean brass spheres one cm apart in dry air, then the assumption is that a spark of 1 m length must correspond to a voltage of 3 MV. This figure has always been recognized as too high for Tesla coil sparks, but a value of 1 MV per meter has been used in the past. The range of possible values is illustrated in the following exchange in the **TCBA News**.[5]

> ***Question.*** *Harry [Goldman], it seems that most of the Tesla coil builders are confused by the voltage-versus-spark dilemma. Thanks to some previous comments, we no longer have a standard to go by. I have spent time-and-effort researching this subject and have been in contact with so-called experts. None were able to give me a pat answer. It seems that there are just too many variables. My vote would be for a 25 kilovolt-per-inch [1 MV/m] value as a good average.*
>
> ***Answer.*** *[by Harry Goldman]. I know from what direction you are coming. I can recall giving lectures using the 'million-volts-per-meter' statistic. That sure impressed my audiences. Now, we have been deflated. The new standard for high voltages at high frequencies is somewhere between 5,000 and 10,000 volts per inch [200 to 400 kV/m].*

We see that extrapolations by knowledgeable people can differ by a factor of five (200 kV/m to 1 MV/m). It is therefore probably more meaningful to compare Tesla coils by other parameters that can be readily measured, such as coil diameter and height, input power, and spark length.

Any voltmeter attached to the top of a Tesla coil, even for observing waveform and relative amplitude, must have several characteristics. These include a high input impedance, a minimal effect on coil operation, and an upper operating frequency several times the fundamental frequency of the Tesla coil secondary. We are all familiar with oscilloscope probes, and it is tempting to use one to measure the top voltage. To see why it is not appropriate, consider the case of a probe with 10 MΩ resistance paralleled by a 20 pF capacitor, and connected to the top of a Tesla coil operating at 100 kV and 200 kHz. The power dissipated in the resistor is

$$P = \frac{V^2}{R} = \frac{(10^5)^2}{10^7} = 10^3 \text{ W}$$

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depicted three circuits for medical use. The one on the left is to be used to sterilize wounds, the center circuit is that of an electrosurgical knife, and the device on the right is used to produce whole body heating by induction.

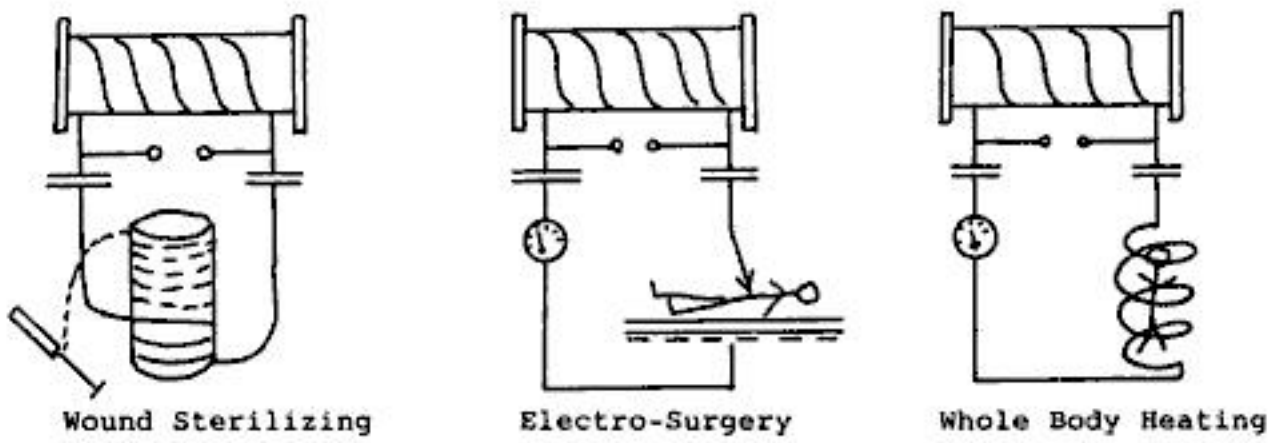

Figure 1. Electrotherapy devices

In early 1892, Tesla traveled to England and France to deliver lectures on his recent research. While in France he met d'Arsonval and they became good friends. Tesla was pleasantly surprised to find that d'Arsonval used his oscillators to investigate the physiological effects of high frequency currents.

Tesla's interest in the therapeutic uses of high frequency currents continued for a number of years and in 1898 he read a paper before The American Electro-Therapeutic Association reviewing various oscillator designs. [15] Several modes of application of the electromagnetic energy such as capacitive coupling, direct contact electrodes, and inductive coupling to the patient were described. All of theses techniques are used today for cancer therapy and diathermy. In Figure 2 is shown a simplified schematic of one of the devices Tesla suggested for patient treatment by use of contact electrodes.

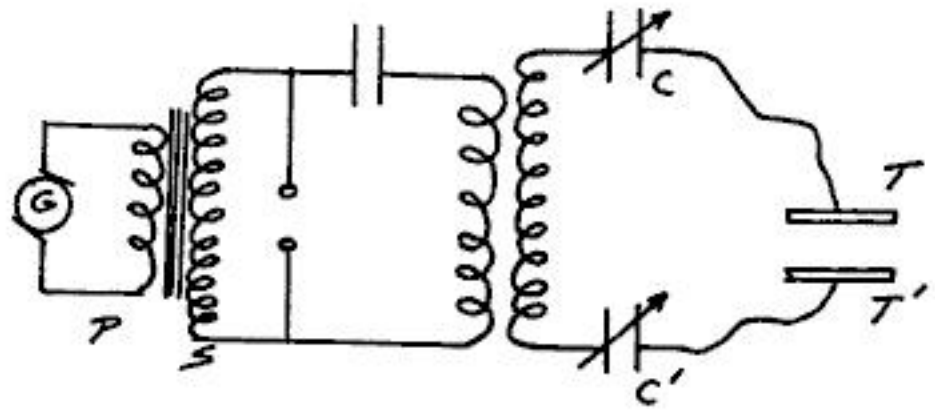

Figure 2. RF Heating with contact plates.

