Dr. Nikola Tesla's Radiant Energy – The Timeline

This document is an attempt to follow Dr. Tesla's the train of thought about "radiant energy". This subject has nothing to do with "free" energy. It is about fuelless electricity generation. Hydroelectric power generation is an example of fuelless electricity generation. It harvests the kinetic energy of falling water actuated by gravity to produce a constant supply of controllable electricity. Those are the two main requirements of any efficient electrical system - constancy and controllability. Constancy so that it is available at all times. Controllability so that it may be varied depending upon demand requirements.

Look up at the night sky and you see the universe is full of nuclear fusion reactors - the stars. Today it is estimated that there are one hundred billion galaxies in the universe and that each galaxy contains an average of one hundred billion stars. And each and every one of them and all of their constituent parts are in motion. The medium between the galaxies, the galaxies themselves, the stars, the galactic gases between the stars, the planets in a solar system, the moons around those planets, the atmospheres and tectonic plates on those planets and moons, the molecules that each of those are made of, and even the components of the atoms comprising the molecules are all in motion. Most of those are things we can see with the naked or aided eye but there are as many or more things that are not in the visible spectrum that are also in motion such as X-rays and gamma rays and magnetic fields. So when Dr. Tesla said in 1891, "We are whirling through endless space, with an inconceivable speed, all around us everything is spinning, everything is moving, every where there is energy." only a small part of the truth of that was known. At that time the atom was widely considered to be the indivisible minimum of matter, the galaxies were considered to be stars because the astronomers didn't yet have powerful enough telescopes to distinguish galaxies, and even our own galaxy was unknown.

To understand Dr. Tesla's train of thought one must first grasp how little was actually known at the time, how primitive (by today's standards) their investigative tools were, and, as knowledge was acquired, how it grew into the body science and engineering of today. Ninety nine percent of what we take for granted today was totally unknown. It was Dr. Tesla and the scientists of his day that laid the foundation for acquiring the rest of that 99%. That journey in knowledge is much, much more than I wish to cover in this document. So let us get back to radiant energy.

Dr. Tesla's vision was to tap into the boundless energy of the universe and convert some of it into electricity without using fuel. That energy is also contained in coal and oil and natural gas. So, in a way, we can say those sources of energy are from the energy of the universe. But they must be extracted and burned to convert their energy to electricity. This is what Dr. Tesla was attempting to circumvent and I believe he succeeded. Why not just tap into the energy that is continually bombarding our planet? This, I contend, was Dr. Tesla's goal and I believe he achieved it and along the way discovered that the earth was being bombarded by the energy of cosmic rays from all directions rather than just from the sun and at all times, not just the sun's radiations during the day. Today they are known as neutrinos, extreme energy cosmic rays, ultra high energy cosmic rays, and high energy cosmic rays.

Dr. Tesla started at the fundamental level of what was available to him for observation at the time. As his research progressed and he and others developed tools for better observations, his ideas developed more fully and as they did, the scope of the energy source changed. It started with simple observations in his lab, expanded to include the sun, and eventually made the leap to the universe.

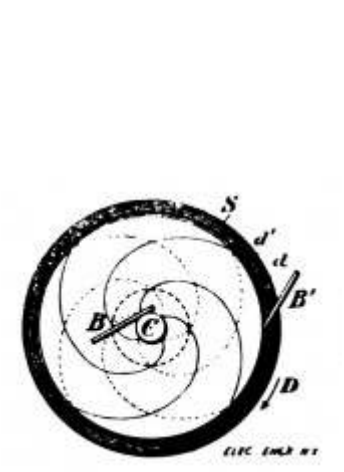
Since we are trying to determine Dr. Tesla's train of thought, the dates used to identify his patents will be the application dates rather than the date the patent was granted. This more accurately reflects the continuity of his train of thought for three reasons: it negates the time delay between the application and the approval which can be years; it shows the point in time at which he had developed his idea sufficiently to reduce it to a patent; and it groups the patents of related ideas together.

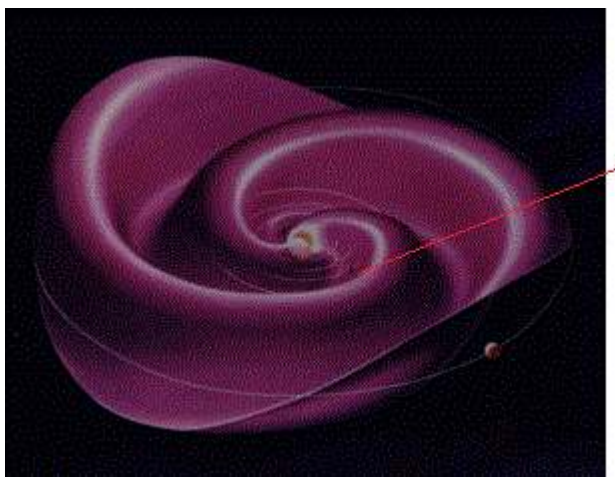
Dr. Tesla's years before 1889 were primarily devoted to development of the alternating current generator and motor and the conventional distribution of power over conductors. This document does not cover these years. In 1889, however, Dr. Tesla patents a "unipolar dynamo". He was also still working on perfecting his earlier patents and devices in this time frame but we will focus on radiant energy in this document.

1889 03/23 Age 32

US PATENT 406,968 DYNAMO-ELECTRIC MACHINE

This is the unipolar dynamo where current flows in spirals from the center to the edge or from the edge to the center depending on the polarity of the magnet surrounding the conductor and the direction of rotation. This is interesting in relation to radiant energy because, for all intents and purposes, the sun is, from our perspective, a unipolar dynamo that emits energy without a return circuit. Comparing the unipolar dynamo with the sun's heliospheric current sheet yields an interesting perspective.





1891 05/20 Age 34

"Experiments with Alternate Currents of very high Frequency and their Application for methods of artificial lighting", *Lecture before the American Institute of Electrical Engineers, Columbia College*

"There is no subject more captivating, more worthy of study, than nature. To understand this great mechanism, to discover the forces which are active, and the laws which govern them, is the highest aim of the intellect of man. Nature has stored up in the universe infinite energy."

Here Dr. Tesla states that he is studying nature and is attempting to discover the forces which are active. This is tremendously important because we must understand that these are experiments to understand natural processes and harness nature's energy. I contend he did not generate "radiant energy" but harnessed nature's radiant energy.

"It is likewise practicable to light with one leading-in wire lamps such as illustrated in Fig. 20 and Fig. 21, by connecting one terminal of the lamp to one terminal of the source, and the other to an insulated body of the required size. In all cases the insulated body serves to give off the energy into the surrounding space, and is equivalent to a return wire."

Here Dr. Tesla describes his experiments with one wire transmission of power with no ground return. This is similar to the way the sun transmits power. Think of the sun as the source, the leading-in wire as the rays emanating from the sun, and the insulated body as earth's body. So what is needed is a device to connect the leading-in wire of the rays to one terminal of a lamp, the other terminal of the lamp being connected to the insulated body of the earth.

"We are whirling through endless space, with an inconceivable speed, all around us everything is spinning, everything is moving, every where there is energy. There must be some way of availing ourselves of this energy more directly. Then, with the light obtained from the medium, with the power derived from it, with every form of energy obtained without effort, from the store forever inexhaustible, humanity will advance with giant strides."

Here, again, Dr, Tesla states that the universe is full of energy but goes further to say that there must be some way to acquire power from that inexhaustible supply of energy. The "everything is moving" portion indicates that he is thinking of kinetic energy, the energy of matter in motion.

1892 02/03-04 Age 35

"Experiments with Alternate Currents of High Potential and High Frequency", *Lecture before the Institution of Electrical Engineers, London*

"Ere many generations pass, our machinery will be driven by a power obtainable at any point of the universe."

Here again Dr. Tesla states his belief that power is obtainable from the universe. Although some scientists are looking into smaller particles at this time, it is a widely held belief in the scientific community that the atom is the indivisible minimum of matter.

"Throughout space there is energy. Is this energy static or kinetic? If static our hopes are in vain; if kinetic – and this we know it is, for certain – then it is a mere question of time when men will succeed in attaching their machinery to the very wheelwork of nature."

Here Dr. Tesla states once again he is talking about space. He is not looking inward to subatomic particles but outward to space and the universe and asserts his conviction that the kinetic energy can be harnessed. Think of the "wheelwork" as a waterwheel. It draws energy from the flowing water without diminishing the flow. The water flows to the wheel, imparts some energy, and continues on – kinetic energy transformed into mechanical motion. In essence, we still produce electricity this way today whether it is by gravity at Niagara Falls or water heated by whatever means to create steam that is used to turn a turbine (wheelwork) connected to the generating equipment.

