

September 22, 1929

NIKOLA TESLA TELLS OF NEW RADIO THEORIES \*  
– Does Not Believe in Hertz Waves and Heaviside Layer, Interview Discloses

The model of a "Tesla Coil" which will be featured in the historic exhibit of the radio show reawakens interest in its inventor.

It is not generally appreciated that this curious apparatus, often associated with pretty or spectacular demonstrations of high voltage electricity, is really a fundamental part of modern radio. For all the tuning apparatus and circuits in every transmitting and receiving set are simply variations of Tesla coils and Tesla coil circuits.

It was for this invention, and other inventions and principles concerned with tuning, heterodyning, and the generation of continuous waves, which were made at least several years before the very first experiments of Marconi, that many of our most reputable engineers have conceded to Nikola Tesla the title of "Father of Radio".

Mr. Tesla, still actively working, was interviewed last week to get his ideas regarding the prospects of the radio of 1930, and beyond. As a prophet, however, he balked. He had repeated time and again his visions for the future. As far back as 1900, he had contemplated a world-wireless system which included broadcasting, picture transmission, international time service, and in addition television and the distribution of electrical power. Part of this early prophecy has been realized — what remained, still stood as his prediction..

Disputes Hertz Waves.

What, then, about power transmission by radio? Laurence M. Cockaday, the technical editor of this radio section, had expressed the opinion several weeks ago that, with present apparatus at least, it was hardly feasible. Mr. Tesla agreed to discuss the point at length. As a result, he made public for the first time one of the most extraordinary conclusions - that Hertz waves do not exist! If his theory is true, there may be found in it more adequate explanations of "dead spots", fading, reflection and a dozen other problems that have always puzzled the profession.

The inventor began by referring to Cockaday's article:

"I have read the article, and I quite agree with the opinion expressed — that wireless power transmission is impractical with present apparatus. This conclusion will be naturally reached by any one who recognizes the nature of the agent by which the impulses are transmitted in present wireless practice.

"When Dr. Heinrich Hertz undertook his experiments from 1887 to 1889 his object was to demonstrate a theory postulating a medium filling all space, called the ether. which was structureless, of inconceivable tenuity and yet solid and possessed of rigidity incomparably greater than that of the hardest steel. He obtained certain results and the whole world acclaimed them as an experimental verification of that cherished theory. But in reality what he observed tended to prove just its fallacy.

"I had maintained for many years before that such a medium as supposed could not exist, and that we must rather accept the view that all space is filled with a gaseous substance. On repeating the Hertz experiments with much improved and very powerful apparatus, I satisfied myself that what he had observed was nothing else but effects of longitudinal waves in a gaseous medium, that is to say, waves, propagated by alternate compression and expansion. He had observed waves in the ether much of the nature of sound waves in the air.

"Up to 1896, however, I did not succeed in obtaining a positive experimental proof of the existence of such a medium. But in that year I brought out a new form of vacuum tube capable of being charged to any desired potential, and operated it with effective pressures of about 4,000,000 volts. I produced cathodic and other rays of transcending intensity. The effects, according to my view, were due to minute particles of matter carrying enormous electrical charges, which, for want of a better name, I designated as matter not further decomposable. Subsequently those particles were called electrons.

"One of the first striking observations made with my tubes was that a purplish glow for several feet around the end of the tube was formed, and I readily ascertained that it was due to the escape of the charges of the particles as soon as they passed out into the air; for it was only in a nearly perfect vacuum that these charges could be confined to them. The coronal discharge proved that there must be a medium besides air in the space,

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composed of particles immeasurably smaller than those of air, as otherwise such a discharge would not be possible. On further investigation I found that this gas was so light that a volume equal to that of the earth would weigh only about one-twentieth of a pound.

"The velocity of any sound wave depends on a certain ratio between elasticity and density, and for this ether or universal gas the ratio is 800,000,000,000 times greater than for air. This means that the velocity of the sound waves propagated through the ether is about 300,000 times greater than that of the sound waves in air, which travel at approximately 1,085 feet a second. Consequently the speed in ether is  $900,000 \times 1,085$  feet, or 186,000 miles, and that is the speed of light.

"As the waves of this kind are all the more penetrative the shorter they are, I have for years urged the wireless experts to use such waves in order to get good results, but it took a long time before they settled upon this practice.

"Although the world is still skeptical as to the feasibility of my undertaking, I note that some advanced experts, at least, share my views, and I hope that before long wireless power transmission will be as common as transmission by wires."

According to Mr. Tesla, the present broadcasting station does not propagate Hertzian waves, as has always been supposed, but acts more like an "ether whistle" — transmitting waves through the ether similar to the waves transmitted by an ordinary whistle through the air. He also expressed his disbelief in the Heavenside layer, and claimed that the reflection of waves back toward the earth was due to the change of medium encountered at the vacuous boundary of the atmosphere.

At Colorado Springs, about thirty years ago, this scientist had a Tesla coil seventy-five feet in diameter which produced voltages above 12,000,000, and sparks over 100 feet long. Electrical flashes were created which were the nearest approach to lightning that man has ever made. During his experiments there, of over a year, Tesla claims that he transmitted a considerable amount of electrical current to the other side of the earth. It was upon these, and later experiments that he bases his present prediction.