Radio frequency currents are produced by a Tesla coil; adjustable condensers C and C' are used to match the impedance of the power supply to that presented by the patient. Metal contact electrodes T and T' are placed on the patient and relatively large currents can be passed through the patient without discomfort providing the frequency is of the order of 10kHZ or greater. The tissue between the electrodes is elevated in temperature as a result of the joules heating produced by the current. The major components of some modern hyperthermia units perform similar functions (rf power supply, impedance matching network, and coupling electrodes).

An interesting device described by Tesla in his lecture is shown in Figure 3.

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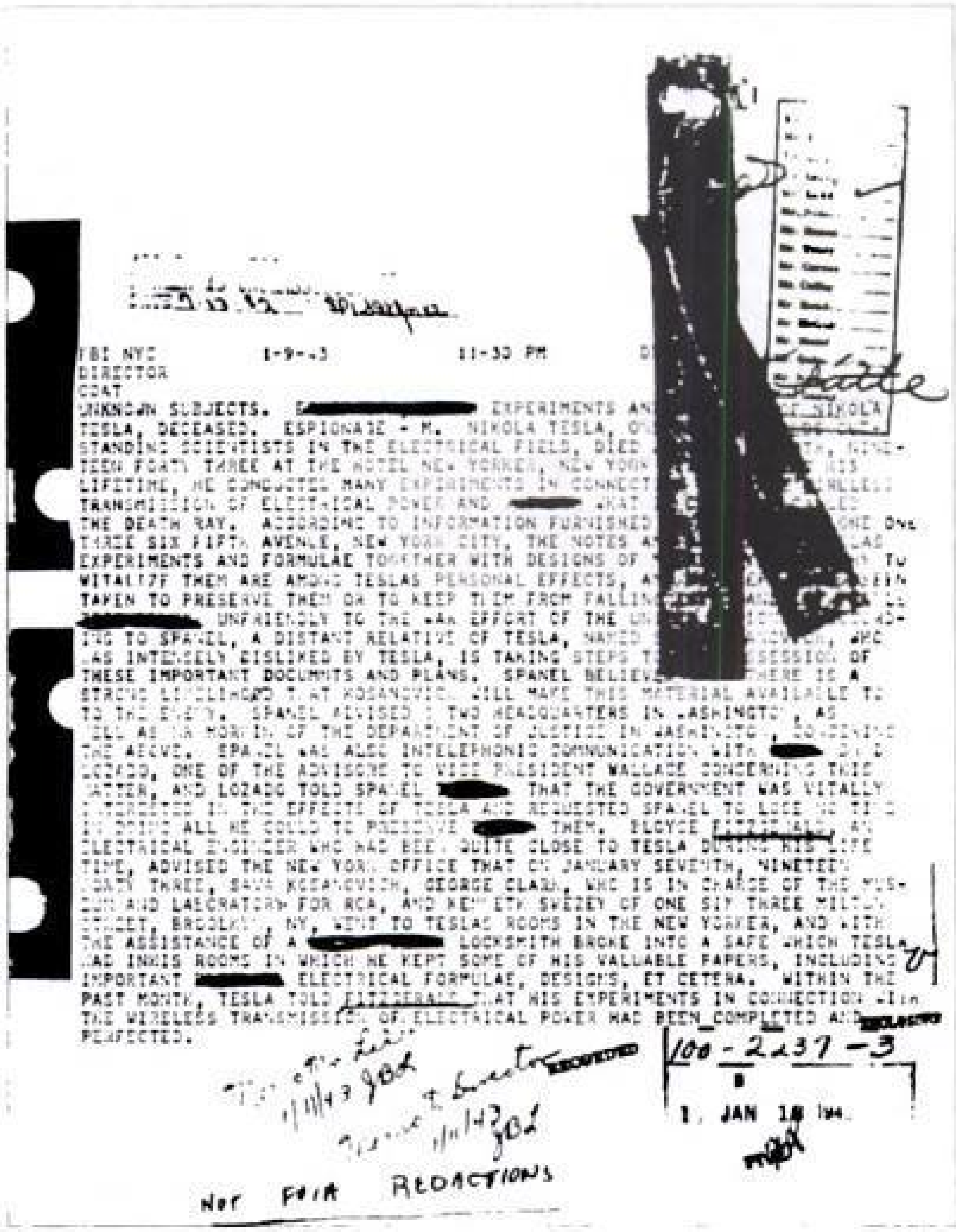