" I think, however, that in the case of an electrode immersed in a fluid insulating medium, and surrounded by independent carriers of electric charges, a sufficiently high frequency of the impulses would probably result in a gravitation of the gas all around to the electrode."

If we take "fluid insulating medium" to mean the earth's atmosphere then he is stating that he believes an electrode in the atmosphere (an antenna) can draw the "independent carriers of electric charges" toward itself. He later patented this as his lightning protector U.S. Patent 1,266,175, 1916-05-06. This seems to concern static electricity but "independent carriers of electric charges" could be the ions generated by the secondary emissions of cosmic rays' collision with molecules in the atmosphere or the cosmic rays themselves.

1893 02/24 Age 36

"On Light and Other High Frequency Phenomena", *Lecture before the National Electric Light Association, St. Louis.*

"It is clear, that if we succeed in employing the effects of resonance practically in the operation of electric devices the return wire will, as a matter of course, become unnecessary, for the electric vibration may be conveyed with one wire just as well as, and sometimes even better than, with two."

Here Dr. Tesla describes one wire transmission with no return. This is the same way the sun and stars transmit energy.

1895 03/13 Age 38

Dr. Tesla's South Fifth Avenue laboratory is destroyed by fire. It is probably this event that makes Dr. Tesla less willing to discuss details of his work.

1896 05/22 Age 39

"Tesla's latest Roentgen Ray Investigations", *Electrical Review, New York* **28** No.17

"…streams resembling the cathodic must be emitted by the sun and probably also by other sources of radiant energy, such as an arc light or Bunsen burner."

This is the earliest reference I have found where he used the term "radiant energy". Note also his references to an arc light and the Bunsen burner both of which have plasmas. In the former, a plasma is formed by the arc and in the latter, the flame itself is a plasma. Although unknown in his day, we now understand that interplanetary and interstellar space is filled more or less with plasma and the solar wind from our own sun is itself a plasma of charged particles. The other thing common to all is light and that, in essence, is what he means by radiant energy.

1897 03/?? Age 40

Cassier's Magazine

"But we shall not satisfy ourselves simply with improving steam and explosive engines or inventing new batteries; we have something much better to work for, a greater task to fulfill. We have to evolve means for obtaining energy from stores which are forever inexhaustible, to perfect methods which do not imply consumption and waste of any material whatever. Upon this great possibility, upon this great problem, the practical solution of which means so much for humanity, I have myself concentrated my efforts for a number of years…"

"… stores which are forever inexhaustible…" - the sun or the universe. At this time the sun was thought to be eternal and even today the calculated life span is roughly another four billion years which is close enough to eternal. Also keep in mind that at this point Dr. Tesla is still thinking about the sun, not the universe.

"… do not imply consumption and waste of any material whatever." - harness nature's energy without consuming fuel.

1897 04/14 Age 40

"An Interesting Electrical Exhibition – Address by Nikola Tesla, Announcing Recent Achievements", *Electrical Review*

"Mr. Tesla announced two important discoveries relating to the Roentgen rays. First, he said he had discovered a new and powerful source of the rays in an electric arc formed under peculiar conditions."

Following the above hypothesis about Dr. Tesla's train of thought I contend that he was studying the tools and methods of creating "rays" only with the goal of developing instruments to explore the properties and attributes of nature's rays under controllable conditions. We often overlook his medical experimentation because we are interested in power generation applications, not medical applications. I contend he was developing tools for acquiring power from nature's rays. Consider, if you will, his "rays in an electric arc formed under peculiar conditions" as the emissions of the sun's rays. Not light, but what today we call high energy cosmic rays. They are, indeed, created under peculiar conditions. Today it is thought that high

energy cosmic rays are emitted from explosive stellar events known as novae and supernovae and, possibly, the polar jets of quasars and rotating black holes. http://www.nasa.gov/mission_pages/GLAST/news/cosmic-rays-source.html http://en.wikipedia.org/wiki/Polar_jet

We also know today that space is filled with X-rays and gamma rays coming from all directions.

1898 11/30 Age 42

"Tesla Describes his Efforts in Various Fields of Work" *Electrical Review*

"As to the idea of rendering the energy of the sun available for industrial purposes, it fascinated me early but I must admit it was only long after I discovered the rotating magnetic field that it took a firm hold upon my mind. In assailing the problem I found two possible ways of solving it. Either power was to be developed on the spot by converting the energy of the sun's radiations or the energy of vast reservoirs was to be transmitted economically to any distance. Though there were other possible sources of economical power, only the two solutions mentioned offer the ideal feature of power being obtained without any consumption of material. After long thought I finally arrived at two solutions, but on the first of these, namely, that referring to the development of power in any locality from the sun's radiations, I can not dwell at present. The system of power transmission without wires, in the form in which I have described it recently, originated in this manner. Starting from two facts that the earth was a conductor insulated in space, and that a body cannot be charged without causing an equivalent displacement of electricity in the earth, I undertook to construct a machine suited for creating as large a displacement as possible of the earth's electricity."

Here Dr. Tesla speaks of two methods of "rendering the energy of the sun available for industrial purposes" and he states that it was long after he discovered the rotating magnetic field that it became his line of enquiry. That validates the approach in this document of starting in 1889.

The first method of developing power "on the spot" also implies consumption on the spot with no need of transmission. I believe this is what he pursued after the failure of the Wardenclyffe project. We will come back to that further along in the timeline.

The second method he describes accesses "vast reservoirs" that will be transmitted. He then goes on to say that the earth, taken as a whole, can be viewed as an insulated conductor and that the sun's charging of the conductor creates displacements of the earth's electricity. From this we can deduce that the vast reservoirs of energy of which he speaks are those stored in the earth and continuously charged by the sun's radiations.

So at this point he is still looking at the sun as the source of "radiant energy". This changes at a later time as shown below. It is at this time in 1898 that his focus changes to the transmission of power rather than the harnessing of nature's energy and he spends many years in this pursuit. Although he keeps an open mind about harnessing radiant energy he is primarily focused on power transmission utilizing the earth as the conductor.

1899 05 Age 43

Dr. Tesla travels to Colorado Springs, Colorado to research the laws of propagation of electrical currents through the earth and atmosphere. He kept a diary of the experiments he conducted there but it was not published until 1999. The diary covers his experiments from June 1899 to January 1900.

1899 07/04 Age 43

Colorado Springs Notes

Observations made last night. They were such as not to be easily forgotten, for more than one reason. First of all a magnificent sight was afforded by the extraordinary display of lightning, no less than 10 - 12 thousand discharges being witnessed inside of two hours. The flashing was almost continuous and even later in the night when the storm had abated 15 - 20 discharges per minute were witnessed. Some of the discharges were of a wonderful brilliancy and showed 10 or twice as many branches. They also appeared frequently *thicker* on the *bottom* than on top. Can this be so? Perhaps it is only due to the fact that the portion closer to the ground was nearer to the observer[1]. The storm began to be perceptible at a distance as it grew dark and continuously increased. An instrument (rotating "coherer") was connected to ground and a plate above ground, as in my plan of telegraphy, and a condenser was used to magnify the effects transmitted through the ground. This method of magnifying secures much better results and will be described in detail in many modifications. I used it in investigating properties of Lenard and Roentgen rays with excellent results[2]. The relay was not adjusted very sensitively but it began to play, nevertheless, when the storm was still at a distance of about 80 - 100 miles., that is judging the distance from the velocity of sound. As the storm got nearer the adjustment had to be rendered less and less sensitive until the limit of the strength of the spring was reached, but even then it played at every discharge. An ordinary bell was connected to earth and elevated terminal and often it also responded. A small spark gap was bridged by a bright spark when the lightning occurred in the neighborhood. By holding the hands across the gap a shock was felt indicating the strength of the current passing between the ground and the insulated plate. As the storm receded the most interesting and valuable observation was made. It happened this way: the instrument was again adjusted so as to be more sensitive and to respond readily to every discharge which was seen or heard. It did so for a while, then stopped. It was thought that the lightning was now too far and it may have been about 50 miles away. All of a sudden the instrument began again to play, continuously increasing in strength, although the storm was moving away rapidly. After some time, the indications again ceased but half an hour later the instrument began to record again. When it once more ceased the adjustment was rendered more delicate, in fact very considerably so, still the instrument failed to respond, but half an hour or so it again began to play and now the spring was tightened on the relay very much and still it indicated the discharges. By this time the storm had moved away far out of sight. By adjusting the instrument and setting it again so as to be very sensitive, after some time it again began to play periodically. The storm was now at a distance greater than 200 miles at least. Later in the evening repeatedly the instrument played and ceased to play in intervals nearly of half an hour although most of the horizon was clear at that time.