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PIONEER RADIO ENGINEER GIVES VIEWS ON POWER\*

Tesla Says Wireless Waves Are Not Electromagnetic, But Sound In Nature  
Holds Space Not Curved  
Predicts Power Transmission to Other Planets

by Nikola Tesla

The assumption of the Maxwellian ether was thought necessary to explain the propagation of light by transverse vibrations, which can only occur in a solid. So fascinating was this theory that even at present it has many supporters, despite the manifest impossibility of a medium, perfectly mobile and tenuous to a degree inconceivable, and yet extremely rigid, like steel. As a result some illusionary ideas have been formed and various phenomena erroneously interpreted. The so-called Hertz waves are still considered a reality proving that light is electrical in its nature, and also that the ether is capable of transmitting transverse vibrations of frequencies however low. This view has become untenable since I showed that the universal medium is a gaseous body in which only longitudinal pulses can be propagated, involving alternating compressions and expansions similar to those produced by sound waves in the air. Thus, a wireless transmitter does not emit Hertz waves which are a myth, but sound waves in the ether, behaving in every respect like those in the air, except that, owing to the great elastic force and extremely small density of the medium, their speed is that of light.

Suggested Short Waves Early

Since waves of this kind are all the more penetrating, the shorter they are, I have urged the experts engaged in the commercial application of the wireless art to employ very short waves, but for a long time my suggestions were not heeded. Eventually, though, this was done, and gradually the wave lengths were reduced to but a few meters. Invariably it was found that these waves, just as those in the air, follow the curvature of the earth and bend around obstacles, a peculiarity exhibited to a much lesser degree by transverse vibrations in a solid. Recently, however, ultrashort waves have been experimented with and the fact that they also have the same property was hailed as a great discovery, offering the stupendous promise to make wireless transmission infinitely simpler and cheaper.

It is of interest to know what wireless experts have expected, knowing that waves a few meters long are transmitted clear to the antipodes. Is there any reason that they would behave radically different when their length is reduced to about half of one meter?

Waves Go Around World.

As the general knowledge of this subject seems very limited, I may state, that even waves only one or two millimeters long, which I produced thirty-three years -ago, provided that they carry sufficient energy, can be transmitted around the globe. This is not so much due to refraction and reflection as to the properties of a gaseous medium and certain peculiar action which I shall explain some time in the future. At present it may be sufficient to call attention to an important fact in this connection, namely, that this bending of the beam projected from reflector does not affect in the least its behavior in other respects. As regards deflection in a horizontal plane, it acts just as though it were straight. To be explicit the horizontal deviations are comparatively slight. In a proposed ultrashort wave transmission, the vertical bending, far from being an advantage, is a serious drawback, as it increased greatly the liability of disturbances by obstacles at the earth's surface. The downward deflection always occurs, irrespective of wave length, and also if the beam is thrown upward at an angle to the horizontal, and this tendency is, according to my finding, all the more pronounced the bigger the planet. On a body as large as the sun, it would be impossible to project a disturbance of this kind to any considerable distance except along the surface.

It might be inferred that I am alluding to the curvature of space supposed to exist according to the teachings of relativity, but nothing could be further from my mind. I hold that space cannot be curved, for the simple reason that it can have no properties. It might as well be said that God has properties. He has not, but only attributes and

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these are of our own making. Of properties we can only speak when dealing with matter filling the space. To say that in the presence of large bodies space becomes curved, is equivalent to stating that something can act upon nothing. I, for one, refuse to subscribe to such a view.

Need Radio Channels.

The chief object of employing very short waves is to provide an increased number of channels required to satisfy the ever-growing demand for wireless appliances. But this is only because the transmitting and receiving apparatus, as generally employed, is ill-conceived and not well adapted for selection. The transmitter generates several systems of waves, all of which, except one, are useless. As a consequence, only an infinitesimal amount of energy reaches the receiver and dependence is placed on extreme amplification, which can be easily affected by the use of the so-called three-electrode tubes. This invention has been credited to others, but as a matter of fact, it was brought out by me in 1892, the principle being described and illustrated in my lecture before the Franklin Institute and National Electric Light Association. In my original device I put around the incandescent filament a conducting member, which I called a "sieve." This device is connected to a wire leading outside of the bulb and serves to modify the stream of particles projected from the filament according to the charge imparted to it. In this manner a new kind of detector, rectifier and amplifier was provided. Many forms of tubes on this principle were constructed by me and various interesting effects obtained by their means shown to visitors in my laboratory from 1893 to 1899, when I undertook the erection of an experimental world-system wireless plant at Colorado Springs.

During the last thirty-two years these tubes have been made veritable marvels of mechanical perfection, but while helpful in many ways they have drawn the experts away from the simpler and much superior arrangement which I attempted to introduce in 1901. My plans involved the use of a highly effective and efficient transmitter conveying to any receiver at whatever distance, a relatively large amount of energy. The receiver is itself a device of elementary simplicity partaking of the characteristics of the ear, except that it is immensely more sensitive. In such a system resonant amplification is the only one necessary and the selectivity is so great that any desired number of separate channels can be provided without going to waves shorter than a few meters

For this reason, and because of other shortcomings, I do not attach much importance to the employment of waves which are now being experimented with. Besides, I am contemplating the practical use of another principle, which I have discovered and which is almost unlimited in the number of channels and in the energy three-electrode tubes. This invention has been credited to others, but as a matter of fact, it was brought out by me in 1892, the principle being transmitted. It should enable us to obtain many important results heretofore considered impossible. With the knowledge of the facts before me, I do not think it hazardous to predict that we will be enabled to illuminate the whole sky at night and that eventually we will flash power in virtually unlimited amounts to planets. It would not surprise me at all if an experiment to transmit thousands of horsepower to the moon by this new method were made in a few years from now.