FBI NYC 1-9-43 11-30 PM [redacted]
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UNKNOWN SUBJECTS. [redacted] EXPERIMENTS AN[redacted] NIKOLA
TESLA, DECEASED. ESPIONAGE - M. NIKOLA TESLA, O[redacted]
STANDING SCIENTISTS IN THE ELECTRICAL FIELD, DIED [redacted] NINE-
TEEN FORTY THREE AT THE HOTEL NEW YORKER, NEW YORK [redacted] HIS
LIFETIME, HE CONDUCTED MANY EXPERIMENTS IN CONNECT[redacted]
TRANSMISSION OF ELECTRICAL POWER AND [redacted] WHAT [redacted]
THE DEATH RAY. ACCORDING TO INFORMATION FURNISHED [redacted] ONE
THREE SIX FIFTH AVENUE, NEW YORK CITY, THE NOTES A[redacted]
EXPERIMENTS AND FORMULAE TOGETHER WITH DESIGNS OF [redacted] TO
VITALIZE THEM ARE AMONG TESLAS PERSONAL EFFECTS, A[redacted]
TAKEN TO PRESERVE THEM OR TO KEEP THEM FROM FALLIN[redacted]
[redacted] UNFRIENDLY TO THE WAR EFFORT OF THE UN[redacted]
ING TO SPANEL, A DISTANT RELATIVE OF TESLA, NAMED [redacted] WHO
WAS INTENSELY DISLIKED BY TESLA, IS TAKING STEPS T[redacted]SESSION OF
THESE IMPORTANT DOCUMENTS AND PLANS. SPANEL BELIEVE[redacted] THERE IS A
STRONG LIKELIHOOD THAT KOSANOVICH WILL MAKE THIS MATERIAL AVAILABLE TO
TO THE ENEMY. SPANEL ADVISED [illegible] TWO HEADQUARTERS IN WASHINGTON, AS
WELL AS [illegible] OF THE DEPARTMENT OF JUSTICE IN WASHINGTON, [illegible]
THE ABOVE. SPANEL WAS ALSO INTELEPHONIC COMMUNICATION WITH [redacted] [illegible]
LOZADO, ONE OF THE ADVISORS TO VICE PRESIDENT WALLACE CONCERNING THIS
MATTER, AND LOZADO TOLD SPANEL [redacted] THAT THE GOVERNMENT WAS VITALLY
INTERESTED IN THE EFFECTS OF TESLA AND REQUESTED SPANEL TO LOSE NO TIME
IN DOING ALL HE COULD TO PRESERVE [redacted] THEM. BLOYCE FITZGERALD, AN
ELECTRICAL ENGINEER WHO HAD BEEN QUITE CLOSE TO TESLA DURING HIS LIFE
TIME, ADVISED THE NEW YORK OFFICE THAT ON JANUARY SEVENTH, NINETEEN
FORTY THREE, SAVA KOSANOVICH, GEORGE CLARK, WHO IS IN CHARGE OF THE MUS-
EUM AND LABORATORY FOR RCA, AND KENNETH SWEZEY OF ONE SIX THREE MILTON
STREET, BROOKLYN, NY, WENT TO TESLAS ROOMS IN THE NEW YORKER, AND WITH
THE ASSISTANCE OF A [redacted] LOCKSMITH BROKE INTO A SAFE WHICH TESLA
HAD INHIS ROOMS IN WHICH HE KEPT SOME OF HIS VALUABLE PAPERS, INCLUDING
IMPORTANT [redacted] ELECTRICAL FORMULAE, DESIGNS, ET CETERA. WITHIN THE
PAST MONTH, TESLA TOLD FITZGERALD THAT HIS EXPERIMENTS IN CONNECTION WITH
THE WIRELESS TRANSMISSION OF ELECTRICAL POWER HAD BEEN COMPLETED AND
PERFECTED.

100-2237-3

1 JAN 18 1943

NOT FOIA REDACTIONS

An FBI memorandum from agent P.E. Foxworth dated January 9. 1943 concerning Tesla's death. This is a typical page from Tesla's FBI file, with much of the text redacted (blacked-out).

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SPECIFICATIONS FURTHER STATE THAT "THE RESULTS WERE PARTICULARLY SATISFACTORY WHEN THE PRIMARY COIL OR SYSTEM A' WITH ITS SECONDARY C' (OF THE RECEIVER) WAS CAREFULLY ADJUSTED, SO AS TO VIBRATE IN SYNCHRONISM WITH THE TRANSMITTING COIL OR SYSTEM AC." TESLA THUS ANTICIPATED THE FOLLOWING FEATURES OF THE MARCONI PATENT: A CHARGING CIRCUIT IN THE TRANSMITTER FOR CAUSING OSCILLATIONS OF THE DESIRED FREQUENCY, COUPLED, THROUGH A TRANSFORMER, WITH THE OPEN ANTENNA CIRCUIT, AND THE SYNCHRONIZATION OF THE TWO CIRCUITS BY THE PROPER DISPOSITION OF THE INDUCTANCE IN EITHER THE CLOSED OR THE ANTENNA CIRCUIT OR BOTH. BY THIS AND THE ADDED DISCLOSURE OF THE TWO CIRCUIT ARRANGEMENT IN THE RECEIVER WITH SIMILAR ADJUSTMENT, HE ANTICIPATED THE FOUR-CIRCUIT TUNED COMBINATION OF MARCONI. A FEATURE OF THE MARCONI COMBINATION NOT SHOWN BY TESLA WAS THE USE OF A VARIABLE INDUCTANCE AS A MEANS OF ADJUSTING THE TUNING OF THE ANTENNA CIRCUIT OF TRANSMITTER AND RECEIVER. THIS WAS DEVELOPED BY LODGE AFTER TESLA'S PATENT BUT BEFORE THE MARCONI PATENT IN SUIT.

IN PATENT NO. 609,154, APPLIED FOR FEBRUARY 1, 1898 AND ALLOWED AUGUST 16, 1898, BEFORE MARCONI'S APPLICATION, LODGE DISCLOSED AN ADJUSTABLE INDUCTION COIL IN THE OPEN OR ANTENNA CIRCUIT IN A WIRELESS TRANSMITTER OR RECEIVER OR BOTH TO ENABLE TRANSMITTER AND RECEIVER TO BE TUNED TOGETHER. HIS PATENT PROVIDED FOR THE USE, IN THE OPEN CIRCUITS OF A TRANSMITTER AND A RECEIVER OF HERTZIAN WAVES, OF A SELF INDUCTION COIL BETWEEN A PAIR OF CAPACITY AREAS WHICH HE STATED MIGHT BE ANTENNA AND EARTH. HIS SPECIFICATIONS STATE THAT A COIL LOCATED AS DESCRIBED COULD BE MADE ADJUSTABLE AT WILL SO AS TO VARY THE VALUE OF ITS SELF-INDUCTANCE; THAT THE ADJUSTMENT, TO SECURE THE "DESIRED FREQUENCY OF VIBRATION OR SYNTONY WITH A PARTICULAR DISTANT STATION," MAY BE ATTAINED EITHER "BY REPLACING ONE COIL BY ANOTHER" OR BY THE USE OF A COIL CONSTRUCTED WITH A MOVABLE SWITCH SO RELATED TO THE COIL AS TO SHORT CIRCUIT, WHEN CLOSED, ANY DESIRED NUMBER OF TURNS OF THE WIRE, "SO THAT THE WHOLE OR ANY SMALLER PORTION OF THE INDUCTANCE AVAILABLE MAY BE USED IN ACCORDANCE WITH THE CORRESPONDINGLY-ATTUNED RECEIVER AT THE PARTICULAR STATION TO WHICH IT IS DESIRED TO SIGNAL." THUS LODGE ADJUSTED HIS TUNING BY VARYING THE SELF-INDUCTANCE OF THE ANTENNA CIRCUITS, FOR, AS HE EXPLAINED, THE ADJUSTMENT OF WAVE LENGTHS, AND HENCE OF FREQUENCY IN THE CIRCUITS, COULD BE MADE BY VARYING EITHER OR BOTH THE INDUCTANCE AND CAPACITY, WHICH ARE THE FACTORS CONTROLLING WAVE LENGTH AND HENCE FREQUENCY IN THE ANTENNA CIRCUITS.