This was a wonderful and most interesting experience from the scientific point of view. It showed clearly the existence of *stationary waves*, for how could these observations be otherwise explained? How can these waves be stationary unless reflected and where can they reflected from unless from the point where they started? It would be difficult to believe that they were reflected from the opposite point of the Earth's surface, though it may be possible. But I rather think they are reflected from the point of the cloud where the conducting path began; in this case the point where the lightning struck the ground would be the nodal point. It is now certain that they *can be produced* with an oscillator (*this is of immense importance*)

1. Yes, lightning can originate from the ground and travel to the clouds. It has been shown to occur using very high speed recordings capable of capturing the tendrils of lightning as it traverses the sky. Interestingly, it was first captured on a recording near Colorado Springs.

2. This confirms the proposition above that he was using vacuum tubes not to produce power but to explore the properties of the rays emitted by them.

Although unknown in Dr. Tesla's day, lightning does at times originate from the ground as shown in note one above. In that case the conducting path begins at the ground and the nodal point would be in the atmosphere. Considering the turbulence and constantly varying densities and parameters in the atmosphere it seems most likely that the waves were reflected from the polar opposite point on the earth. I believe Dr. Tesla later realized this also and the Wardenclyffe project was to transmit signals and power through the ground as evidenced by the extensive underground work that provided the electrical connection that would allow Dr. Tesla's apparatus, in his words, "to get a grip on the earth."

There are parallels between radiant energy and the wireless transmission of electrical power in that we receive radiant energy from the sun and universe as a wireless transmission with no return. It also shows how easily the two can be combined and confused with an explanation of the radiant energy information. They are, however, separate functions. The patents for wireless transmission do not reference the radiant energy patents at all.

1899 08/01 Age 43

US PATENT 685,956 APPARATUS FOR UTILIZING EFFECTS TRANSMITTED THROUGH NATURAL MEDIA

While this patent is generally about transmission of signals and/or power, there are statements in the patent which can be construed as relating to cosmic rays as well.

To overcome these and other limitations and disadvantages that have heretofore existed in such systems of transmission of signals or intelligence and to render possible an investigation of impulses or disturbances propagated through the natural media from any kind of source and their practical utilization for any purpose to which they are applicable

The power of both the sun and cosmic rays propagates through "natural media" and the "from any kind of source" would include this energy.

The chief feature which distinguishes the method of my present from that of my former invention, just referred to, is that the energy stored is not, as in the former instance, obtained from the energy of the disturbances or effects transmitted from a distance, but from an independent source.

The independent source is not energy from the natural medium but from a generator or battery as shown in the illustrations in this patent. This is one of the things that separates his work on harnessing nature's energy and the wireless transmission of power.

A great variety of disturbances, produced either by suitably-constructed transmitters or by natural causes, are at present known to be propagated through the natural media, and there are also a variety of means or devices enabling energy to be stored, and in view of this I wish to say that I consider the utilization of any such disturbances and the employment of any of these means as within the scope of my present invention so long as the use of the general methods hereinbefore stated is involved.

Here he covers all the bases by saying that the patent, while having an independent source still includes the natural sources. "Disturbances produced … by natural causes … propagated through natural media…" covers all natural processes including telluric current, lightning, sun rays, cosmic rays, etc. as well as manmade sources such as generators and batteries.

The best way of carrying out my invention which I at present know is to store electrical energy obtained from a suitable electrical generator in a condenser and to control the storage on the application of this energy by means of a sensitive device acted upon by the effects or disturbances, and thereby cause the operation of the receiver."

"Suitable electrical generator" could be manmade or a natural process. See *Tesla's Colorado Springs Receivers* by K. L. Corum and J. F. Corum about the "sensitive devices".

1900 01 Age 44

Dr. Tesla returns from Colorado Springs

1901 03/21 Age 44

US PATENT 685,957 APPARATUS FOR THE UTILIZATION OF RADIANT ENERGY

"It is well known that certain radiations—such as those of ultra-violet light, cathodic, Roentgen rays, or the like—possess the property of charging and discharging conductors of electricity, the discharge being particularly noticeable when the conductor upon which the rays impinge is negatively electrified. These radiations are generally considered to be ether vibrations of extremely small wave lengths and in explanation of the phenomena noted it has been assumed by some authorities that they ionize or render conducting the atmosphere through which they are propagated. My own experiments and observations, however, lead me to conclusions more in accord with the theory heretofore advanced by me that sources of such radiant energy throw off with great velocity minute particles of matter which are strongly electrified, and therefore capable of charging an electrical conductor, or, even if not so, may at any rate discharge an electrified conductor either by carrying off bodily its charge or otherwise."

"My present application is based upon a discovery which I have made that when rays or radiations of the above kind are permitted to fall upon an insulated conducting-body connected to one of the terminals of a condenser while the other terminal of the same is made by independent means to receive or to carry away electricity a current flows into the condenser so long as the insulated body is exposed to the rays, and under the conditions hereinafter specified an indefinite accumulation of electrical energy in the condenser takes place. This energy, after a suitable time interval, during which the rays are allowed to act, may manifest itself in a powerful discharge, which may be utilized for the operation or control of mechanical or electrical devices or rendered useful in many other ways."

The patent mentions the sun, ultra-violet light, Roentgen and Lenard rays as possible sources but in all cases the device is described as intercepting particles thrown off from something with great velocity, be it the sun or a vacuum tube. The patent also states that it is a polarized device and as long as charges of opposite polarity impinge upon the opposing plates it will work.

Particles in motion again refers to kinetic energy that Dr. Tesla has been trying to harness since 1892.

The insulating material of the "insulated conducting body" plays a critical role in this device but its importance is often overlooked. To a large degree it determines the effectiveness of the elevated conducting body. This is more fully explained further down in this document.

"The sun, as well as other sources of **radiant energy** throw off minute particles of matter positively electrified, which, impinging upon the upper plate, communicate continuously an electrical charge to the same. The opposite terminal of the condenser being connected to ground, which may be considered as a vast reservoir of negative electricity, a feeble current flows continuously into the condenser and inasmuch as the particles are charged to a very high potential, this charging of the condenser may continue, as I have actually observed, almost indefinitely, even to the point of rupturing the dielectric. "

Here he clearly states that the upper plate is to collect the positive charge of radiant energy particles and the ground is the source of a "vast reservoir" of negative charge.

1901 03/21 Age 44

US PATENT 685,958 METHOD OF UTILIZING RADIANT ENERGY

The patent text is substantially the same as above. This patent is for claiming rights to the method as opposed to the devices.

1901 Age 44

Wardenclyffe construction begins. The Wardenclyffe project was, however, not about radiant energy collection as some believe. It was about the wireless transmission of power through the crust of the earth regardless of the source of the power. It is mentioned here because it played such an important part in Dr. Tesla's life and to make clear it is not a part of the radiant energy system.

1902 01/18 Age 45

US PATENT 1,119,732 APPARATUS FOR TRANSMITTING ELECTRICAL ENERGY

This is the Wardenclyffe tower patent. Although some surmise that this device is intended to collect radiant energy, I disagree. This device is for transmitting signals and/or power, however it is generated. There is no mention of radiant energy in this patent nor is there any reference to other patents concerning radiant energy. It is also known that the plant accompanying the tower contained an electrical generator.

1902 06 Age 45

Dr. Tesla moves his Houston Street laboratory to Wardenclyffe

1903 Age 46
Wardenclyffe tower still not complete due to design changes necessitated by low funding. Dr. Tesla was not able to acquire financing for the Wardenclyffe tower as originally envisioned and had to reduce its physical size to fit within the budget constraints.

1905 05 Age 48
Dr. Tesla's alternating current patents for motors and power distribution expire halting his royalty income from same.

1906 Age 49
Wardenclyffe employees are laid off.

1909 10/21 Age 53
US PATENT 1,061,206 TURBINE
This is his turbine and the patent immediately below was filed on the same date.

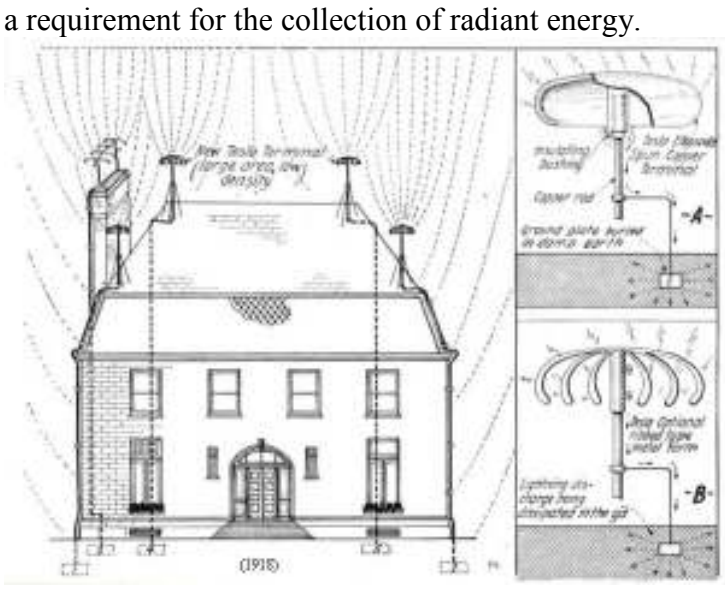
1909 10/21 Age 53
US PATENT 1,061,142 FLUID PROPULSION
This patent is for his turbine but note it mentions gasses, liquids, and particles. This device could be construed as a particle accelerator although there is no mention of such usage. Dr. Tesla was in need of funds because his royalty income had ceased so this may have just been a way to raise some funds. Never the less, it does mention particles.

1911 Age 55
Wardenclyffe abandoned. Work on turbine proceeds.

1914 07/28
World War I begins.

1916 05/16 Age 62
US PATENT 1,266,175 LIGHTNING PROTECTOR
The drawing below is from an article in the October 1918 issue of The Electrical Experimenter discussing this patent. What is shown in the article that is not shown in the patent drawings is that the device is attracting energy and carrying it away so that a charge imbalance does not develop to initiate a lightning strike. On the other hand, the patent drawings show what appears to be a spark gap just above the ground but it is not identified as such (nor at all) in the patent and it is not shown in the magazine article so there is some confusion here.

At first glance this would appear to relate to radiant energy but it does not. The text of the patent states that the device need not be insulated which is a requirement for the collection of radiant energy.



1917 Age 61
Dr. Tesla moves to Chicago to perfect his turbine with Pyle National Company

1918 11/11 Age 62
World War I ends

1928 11 Age 72
Popular Science Monthly interview with Nikola Tesla by Alden P. Armagnac

"And – more widely interesting in this day of radio – this strange, many-sided man clings to the opinion he expressed in his scientific investigations published from 1896-1898, that the source of all rays we know is always a stream of tangible particles or 'corpuscles,' rather than waves or vibrations. Even before the discovery of radium, Tesla expressed his belief that radioactive rays were of this sort, a view ridiculed at that time. When radium was discovered it was found actually to emit particles of matter – flying nuclei of helium atoms, called 'alpha' rays. Tesla has maintained ever since that radium is not a generator but a transformer of energy, the emanations being caused by cosmic rays of immense power capable of penetrating all obstacles however thick. The existence of this radiation – which, he says, should not be confounded with the comparatively very feeble 'cosmic rays' observed more recently – he has proved by mathematical theory agreeing closely with experiment.

"…a stream of tangible particles or 'corpuscles,' rather than waves or vibrations." He is not talking about coupling to waves. "…flying nuclei…" indicates subatomic particles. "… comparatively very feeble 'cosmic rays'" refers to emanations from the sun in this context …"cosmic rays of immense power capable of penetrating all obstacles however thick" refers to high energy cosmic rays originating in cosmological processes capable of accelerating subatomic particles to near light speed.

These conclusions Tesla has drawn from experiments with a remarkable vacuum tube of his own invention, with a single electrode, operated at millions of volts.

This backs up the idea stated earlier that he was using vacuum tubes to study rays.

1931 Age 75

Dr. Tesla's nephew, Mr. Petar Savo

Pierce-Arrow fuelless automobile

The documentation I have seen on this is dubious. Nevertheless, it seems feasible. There are several ways that this car could have been powered. One would be using his wireless transmission system, one of which was built in Canada and would have been close enough to power the car in Buffalo, New York where it was said to be tested. The other way to power the car would be to derive the power from the rays impacting the metal car body, the paint covering the body being the insulator and the antenna being a device to attract the rays. There simply isn't enough information available to determine how the car was powered. There is, however, another possibility that is covered further down.

1931 07/05 Age 75

Tesla, 75, Predicts New Power Source, New York Times, Section 2, 1

I have satisfied myself that the [cosmic] rays are not generated by the formation of new matter in space, a process which would be like water running up a hill. Nor do they come to any appreciable amount from the stars. According to my investigations the sun emits a radiation of such penetrative power that it is virtually impossible to absorb it in lead or other substances. ... This ray, which I call the primary solar ray, gives rise to a secondary radiation by impact against the cosmic dust scattered through space. It is the secondary radiation which now is commonly called the cosmic ray, and comes, of course, equally from all directions in space. [The article continues: **The phenomena of radioactivity are not the result of forces within the radioactive substances but are caused by this ray emitted by the sun. If radium could be screened effectively against this ray it would cease to be radioactive, he said.**]

"Nor do they come to any appreciable amount from the stars." In this he appears to be incorrect. Today's scientists are slowly working out the source of cosmic rays and it appears that they are the product of cosmological processes far more powerful than anything that occurs around a single star, except at its demise. At a later time he changes his opinion on this.

But the more important part of this is the last part. It bears repeating.

[The article continues: The phenomena of radioactivity are not the result of forces within the radioactive substances but are caused by this ray emitted by the sun. If radium could be screened effectively against this ray it would cease to be radioactive, he said.]

Whether this is actually true or not is of little importance to us. The point is that this is what Dr. Tesla believed and it colors his thinking. Personally, it makes me wonder because so much of what he said has been proven true that even this may be possible. Today's scientists think that radioactive decay occurs because of an imbalance in the subatomic particles of an element. If, however, the first law of motion (a body at rest tends to stay at rest and a body in motion tends to stay in motion unless acted upon by an outside force) holds true for subatomic particles then what outside force is acting upon the atom to cause it to eject a particle? Could it be cosmic rays or neutrinos? I suppose the forces between particles within an atom would be considered external to the particle itself so current theory could also be correct. Or it could be a combination of the two: the atom's components are unstable and impact of the miniscule mass of a neutrino pushes the instability over the limit and the atom emits a particle.

1932 07/10 Age 76

“Tesla Cosmic Ray Motor May Transmit Power ‘Round Earth”, by John A. O’NEILL for *Brooklin Eagle*

”I have harnessed the cosmic rays and caused them to operate a motive device”, declared Nikola Tesla, famous scientist, in an interview last evening on the eve of his 76th birthday. “Cosmic ray investigation is a subject that is very close to me. I was the first to discover these rays and I naturally feel toward them as I would toward my own flesh and blood.”, said Dr. Tesla. ... Dr. Tesla stated that the amount of power he was able to develop in the device was insignificant. I asked him if its power output was of the same magnitude as that of Crookes‘ radiometer, the device with four vanes in a glass tube that are rotated by sunlight, and which is often seen in jewelers‘ windows. He stated that the power output was many thousand times that of a Crookes‘ radiometer. “The attractive feature of the cosmic rays is their constancy. They shower down on us throughout the whole 24 hours, and if a plant is developed to use their power **it will not require devices for storing energy** as would be necessary with devices using wind, tide or sunlight. All of my investigations seem to point to the conclusion that they are small particles, each carrying so small a charge that we are justified in calling them neutrons. They move with great velocity, exceeding that of light. More than 25 years ago I began my efforts to harness the cosmic rays and I can now state that I have succeeded in operating a motive device by means of them.”

Note that this is about cosmic rays, not the sun's rays. “…harnessed the cosmic rays…”, meaning harnessed a force of nature rather than creating “radiant energy”.

"Insignificant" compared to industrial scale power. Dr. Tesla was always working on industrial scale power. He considered the power required by a town small.

“They shower down on us throughout the whole 24 hours…” means not sunlight. Dr. Tesla's “radiant energy” is not sunlight as in today’s photovoltaic systems.