LODGE THUS BROADLY CLAIMED THE TUNING, BY MEANS OF A VARIABLE INDUCTANCE, OF THE ANTENNA CIRCUITS IN A SYSTEM OF RADIO COMMUNICATION. HIS SPECIFICATIONS DISCLOSE WHAT IS SUBSTANTIALLY A TWO CIRCUIT SYSTEM, WITH ONE HIGH FREQUENCY CIRCUIT AT THE TRANSMITTER AND ONE AT THE RECEIVER. HE ALSO SHOWED A TWO-CIRCUIT RECEIVER WITH A TUNED ANTENNA CIRCUIT, HIS DETECTOR CIRCUIT AT THE RECEIVER BEING CONNECTED WITH THE TERMINALS OF A SECONDARY COIL WOUND AROUND THE VARIABLE INDUCTANCE COIL IN THE ANTENNA CIRCUIT AND THUS INDUCTIVELY COUPLED THROUGH A TRANSFORMER WITH THE ANTENNA CIRCUIT. FN12 LODGE THUS SUPPLIED THE MEANS OF VARYING INDUCTANCE AND HENCE TUNING WHICH WAS LACKING IN THE TESLA PATENT. HE ALSO SHOWED A RECEIVER WHICH COMPLETELY ANTICIPATED THOSE OF THE MARCONI RECEIVER CLAIMS WHICH PRESCRIBE ADJUSTABLE MEANS OF TUNING ONLY IN THE ANTENNA CIRCUIT (CLAIMS 2, 13 AND 18) AND PARTIALLY ANTICIPATED THE OTHER RECEIVER CLAIMS.

THE STONE PATENT NO. 714,756, APPLIED FOR FEBRUARY 8, 1900, NINE MONTHS BEFORE MARCONI'S APPLICATION, AND ALLOWED DECEMBER 2, 1902, A YEAR AND A HALF BEFORE THE GRANT OF MARCONI'S PATENT, SHOWED A FOUR CIRCUIT WIRELESS TELEGRAPH APPARATUS SUBSTANTIALLY LIKE THAT LATER SPECIFIED AND PATENTED BY MARCONI. IT DESCRIBED ADJUSTABLE TUNING, BY MEANS OF A VARIABLE INDUCTANCE, OF THE CLOSED CIRCUITS OF

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DEC. 24, 1912. NONE OF THESE COURTS CONSIDERED THE STONE PATENT OR HIS LETTERS. ALL REST THEIR FINDINGS OF INVENTION ON MARCONI'S DISCLOSURE OF A FOUR-CIRCUIT SYSTEM AND ON HIS TUNING OF THE FOUR CIRCUITS, IN THE SENSE OF RENDERING THEM RESONANT TO THE SAME FREQUENCY, IN BOTH OF WHICH RESPECTS STONE ANTICIPATED MARCONI, AS WE HAVE SEEN. NONE OF THESE OPINIONS SUGGESTS THAT IF THE COURTS HAD KNOWN OF STONE'S ANTICIPATION, THEY WOULD HAVE HELD THAT MARCONI SHOWED INVENTION OVER STONE BY MAKING THE TUNING OF HIS ANTENNA CIRCUIT ADJUSTABLE, OR BY USING LODGE'S VARIABLE INDUCTANCE FOR THAT PURPOSE. IN MARCONI WIRELESS TELEGRAPH CO. V. KILBOURNE & CLARK MFG. CO., 239 F. 328, AFFIRMED 265 F. 644, THE DISTRICT COURT HELD THAT THE ACCUSED DEVICE DID NOT INFRINGE. WHILE IT ENTERED FORMAL FINDINGS OF VALIDITY WHICH THE CIRCUIT COURT OF APPEALS APPROVED, NEITHER COURT'S OPINION DISCUSSED THE QUESTION OF VALIDITY AND THAT QUESTION WAS NOT ARGUED IN THE CIRCUIT COURT OF APPEALS. FN21 MARCONI'S REPUTATION AS THE MAN WHO FIRST ACHIEVED SUCCESSFUL RADIO TRANSMISSION RESTS ON HIS ORIGINAL PATENT, WHICH BECAME REISSUE NO. 11,913, AND WHICH IS NOT HERE IN QUESTION. THAT REPUTATION, HOWEVER WELL-DESERVED, DOES NOT ENTITLE HIM TO A PATENT FOR EVERY LATER IMPROVEMENT WHICH HE CLAIMS IN THE RADIO FIELD. PATENT CASES, LIKE OTHERS, MUST BE DECIDED NOT BY WEIGHING THE REPUTATIONS OF THE LITIGANTS, BUT BY CAREFUL STUDY OF THE MERITS OF THEIR RESPECTIVE CONTENTIONS AND PROOFS. AS THE RESULT OF SUCH A STUDY WE ARE FORCED TO CONCLUDE, WITHOUT UNDERTAKING TO DETERMINE WHETHER STONE'S PATENT INVOLVED INVENTION, THAT THE COURT OF CLAIMS WAS RIGHT IN DECIDING THAT STONE ANTICIPATED MARCONI, AND THAT MARCONI'S PATENT DID NOT DISCLOSE INVENTION OVER STONE. HENCE THE JUDGMENT BELOW HOLDING INVALID THE BROAD CLAIMS OF THE MARCONI PATENT MUST BE AFFIRMED. IN VIEW OF OUR INTERPRETATION OF THE STONE APPLICATION AND PATENT WE NEED NOT CONSIDER THE CORRECTNESS OF THE COURT'S CONCLUSION THAT EVEN IF STONE'S DISCLOSURES SHOULD BE READ AS FAILING TO DIRECT THAT THE ANTENNA CIRCUITS BE MADE RESONANT TO A PARTICULAR FREQUENCY, MARCONI'S PATENT INVOLVED NO INVENTION OVER LODGE, TESLA, AND STONE.