No storage device agrees with the 1931 Pierce-Arrow story.

He may be speaking of neutrinos or what is known today as high energy cosmic rays. Coupled with his belief that these rays are what makes radioactive material emit rays, he may be talking of nuclear power.

More than 25 years ago would be 1907 or earlier.

Although patented in 1892, he now states that he has succeeded in building such a device and that it is of the type to acquire power anywhere, i.e. not a transmission system. Keep in mind it is not always necessary to build a demonstration device to obtain a patent.

I was able to prevail upon Dr. Tesla to give me some idea of the principle upon which his cosmic ray motor works. “I will tell you in the most general way”, he said. “The cosmic ray ionizes the air, setting free many charges – ions and electrons. These charges are captured in a condenser which is made to discharge through the circuit of the motor.”

This may mean he is capturing the secondary emissions in a condenser. The "discharge through the circuit of the motor" lends credence to the idea that this method was used in the 1931 Pierce-Arrow.

1933 09/10 Age 77

“Tremendous New Power Soon to be Unleashed”, by Carol Bird for Kansas City Journal-Post

“My first and most important discovery concerns the harnessing of a new source of power, hitherto unavailable, to be developed through fundamentally novel machines of my invention. ... My power generator will be of the simplest kind – just a big mass of steel, copper and aluminum, comprising a stationary and rotating part, peculiarly assembled. ... Such a source of power obtainable everywhere will solve many problems with which the human race is confronted.”

"Harnessing" means utilizing a natural source, not creating “radiant energy”. Power obtainable everywhere is the “power was to be developed on the spot by converting the energy of the sun’s radiations” from the November 30, 1898 *Electrical Review* article.

1937 07/11 Age 81

Sending of Messages to Planets Predicted by Dr. Tesla On Birthday", New York Times, July 11, 1937. —Inventor, 81, Talks of Key to Interstellar Transmission and Tube to Produce Radium Copiously and Cheaply."

Decorated by Yugoslavia and Czechoslovakia. Reports of discoveries by which it will be possible to communicate with the planets and to produce radium in unlimited quantity for $1 a pound were announced by Dr. Nikola Tesla yesterday at a luncheon on his eighty-first birthday at which he was honored with high orders from the Yugoslav and Czechoslovak Governments. Dr. Tesla, whose discoveries in electrical science have won for him recognition as the father of modern methods of generating and distributing electrical energy, asserted his "absolute" belief that he would win the Pierre Guzman prize of the Institute of France for his discovery relating to the interstellar transmission of energy. Following his annual custom, Dr. Tesla played host to a group of newspaper men at his birthday luncheon at the Hotel New Yorker and issued the announcement of his discoveries of the last year. No apparatus or sketches were shown, but Dr. Tesla said in announcing perfection of the principle of a new tube, which he said would make it possible to smash the atom and produce cheap radium, that he would be able to give a demonstration in 'only a little time.'

Why would it be important to generate radium for one dollar a pound? Dr. Tesla's theory is that the radium is activated by the cosmic rays and can be used to harness their energy. See the July 5, 1931 entry above.

To grasp the importance of one dollar per pound radium we need to look at the radium reserves of the time. I found the following article on the internet.

The Sydney Morning Herald, February 11, 1935, "Price of Radium. Big Drop Expected."

London Feb. 10.

"The 'Sunday Express' says: - 'By the development of sources of radium in the Great Bear Lake (Canada), which are believed to be sufficient to supply the whole Empire, it is expected that the value of radium will drop from £10,000 to £1,000 per gramme. The present world's stock is 600 grammes; London hospitals between them have three-quarters of an ounce (about 31 grammes) valued at £250,000.'"

http://trove.nla.gov.au/ndp/del/article/17152322

A British Pound in 1935 has the purchasing power of about £58 GBP today. So in 1935 the cost in today's money was £580,000 per gram and was expected to be reduced to £58,000 per gram. Dr. Tesla speaks of obtaining radium for $1.00 per pound and there are roughly 450 grams in a pound so that would be $0.0022 per gram at that time. Examine the following for a grasp of this:

What Things Cost in 1935: Car: $580, Gasoline: 19 cents/gal, House: $6,300, Bread: 8 cents/loaf, Milk: 47 cents/gal, Postage Stamp: 3 cents, Stock Market: 144, Average Annual Salary: $1,500

Consider this in the light of the reported 1931 Pierce Arrow automobile. Also keep in mind that governments did not begin regulating radioactive materials until the mid-1940's. It was said that the Pierce Arrow could power a home while not in use as a conveyance. It was reported to have a normal 12 volt battery. But would anyone at that time recognize an atomic battery? No, because no one had ever built one before. Imagine a battery case with the insides removed and layers of dielectric insulation, metal collector plates, and radium interleaved and placed inside the normal looking battery case. The 12 vacuum tubes reported could very well have been to rectify and control the power feed to the electric motor and they too could have radioactive materials in them to amplify the output of the battery. With the radium half life being 1601 years one battery would last many generations.

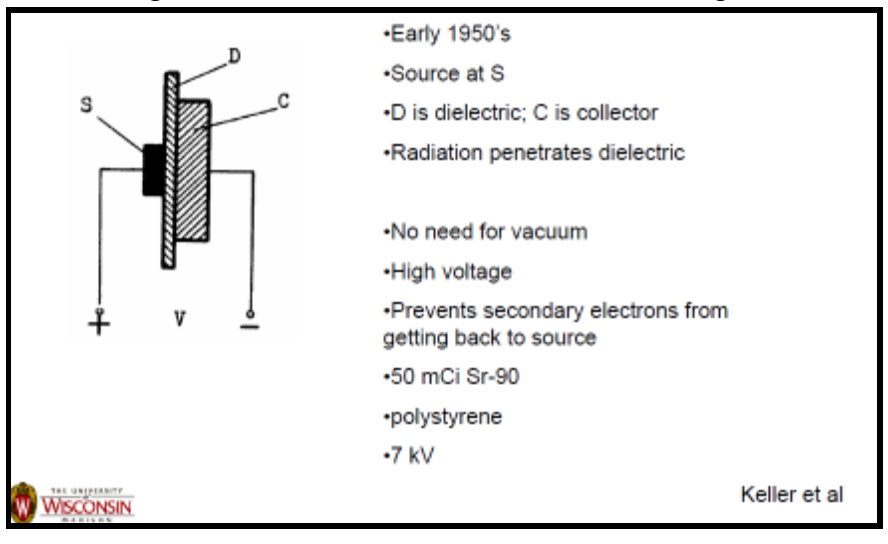
It has also been reported that Dr. Thomas Henry Moray's system of utilizing radiant energy also used vacuum tubes with radioactive elements. They were called valves at the time and used Germanium also. His work was done roughly from 1911 into the 1950's. Interestingly, he didn't run into problems with nefarious people until the mid-1940's - about the time the government began regulating radioactive materials. It was not until 1946 when President Truman signs the Atomic Energy Act of 1946 that government regulation was started. Keep in mind that the first nuclear weapon was used in 1945 so government had a very real reason for controlling radioactive materials. From that point forward government got further and further into regulating radioactive materials, their storage and transportation: Radioactive Material Regulations History Dr. Tesla died in 1943 before there were any regulations whatsoever on nuclear materials in the U.S.

By 1937 automobiles were being mass produced in great quantities so the importance of $1.00 per pound radium to power transportation, homes, and eventually industry would have been clear and the regulatory restraints were not yet in place so it was feasible to power the world with, in Dr. Tesla's thinking, cosmic ray activated radioactive materials. This could well have been his reason or refusing to participate in the Manhattan Project which weaponized radioactive materials.

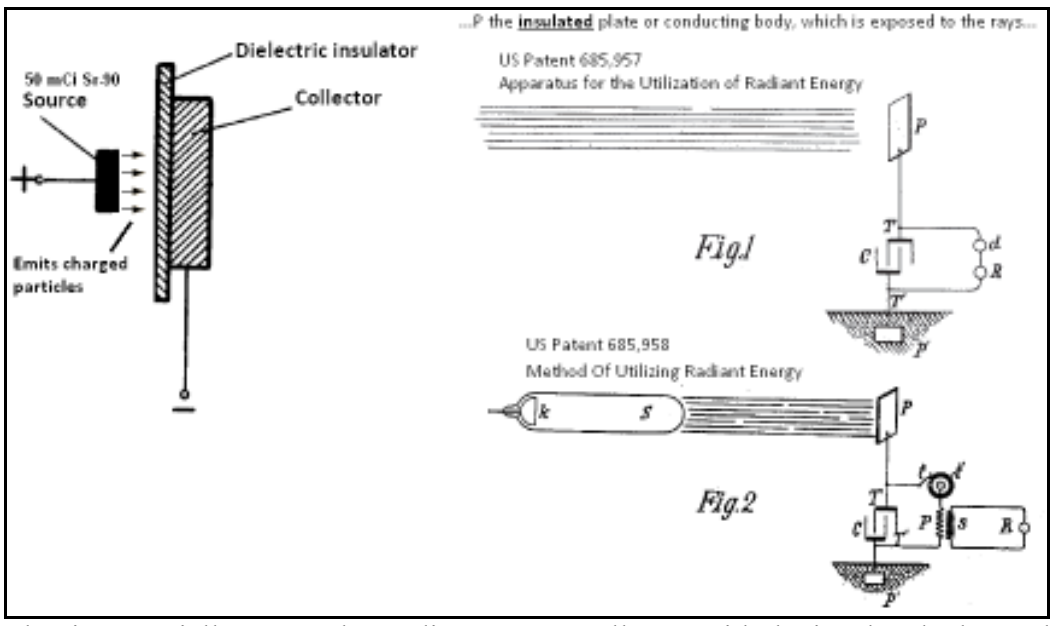
Of course all of this is conjecture but it has a basis in reality. In fact, nuclear batteries are in use today. These batteries are generally low power but perform their function for decades. They are typically used in applications where maintenance is difficult, if not impossible, and where the application is not able to use solar power arrays. The two Voyager spacecraft which will shortly exit the solar system into interstellar space use atomic batteries. Their distance from the sun makes solar arrays useless and service is out of the question. Russia has also used them in light houses around the Arctic Circle which are difficult to reach and, being near the pole, spend a lot of time in darkness.

These atomic batteries do not provide industrial scale power chiefly because the size and weight are limited. For example, the Voyager spacecraft has three atomic batteries but together they only provided 740 watts at their peak. That figure is slowly degrading - but very slowly. The spacecraft were launched in 1977 and are still running in 2013 and are expected to fall below the minimum required power levels of the spacecraft in 2025. That is forty eight years of continuous operation with zero failures and zero service.

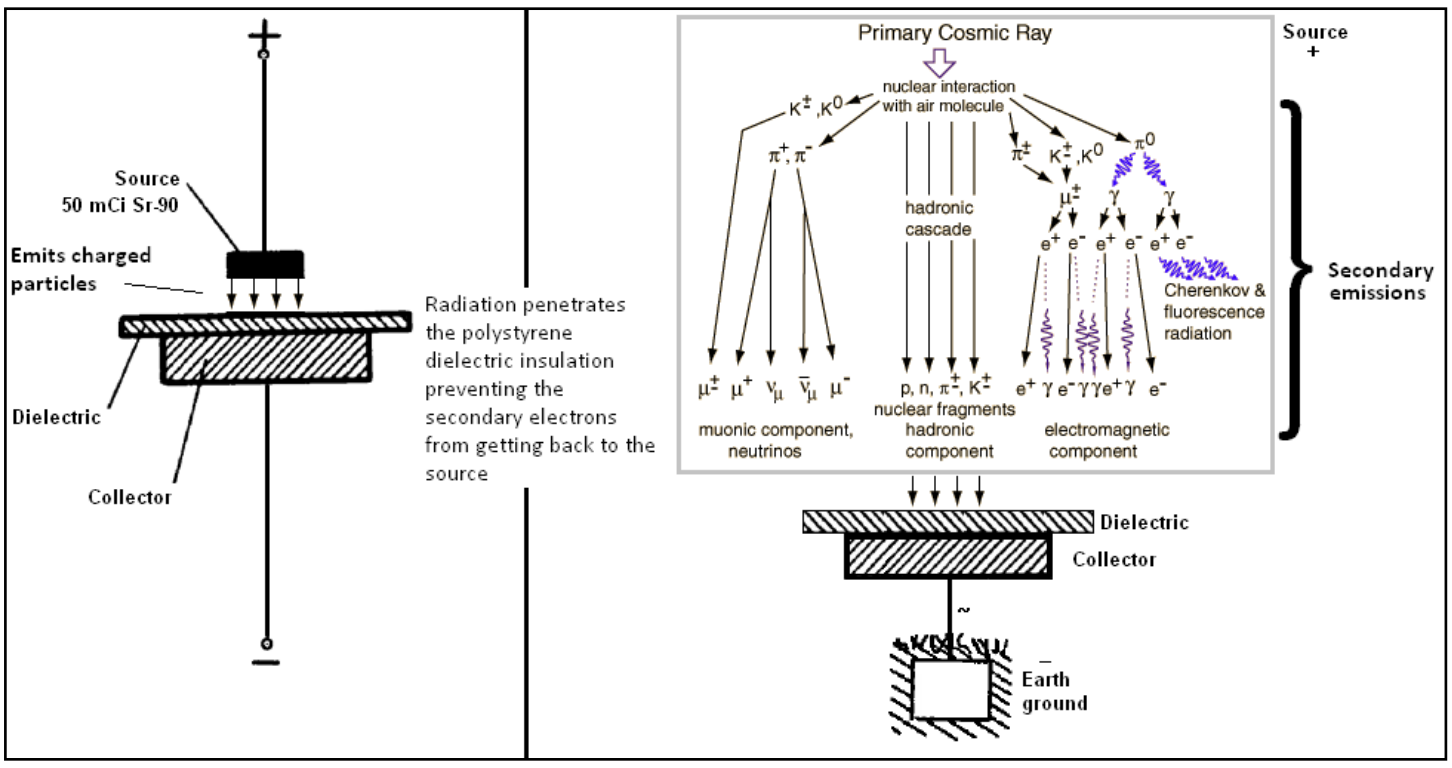
Researching the atomic batteries led me to the following link: Radioisotope Batteries for MEMS . On page 13 of that document is the following



The battery above can be redrawn as shown below and is very similar to Dr. Tesla's patent drawings.

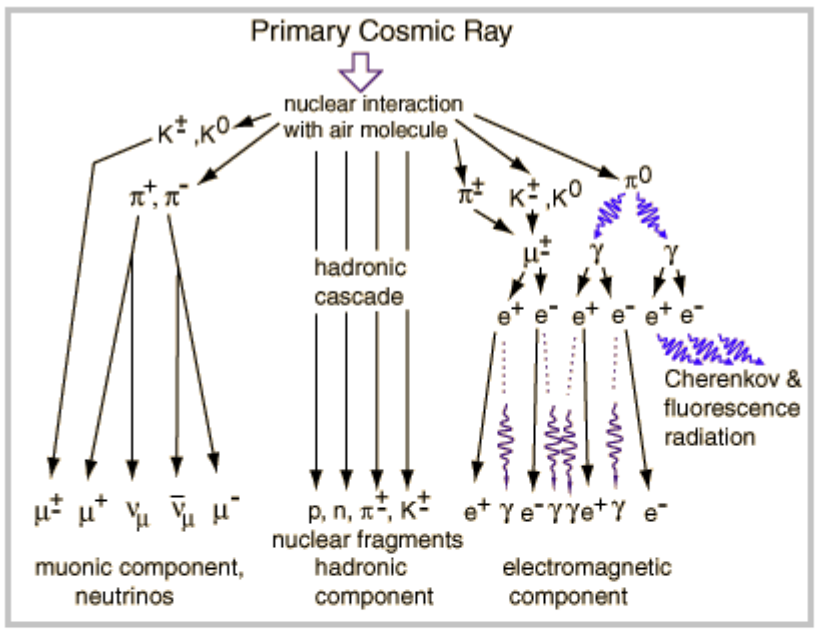


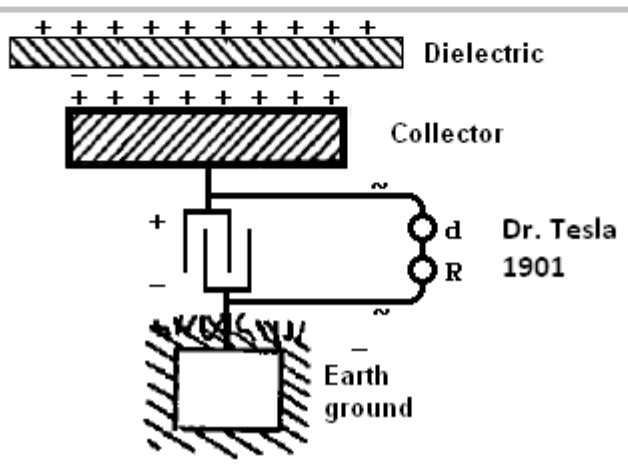
That is essentially Dr. Tesla's radiant energy collector with the insulated, elevated plate horizontal and the charged particles provided by cosmic rays rather than Strontium 90. Note that the plate is not only insulated but insulated with a dielectric, the purpose of which is to separate the charges and keep the collected charges in the conducting metal circuit by preventing them from equalizing with charges in the surrounding air.