CLAIM 16 OF MARCONI PATENT NO. 763,772.

THE GOVERNMENT ASKS US TO REVIEW SO MUCH OF THE DECISION OF THE COURT OF CLAIMS AS HELD VALID AND INFRINGED CLAIM 16 OF MARCONI'S PATENT NO. 763,772. THAT CLAIM IS FOR AN ANTENNA CIRCUIT AT THE RECEIVER CONNECTED AT ONE END TO "AN OSCILLATION-RECEIVING CONDUCTOR" AND AT THE OTHER TO A CAPACITY (WHICH COULD BE THE EARTH), CONTAINING THE PRIMARY WINDING OF A TRANSFORMER, "MEANS FOR ADJUSTING THE TWO TRANSFORMER CIRCUITS IN ELECTRICAL RESONANCE WITH EACH OTHER," AND "AN ADJUSTABLE CONDENSER IN A SHUNT CONNECTED WITH THE OPEN CIRCUIT, AND AROUND SAID TRANSFORMER-COIL." MARCONI THUS DISCLOSES AND CLAIMS THE ADDITION TO THE RECEIVER ANTENNA OF AN ADJUSTABLE CONDENSER CONNECTED IN A SHUNT AROUND THE PRIMARY OF THE TRANSFORMER. THE SPECIFICATIONS DESCRIBE THE CONDENSER AS "PREFERABLY ONE PROVIDED WITH TWO TELESCOPING METALLIC TUBES SEPARATED BY A DIELECTRIC AND ARRANGED TO READILY VARY THE CAPACITY BY BEING SLID UPON EACH OTHER." MARCONI, HOWEVER, MAKES NO CLAIM FOR THE PARTICULAR CONSTRUCTION OF THE CONDENSER.

ALTHOUGH THE CLAIM BROADLY PROVIDES FOR "MEANS OF ADJUSTING THE TWO TRANSFORMER-CIRCUITS IN ELECTRICAL RESONANCE," MARCONI'S DRAWINGS DISCLOSE THE USE OF A VARIABLE INDUCTANCE CONNECTED BETWEEN THE AERIAL CONDUCTOR AND THE TRANSFORMER-COIL IN SUCH A MANNER THAT THE VARIABLE INDUCTANCE IS NOT INCLUDED IN THAT PART OF THE ANTENNA CIRCUIT WHICH IS BRIDGED BY THE CONDENSER. THE CONDENSER IS THUS ARRANGED IN PARALLEL WITH THE TRANSFORMER COIL AND IN SERIES WITH THE VARIABLE INDUCTANCE. IN HIS SPECIFICATIONS MARCONI ENUMERATES A NUMBER OF PREFERRED ADJUSTMENTS FOR TUNING THE TRANSMITTING AND RECEIVING STATIONS,

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ASSERTION THAT THE CLAIMED USE OF THE INVENTION WITH LOW FREQUENCIES WAS NOT THE INVENTION OF THE PATENTEE, WHOSE RIGHTS WERE DERIVED WHOLLY FROM FLEMING. THIS IMPROPER CLAIM FOR SOMETHING NOT THE INVENTION OF THE PATENTEE RENDERED THE WHOLE PATENT INVALID UNLESS SAVED BY A TIMELY DISCLAIMER WHICH WAS NOT MADE.

THE MARCONI COMPANY ALSO ASSERTS THAT, AS IT IS SUING AS ASSIGNEE OF THE PATENTEE, IT IS UNAFFECTED BY THE PROVISIONS OF THE DISCLAIMER STATUTES, WHICH IT CONSTRUES AS RESTRICTING TO THE "PATENTEE" THE CONSEQUENCES OF UNREASONABLE DELAY IN MAKING THE DISCLAIMER AND AS EXEMPTING THE ASSIGNEE FROM THOSE CONSEQUENCES BY THE SENTENCE "BUT NO PATENTEE SHALL BE ENTITLED TO THE BENEFITS OF THIS SECTION IF HE HAS UNREASONABLY NEGLECTED OR DELAYED TO ENTER A DISCLAIMER." 35 U.S.C. 71. AS THE COURT BELOW FOUND, THE MARCONI COMPANY WAS ITSELF THE PATENTEE TO WHOM THE PATENT WAS ISSUED ON THE ASSIGNMENT OF FLEMING'S APPLICATION IN CONFORMITY TO 35 U.S.C. SEC. 44. THE RIGHT GIVEN BY SEC. 71 TO THE PATENTEE OR HIS ASSIGNEES TO SUE FOR INFRINGEMENT UPON A PROPER DISCLAIMER OBVIOUSLY DOES NOT RELIEVE THE PATENTEE FROM THE CONSEQUENCES OF HIS FAILURE TO COMPLY WITH THE STATUTE BECAUSE HE ACQUIRED HIS PATENT UNDER AN ASSIGNMENT OF THE APPLICATION. ALTOONA THEATRES V. TRI-ERGON CORP., SUPRA; MAYTAG CO. V. HURLEY CO., SUPRA; FRANCE MFG. CO. V. JEFFERSON ELECTRIC CO., 106 F.2D 605, 610. SUCH A CONTENTION IS NOT SUPPORTED BY THE WORDS OF THE STATUTE AND IF ALLOWED WOULD PERMIT THE NULLIFICATION OF THE DISCLAIMER STATUTE BY THE EXPEDIENT OF AN ASSIGNMENT OF THE APPLICATION. WE NEED NOT CONSIDER WHETHER ONE WHO HAS TAKEN AN ASSIGNMENT OF A PATENT AFTER ITS ISSUANCE WOULD HAVE ANY GREATER RIGHTS THAN HIS ASSIGNOR IN THE EVENT OF THE LATTER'S UNDUE DELAY IN FILING A DISCLAIMER. COMPARE APEX ELECTRICAL MFG. CO. V. MAYTAG CO., 122 F.2D 182, 189.

THE JUDGMENT IN NO. 373 IS VACATED AND THE CAUSE REMANDED TO THE COURT OF CLAIMS FOR FURTHER PROCEEDINGS NOT INCONSISTENT WITH THIS OPINION.

THE JUDGMENT IN NO. 369 IS AFFIRMED. SO ORDERED.

FN1 ON NOVEMBER 20, 1919, THE MARCONI COMPANY ASSIGNED TO THE RADIO CORPORATION OF AMERICA ALL OF ITS ASSETS, INCLUDING THE PATENTS HERE IN SUIT, BUT RESERVED, AND AGREED TO PROSECUTE, THE PRESENT CLAIMS AGAINST THE UNITED STATES, ON WHICH IT HAD INSTITUTED SUIT ON JULY 29, 1916.

FN2 SEE MARCONI WIRELESS TEL. CO. V. NATIONAL ELECTRIC SIGNALLING CO., 213 F. 815, 825, 829-31; ENCYCLOPEDIA BRITANNICA (14TH ED.) VOL. 14, P. 869; DUNLAP, MARCONI, THE MAN AND HIS WIRELESS; JACOT AND COLLIER, MARCONI - MASTER OF SPACE; VYVYAN, WIRELESS OVER THIRTY YEARS; FLEMING, ELECTRIC WAVE TELEGRAPHY, 426-443.

MARCONI WAS GRANTED EIGHT OTHER UNITED STATES PATENTS FOR WIRELESS APPARATUS ON APPLICATIONS FILED BETWEEN THE FILING DATES OF NOS. 586,193 AND 763,772. THEY ARE NOS. 624,516, 627,650, 647,007, 647,008, 647,009, 650,109, 650,110, 668,315.

FN3 CAPACITY IS THE PROPERTY OF AN ELECTRICAL CIRCUIT WHICH ENABLES IT TO RECEIVE AND STORE AN ELECTRICAL CHARGE WHEN A VOLTAGE IS APPLIED TO IT, AND TO RELEASE THAT CHARGE AS THE APPLIED VOLTAGE IS WITHDRAWN, THEREBY CAUSING A CURRENT TO FLOW IN THE CIRCUIT. ALTHOUGH ANY CONDUCTOR OF ELECTRICITY HAS CAPACITY TO SOME DEGREE, THAT PROPERTY IS SUBSTANTIALLY ENHANCED IN A CIRCUIT BY THE USE OF A CONDENSER, CONSISTING OF TWO OR MORE METAL PLATES SEPARATED BY A NON-CONDUCTOR, SUCH THAT WHEN A VOLTAGE IS APPLIED TO THE CIRCUIT ONE PLATE WILL BECOME POSITIVELY AND THE OTHER NEGATIVELY CHARGED.

SELF-INDUCTANCE IS THE PROPERTY OF A CIRCUIT BY WHICH, WHEN THE AMOUNT OR DIRECTION OF THE CURRENT PASSING THROUGH IT IS CHANGED, THE MAGNETIC STRESSES CREATED INDUCE A VOLTAGE OPPOSED TO THE CHANGE. ALTHOUGH ANY CONDUCTOR HAS SELF-INDUCTANCE TO SOME DEGREE, THAT PROPERTY IS MOST MARKED IN A COIL.

SEE GENERALLY ALBERT, ELECTRICAL FUNDAMENTALS OF COMMUNICATION, CHS. V, VI,

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THE ART. SHORTLY AND SIMPLY, IT WAS THAT AN ELECTRICAL CIRCUIT WHICH IS A GOOD CONSERVER OF ENERGY IS A BAD RADIATOR AND, CONVERSELY, A GOOD RADIATOR IS A BAD CONSERVER OF ENERGY. EFFECTIVE USE OF HERTZIAN WAVES OVER LONG DISTANCES REQUIRED BOTH EFFECTS. TO STATE THE MATTER DIFFERENTLY, LODGE HAD EXPLAINED IN 1894 THE DIFFICULTIES OF FULLY UTILIZING THE PRINCIPLE OF SYMPATHETIC RESONANCE IN DETECTING ETHER WAVES. TO SECURE THIS, IT WAS NECESSARY, ON THE ONE HAND, TO DISCHARGE A LONG SERIES OF WAVES OF EQUAL OR APPROXIMATELY EQUAL LENGTH. SUCH A SERIES CAN BE PRODUCED ONLY BY A CIRCUIT WHICH CONSERVES ITS ENERGY WELL, WHAT MARCONI CALLS A PERSISTENT OSCILLATOR. ON THE OTHER HAND, FOR DISTANT DETECTION, THE WAVES MUST BE OF SUBSTANTIAL AMPLITUDE, AND ONLY A CIRCUIT WHICH LOSES ITS ENERGY RAPIDLY CAN TRANSMIT SUCH WAVES WITH MAXIMUM EFFICIENCY. OBVIOUSLY IN A SINGLE CIRCUIT THE TWO DESIRED EFFECTS TEND TO CANCEL EACH OTHER, AND THEREFORE TO LIMIT THE DISTANCE OF DETECTION. SIMILAR DIFFICULTY CHARACTERIZED THE RECEIVER, FOR A GOOD RADIATOR IS A GOOD ABSORBER, AND THAT VERY QUALITY DISABLES IT TO STORE UP AND HOLD THE EFFECT OF A TRAIN OF WAVES, UNTIL ENOUGH IS ACCUMULATED TO BREAK DOWN THE COHERER, AS DETECTION REQUIRES.