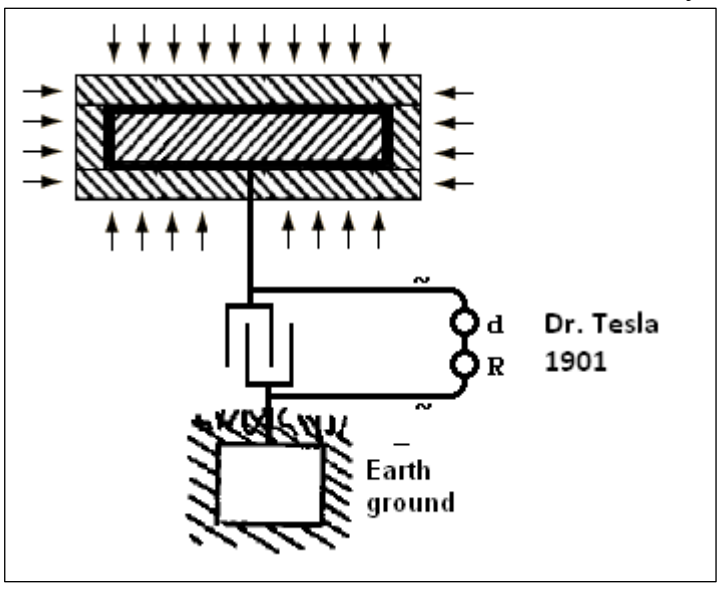
Interstellar cosmic rays penetrate the atmosphere from all directions at all times. They are not, however, constant so the charge is not constant. It is not like a battery but an undulating or pulsing charge. Dr. Moray described it like surging waves in the ocean.

The secondary emissions of the cosmic rays contain positive, negative, and neutral particles. The polarization of the dielectric insulation separates the charges. The negative charge imparted to the collector by its connection to the earth ground draws the positive charges in the dielectric insulation toward the collector, placing the negative charges on the opposite side to attract more positive charges from the secondary emissions of the cosmic rays. Since the secondary emissions are not constant the pulsating charges makes the current in the cable between the collector and the earth ground an AC current, albeit without a fixed frequency so it is not like the AC current we typically think of.





Since the particles are coming from all directions, the collector, the conductor connecting the ground plate, and the circuit connection wire must all be insulated to prevent the charges collected from equalizing with charges in the ambient medium. What would we have if the outside of the dielectric were coated with radium? An atomic battery.



1937 08/22 Age 81

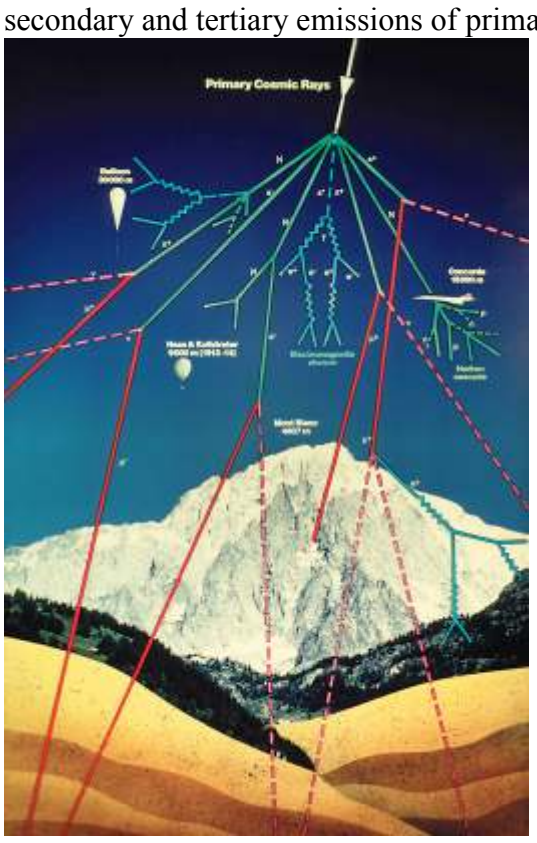
"In the Realm of Science: Tesla. Who Predicted Radio, Now Looks Forward to Sending Waves to the Moon", by John J. O'NEILL for *New York Herald Tribune*

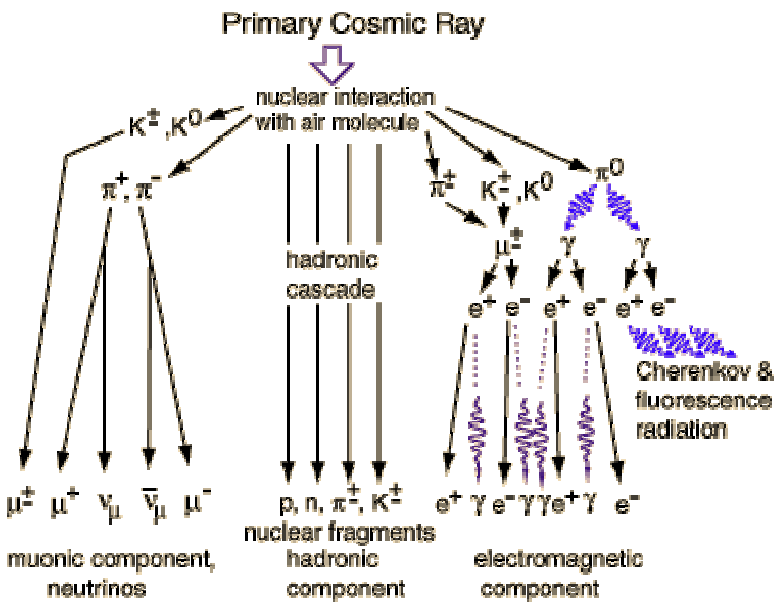
While the origin and character of the rays observed near the earth's surface had thus been sufficiently well ascertained, the so called cosmic rays observed at great altitudes presented a riddle for more than twenty-six years, chiefly because it was found they increased with the height at a rapid rate. My investigations brought out the astonishing fact that the effects at high altitude are of an entirely different nature, having no relation whatever to cosmic rays. These are particles from celestial bodies at very high temperatures and charged to enormous electrical potentials."

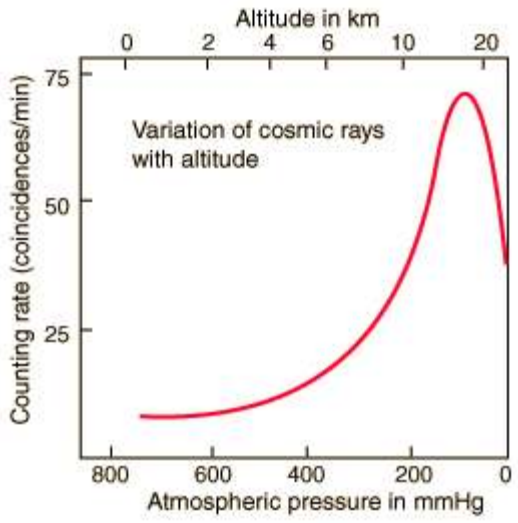
Not the secondary or tertiary emissions of cosmic ray collisions but the primary cosmic rays. The next sentence seems to contradict this, however.

"The effects at great elevations", Dr. Tesla continued, "are due to waves of extremely small lengths produced by the sun in a certain region of the atmosphere. This is the discovery I wish to make known. The process involved in the generation of the waves is the following: The sun projects charged particles constituting an electric current which passes through a conducting stratum of the atmosphere approximately ten kilometers (six miles) thick enveloping the earth. This is a transmission of electrical energy exactly as I illustrated in my experimental lecture in which one end of a wire is connected to an electric generator of high potential, its other end being free. In this case the generator is represented by the sun and the wire by the conducting air. The passage of the solar current involves the transference of electrical charges from particle to particle with the speed of light, resulting in the production of extremely short and penetrating waves. As the air stratum mentioned is the source of the waves it follows that the so-called cosmic rays observed at great altitude must increase as this stratum is approached."