SINCE THE DIFFICULTY WAS INHERENT IN A SINGLE CIRCUIT, WHETHER AT ONE END OR THE OTHER, MARCONI USED TWO IN BOTH TRANSMITTER AND RECEIVER, FOUR IN ALL. IN EACH STATION HE USED ONE CIRCUIT TO OBTAIN ONE OF THE NECESSARY ADVANTAGES AND THE OTHER CIRCUIT TO SECURE THE OTHER ADVANTAGE. THE ANTENNA (OR OPEN) CIRCUITS HE MADE "GOOD RADIATORS" (OR ABSORBERS). THE CLOSED CIRCUITS HE CONSTRUCTED AS "GOOD CONSERVERS." BY COUPLING THE TWO AT EACH END LOOSELY HE SECURED FROM THEIR COMBINATION THE DUAL ADVANTAGES HE SOUGHT. AT THE TRANSMITTER, THE CLOSED CIRCUIT, BY VIRTUE OF ITS CAPACITY FOR CONSERVING ENERGY, GAVE PERSISTENT OSCILLATION, WHICH PASSED SUBSTANTIALLY UNDIMINISHED THROUGH THE COUPLING TRANSFORMER TO THE "GOOD RADIATOR" OPEN CIRCUIT AND FROM IT WAS DISCHARGED WITH LITTLE LOSS OF ENERGY INTO THE ETHER. THENCE IT WAS PICKED UP BY THE "GOOD ABSORBER" OPEN CIRCUIT AND PASSED, WITHOUT SERIOUS LOSS OF ENERGY, THROUGH THE COUPLING TRANSFORMER, INTO THE CLOSED "GOOD CONSERVING" CIRCUIT, WHERE IT ACCUMULATED TO BREAK THE COHERER AND GIVE DETECTION.

MOREOVER, AND FOR PRESENT PURPOSES THIS IS THE IMPORTANT THING, MARCONI BROUGHT THE CLOSED AND OPEN CIRCUITS INTO ALMOST COMPLETE HARMONY BY PLACING VARIABLE INDUCTANCE IN EACH. THROUGH THIS THE PERIODICITY OF THE OPEN CIRCUIT WAS ADJUSTED AUTOMATICALLY TO THAT OF THE CLOSED ONE; AND, SINCE THE CIRCUITS OF THE RECEIVING STATION WERE SIMILARLY ADJUSTABLE, THE MAXIMUM RESONANCE WAS SECURED THROUGHOUT THE SYSTEM. MARCONI THUS NOT ONLY SOLVED THE DILEMMA OF A SINGLE CIRCUIT ARRANGEMENT; HE ATTAINED THE MAXIMUM OF RESONANCE AND SELECTIVITY BY PROVIDING IN EACH CIRCUIT INDEPENDENT MEANS OF TUNING.

IN 1911 THIS SOLUTION WAS HELD INVENTIVE, AS AGAINST LODGE, MARCONI'S PRIOR PATENTS, BRAUN AND OTHER REFERENCES, IN MARCONI V. BRITISH RADIO TEL. & TEL. CO., 27 T.L. R. 274. MR. JUSTICE PARKER CAREFULLY REVIEWED THE PRIOR ART, STATED THE PROBLEM, MARCONI'S SOLUTION, AND IN DISPOSING OF BRAUN'S SPECIFICATION CONCLUDED IT "DID NOT CONTAIN EVEN THE REMOTEST SUGGESTION OF THE PROBLEM ... , MUCH LESS ANY SUGGESTION BEARING ON ITS SOLUTION. ... " AS TO LODGE, MR. JUSTICE PARKER OBSERVED, REFERRING FIRST TO MARCONI: " ... IT IS IMPORTANT TO NOTICE THAT IN THE RECEIVER THE MERE INTRODUCTION OF TWO CIRCUITS INSTEAD OF ONE WAS NO NOVELTY. A FIGURE IN LODGE'S 1897 PATENT SHOWS THE OPEN CIRCUIT OF HIS RECEIVING AERIAL LINKED THROUGH A TRANSFORMER WITH A CLOSED CIRCUIT CONTAINING THE COHERER, HIS IDEA BEING, AS HE STATES, TO LEAVE HIS RECEIVING AERIAL FREER TO VIBRATE ELECTRICALLY WITHOUT DISTURBANCE FROM ATTACHED WIRES. THIS SECONDARY CIRCUIT, AS SHOWN, IS NOT TUNED TO, NOR CAN IT BE TUNED TO, THE CIRCUIT OF THE AERIAL. THIS, IN MY OPINION,

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LOST SCIENCE

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Rediscover the legendary names of suppressed scientific revolution—remarkable lives, astounding discoveries, and incredible inventions which would have produced a world of wonder. How did the aura research of Baron Karl von Reichenbach prove the vitalistic theory and frighten the greatest minds of Germany? How did the physiophone and wireless of Antonio Meucci predate both Bell and Marconi by decades? How does the earth battery technology of Nathan Stubblefield portend an unsuspected energy revolution? How did the geoaetheric engines of Nikola Tesla threaten the establishment of a fuel-dependent America? The microscopes and virus-destroying ray machines of Dr. Royal Rife provided the solution for every world-threatening disease. Why did the FDA and AMA together condemn this great man to Federal Prison? The static crashes on telephone lines enabled Dr. T. Henry Moray to discover the reality of radiant space energy. Was the mysterious "Swedish stone," the powerful mineral which Dr. Moray discovered, the very first historical instance in which stellar power was recognized and secured on earth? Why did the Air Force initially fund the gravitational warp research and warp-cloaking devices of T. Townsend Brown and then reject it? When the controlled fusion devices of Philo Farnsworth achieved the "break-even" point in 1967 the FUSOR project was abruptly cancelled by ITT.