The seeming contradiction can be resolved when one understands that the cosmic rays observed near the surface are not primary cosmic rays but secondary and tertiary emissions of primary cosmic rays colliding with matter in the atmosphere as shown in the images below.







1943 01/07 Age 86

Dr. Tesla dies and the world loses a great mind and a tenacious spirit.

SYNOPSIS

Dr. Tesla's radiant energy is all around us all the time. He started his research with simple things that he could see around him like sun light, arc lights, and Bunsen burners. They all emit radiant energy in the form of light and heat. He concluded the radiated energy was from "corpuscular" matter and set out to determine how to harness nature's radiant energy from the sun, not create something called radiant energy. At the time the atom was believed to be the indivisible minimum of matter. He developed vacuum tubes to explore the properties of radiated corpuscular matter.

As his work progressed so did the work of others and he incorporated their findings into his thinking, thus changing his ideas about what radiant energy really was and how it could be harnessed.

So what is the "radiant energy" that Dr. Tesla wished to harness? First, what it is not.

It is not something generated by some device he made. His vacuum tubes were for studying the properties of radiant energy. Although they did generate radiant energy they required another power source to accelerate the particles to radiant energy levels. His desire was to harness natural

radiant energy. We can look at his vacuum tubes as a source of artificial, not natural, radiant energy used to study the rays under controlled conditions.

It is not radiant energy from the sun. Although he started his investigations with the sun's radiations, he later found a more constant source and even made it clear that he considered the sun's rays "feeble" which they are when compared to cosmic rays made up of subatomic particles accelerated by galactic processes to near light speed. While the sun's rays are used today in photovoltaic systems, the problem with sun light is inconsistency and storage during the dark hours.

Now, what it is.

Radiant energy is the energy of charged subatomic particles accelerated to tremendous speeds by astrophysical processes throughout the universe such as gamma ray bursts, supernovas and black hole polar jet emissions. Some, today called neutrinos, have next to no mass or charge and are very hard to detect much less harness. Others are known as a few types of high energy cosmic rays which have lower energy and more, yet minute, mass. They arrive at the earth from all directions and at all times.

We are constantly bombarded with these particles but due to their low mass we don't notice them or, in that we are constantly bombarded by them even in the womb, we grow so accustomed to them that they become background noise. We are, to a great extent, shielded from them by the atmosphere but the occasional particle does penetrate the atmosphere while most cause several generations of emissions through collisions with atoms and molecules in the atmosphere setting up what we call static electricity which is a misnomer. Static implies unmoving while nothing, absolutely nothing, in the universe is truly static. Even "static" electricity is carried by particles and molecules moving around in the atmosphere which is constantly in motion and constantly bombarded by other particles from all directions. Everything from subatomic particles to galaxies is in motion - there is no static anything anywhere. Perpetual motion? I think so. Will the universe end some day? The opinions of astrophysicists vary so the best that can be said is, um, well, um maybe. Maybe not. Our sun is estimated to last another five billion years. Perpetual? Close enough, in my opinion. And that's just our sun. The universe will still be churning away.

DEVELOPMENT

So now that we know what we are looking for we can determine some parameters for developing a system for capturing this energy.

Does it require radioactive materials? Although beneficial, they are not required for small scale implementations. Keep in mind that Dr. Tesla was interested in economically feasible industrial scale power systems. The following quote is before he expected to use radioactive materials and he was still thinking the rays were from the sun. Although radium was identified in 1898 it had not become a part of Dr. Tesla's thinking at the time he made the statement below.

1900 06 Age 44
Century Illustrated Magazine

"I worked for a long time fully convinced that the practical realization of the method of obtaining energy from the sun would be of incalculable industrial value, but the continued study of the subject revealed the fact that while it will be commercially profitable if my expectations are well founded, it will not be so to an extraordinary degree."

If we are interested in small scale power rather than industrial scale power the task is much less daunting than creating economically feasible industrial scale power. Any power we develop that replaces power derived from the commercial power we use today will be profitable in that it will reduce that expense. Of course we need to determine if it is economically sensible to do it. Spending $100,000 to replace $50,000 worth of electricity would not be sensible.

The higher the altitude above sea level of the system, the thinner the atmosphere and therefore the more energy that can be obtained with the system because the particles have given up less energy to the atoms in the atmosphere. For the same reason the, the lower the humidity (or any airborne particulates), the more energy may be collected.

The greater the area of the dielectric and the collector plate exposed to the cosmic rays, the greater the number of cosmic rays which will impact it and transfer energy to it. The rays impacting perpendicular to the surface of the earth will have traversed the least amount of atmosphere and will deliver more energy than those traversing on a tangent to the ground so it makes sense to position the elevated, insulated plate parallel to the ground. We still need to deal with the atmosphere and its winds so we need a design that can be aerodynamically sound.

The insulation of the polished, elevated plate is critical. It serves several purposes. First it intercepts the particles and they give up energy to it. For this reason the dielectric properties of the insulation are important.

The dielectric polarizes the charges such that those with the opposite polarity of the ground connection are drawn to the conducting plate. This aligns those charges that are the same as the ground connection to the outside of the dielectric which, in turn, attracts more of the charges of opposite polarity.

The dielectric insulation also constrains the collected charges to the metal conductors in the system so that they do not neutralize with charges in the surrounding atmosphere. For this reason the dielectric insulation must totally surround the elevated plate to prevent any charge collected from being dissipated to the atmospheric components surrounding it. For the same reason, all wiring and connections must be insulated from the atmosphere to prevent dissipation. Totally covering the conducting plate with dielectric yields another benefit, namely that no metal is exposed to the atmosphere so no ionization around the metal collecting plate occurs to attract lightning.

For these reasons we want a dielectric with as high a dielectric constant as possible to enhance the polarization of charges and as low a dissipation factor as possible to reduce energy losses within the dielectric by conversion of the collected energy to heat. Of the two, the dissipation factor is the more important.

The reason the plate needs to be highly polished is so it makes the best contact possible with the dielectric material to convey as much charge as possible to the conductors.

This system does not collect direct current electricity. The energy collected is from the impacts of the charged particles so it is not normal sine wave alternating current either. It is impulse energy - tiny impulses created by the impacts of subatomic particles. As the cosmic rays are arriving from sources from all directions and those sources are at varying cosmological distances, while the particles may arrive at the same time, there is no fundamental frequency of the transmitted energy. It is broadband energy and, if not totally random, then very nearly so. Dr. Moray said it sounds like waves surging in an ocean when listening to it with headphones. One might consider it to be more like the white noise of a radio tuned to a channel that does not contain a transmission.

We can, however, impose a frequency upon the electrical energy after it is collected. Dr. Tesla states that this system will continuously charge a condenser even to the point of bursting. So what we can do is accumulate the energy in a condenser and at a regular period partially discharge the condenser through a quenched spark gap and, with resonance and constructive interference of that discharge, slowly build up useable power. The trick here is not to deplete the condenser much faster than it is charged. That rate of charge will depend on the size of the elevated, insulated plate, its elevation above sea level, and the quality of the grounding system. Those factors also control how fast we can use the power from the system because it determines how fast the condenser charges.

Speculation: sufficiently high voltage in the spark gap placed such that the discharge occurs between two insulated plates may gather radiant energy from the spark gap itself, improving efficiency.
^^^^^^??here

I did have one very interesting observation while testing a small system which I believe confirms all of this. While taking readings at the output of the circuit one night there was a cold front moving through the area. It was north of me and traveling west to east. The rain had not yet reached my location. While I was taking the reading there was a flash of lightning that seemed to be from cloud to cloud. I don't know how far away it was and I wasn't really sure what I was seeing at the time so didn't think to count seconds until the thunder arrived but it seemed a long time - maybe 20 or 30 seconds. When the lightning flashed it lit up my insulated, elevated plate so that it stood out in the dark. It uses white, high density polystyrene as the dielectric insulation so it was very visible in the flash. When the flash occurred, my voltage reading immediately jumped to four times its reading and then slowly went back down to the initial reading.

This event first made me think of Dr. Tesla's July 4, 1899 observation about lightning discharges traversing the globe. But I realized that was not the case because the lightning was between clouds and the ground was not involved. A little research revealed that lightning does indeed emit gamma rays and X-rays, e.g. subatomic charged particles.