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British aerospace engineer Cramp began much of the scientific anti-gravity and UFO propulsion analysis back in 1955 with his landmark book *Space, Gravity & the Flying Saucer* (out-of-print and rare). His next books (available from Adventures Unlimited) *UFOs & Anti-Gravity: Piece for a Jig-Saw* and *The Cosmic Matrix: Piece for a Jig-Saw Part 2* began Cramp's in depth look into gravity control, free-energy, and the interlocking web of energy that pervades the universe. In this final book, Cramp brings to a close his detailed and controversial study of UFOs and Anti-Gravity.

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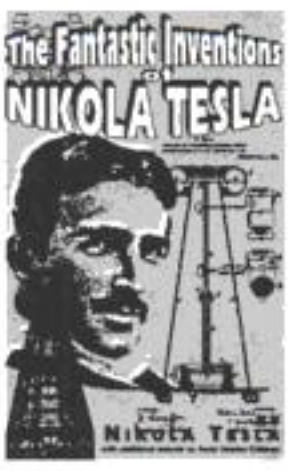

THE FANTASTIC INVENTIONS OF NIKOLA TESLA

by Nikola Tesla with additional material by David Hatcher Childress

This book is a readable compendium of patents, diagrams, photos and explanations of the many incredible inventions of the originator of the modern era of electrification. In Tesla's own words are such topics as wireless transmission of power, death rays, and radio-controlled airships. In addition, rare material on German bases in Antarctica and South America, and a secret city built at a remote jungle site in South America by one of Tesla's students, Guglielmo Marconi. Marconi's secret group claims to have built flying saucers in the 1940s and to have gone to Mars in the early 1950s! Incredible photos of these Tesla craft are included. The Ancient Atlantean system of broadcasting energy through a grid system of obelisks and pyramids is discussed, and a fascinating concept comes out of one chapter: that Egyptian engineers had to wear protective metal head-shields while in these power plants, hence the Egyptian Pharoah's head covering as well as the Face on Mars! •His plan to transmit free electricity into the atmosphere. •How electrical devices would work using only small antennas. •Why unlimited power could be utilized anywhere on earth. •How radio and radar technology can be used as death-ray weapons in Star Wars.

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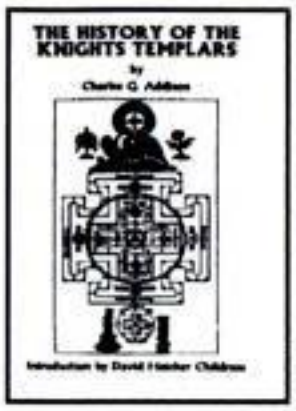

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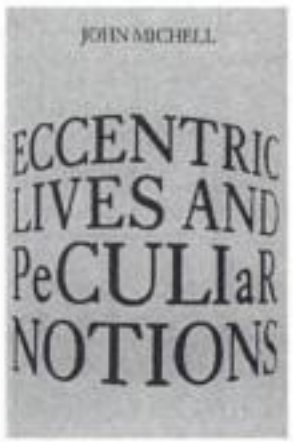

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by John Michell

The first paperback edition of Michell's fascinating study of the lives and beliefs of over 20 eccentric people. Published in hardback by Thames & Hudson in London, *Eccentric Lives and Peculiar Notions* takes us into the bizarre and often humorous lives of such people as Lady Blount, who was sure that the earth is flat; Cyrus Teed, who believed that the earth is a hollow shell with us on the inside; Edward Hine, who believed that the British are the lost Tribes of Israel; and Baron de Guldenstubbe, who was sure that statues wrote him letters. British writer and housewife Nesta Webster devoted her life to exposing international conspiracies, and Father O'Callaghan devoted his to opposing interest on loans. The extraordinary characters in this book were—and in some cases still are—wholehearted enthusiasts for the various causes and outrageous notions they adopted, and John Michell describes their adventures with spirit and compassion. Some of them prospered and lived happily with their obsessions, while others failed dismally. We read, for example, of the hapless inventor of a giant battleship made of ice who died alone and neglected, and of the London couple who achieved peace and prosperity by drilling holes in their heads. Other chapters on the Last of the Welsh Druids; Congressman Ignacius Donnelly, the Great Heretic and Atlantis; Shakespearean Decoders and the Baconian Treasure Hunt; Early Ufologists; Jerusalem in Scotland; Bibliomaniacs; more.

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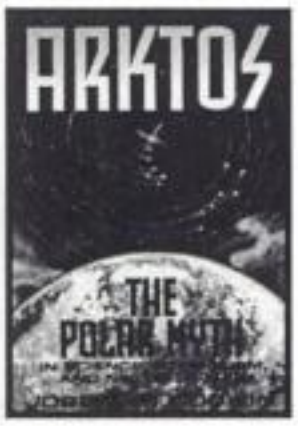

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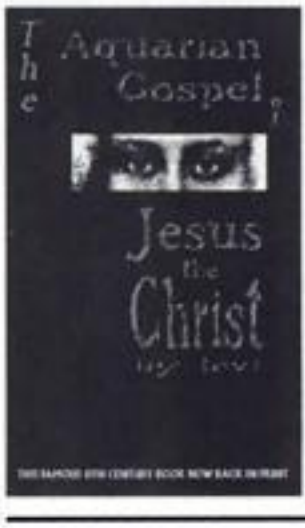

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Transcribed from the Akashic Records

by Levi

First published in 1908, this is the amazing story of Jesus, the man from Galilee, and how he attained the Christ consciousness open to all men. It includes a complete record of the "lost" 18 years of his life, a time on which the New Testament is strangely silent. During this period Jesus travelled widely in India, Tibet, Persia, Egypt and Greece, learning from the Masters, seers and wisemen of the East and the West in their temples and schools. Included is information on the Council of the Seven Sages of the World, Jesus with the Chinese Master Mencius (Meng Tzu) in Tibet, the ministry, trial, execution and resurrection of Jesus.

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