

FORGOTTEN INVENTIONS OF LENR

Part 1: Electric Energy-Producing Effects and Inventions Driven by LENR

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Introduction

Since its inception as organized research in the 1980s, LENR tests were focused on excess heat production and transmutation in the order of ppm and micrograms, mainly as an academic investigation. The technical field is electrochemistry.

At the same time, P.K. Shukla predicted the formation of dust-acoustic waves—far from the LENR field. But most LENR scientists are unaware of early dusty plasma experiments. More than a century ago, in 1907, the transmutation of hydrogen into helium and neon was observed by several researchers in gas discharge tubes. It has happened in dusty plasma, and the dust was created by erosion, or sputtering.

V. Mitkevich published a strange observation in Russian, in St. Petersburg, in 1905: an interrupted arc discharge showed an anomalous energetic “kick.” The voltage in the arc reversed at the moment when the arc was disrupted.

At about the same time, Nikola Tesla and Henry Moray (both of them radio developers) observed that they could get huge electric impulses from discharge tubes with strange shaped electrodes. Then similar devices surfaced from time to time and sank into oblivion.

In 1905, a young assistant professor of physics in Vienna found that strange forces acted on dust particles floating in the air.

The aim of this review paper is to show that different aspects of LENR were discovered in due course, in the early 1900s. Thus there is a vast, and yet untapped, opportunity to generate electricity from inexpensive LENR-driven tabletop devices in a controllable way.

All that is needed is to connect the dots, grasp the hitherto unknown connections between:

- the physical features of oscillating dusty plasma
- the insights and results of early and recent LENR research
- the forgotten transmutation and voltage reversals in discharge tubes
- the forgotten electricity-producing inventions containing dust-producing discharge tubes

Today tabletop plasma-based particle accelerators are being developed in the backwaters of mainstream physics, independently of the above areas, which provide better accelerations than giants like in CERN. They are laser or electron beam-driven plasma “wake field” accelerators. This is

the principle behind the “next big leap” in particle accelerators.

Transient dusty plasma offers even higher local accelerations and energy levels (in the order of several GeV range) at a fraction of the expense and energy input of today’s accelerators.

The forgotten transmutation and voltage reversal results in discharge tubes are examples of early experiments in transient dusty plasma effects. The same holds for the string of forgotten excess electric energy-producing inventions.

In this context, LENR-driven plasma discharge devices are just the art of how to create high local spatial and temporal non-equilibrium conditions, in order to create extreme accelerating electric fields for Coulomb shielding, and thus fusion. This is done by self-organized, highly non-linear effects.

The physical features of dusty non-equilibrium plasma waves will be briefly reviewed in the Appendix (Part 4). Thus the reader shall grasp the plausible events behind the forgotten plasma discharge transmutation effects and inventions. The reader will be able to understand the identical physics behind the reviewed inventions, though technically not all of them are economic. The most feasible paths to exploit the release of LENR-based electric energy will be shown.

In the last 50 years, there have been no radical, disruptive new inventions which drove the economy, or industrial productivity so markedly as the steam engine, or electricity, or semiconductors.

Now LENR effects in the oscillating dusty plasma wave environment offer such an opportunity at the same scale, but they can be done only against the wind of mainstream science.

If this breakthrough ever succeeds, the devices will be revolutionary old inventions.

The age-old riddle of what drove these devices has a clear intelligent answer within the context of LENR effects. Ether oscillations, or a violation of energy conservation, is not the right answer here.

Part 1 of this series, herein, gives the history of LENR discoveries from 1900-1930.

Part 2 will mainly describe Moray’s electric energy-producing invention.

Part 3 will detail other similar electric energy-producing

inventions.

Part 4 will focus on transmutation and briefly on the Mitkevich experiment. This final paper will include an Appendix on the physics of dusty plasma.

The Importance of Correct Physical Models

Earth-centered models were inappropriate to describe the motion of planets. The heliocentric model of Kepler, and the Newtonian model of gravity, gave a better approach. But at that time it was lethal to propose such “nonsense” against the wrath of the Catholic church. The field concept of electrodynamics also met extreme skepticism, despite the self-consistence of the experimental results of Oersted, Ampere and Faraday. Papers by Maxwell were not rejected outright, just ignored, because they were not describing electrodynamics in terms of mechanics. Maxwell tried desperately to invent a sort of ether, consisting of tiny rotating, connected wheels, but it was a wrong set of ideas. Electrodynamics had to be based on a different theoretical foundation—fields.

In medicine the situation now is similar, and disastrous. Take cardiovascular diseases, which kill literally millions of people each year. There the embalmed idea is that excess cholesterol consumption causes cholesterol build-up in the arteries (atheroma), slowly clogging blood circulation.

The mainstream completely ignores experimental evidence contradicting this idea: Eskimos, or African herders, have very high cholesterol intake, but have hardly any heart attacks. The model is plain wrong. Yet cholesterol lowering drugs (statins) became a really big business, which became the cash cow of the pharmaceutical industry. No matter what the evidence is against the mainstream theory, the situation is hopeless. Scientific papers and alternative cures are banned outright.

The situation is just the same in cancer cures. No matter how many people are killed by the “treatments”—poisons—the symptoms are treated, not the cause. The “official” model of cancer is plain wrong. The fact that the weakened immune system must be mended—cured—is a sheer heresy, and this idea is suppressed at every level.

Science as a method creating models of reality is crushed by science as an institution. Science as a body of knowledge and a set of observations is strictly guarded by science as an institution.

However, it is common practice that evidence contradicting mainstream ideas is banished, not to compete with mainstream ideas.

In astronomy, there is overwhelming evidence that spiral galaxies do not obey Newtonian or Einsteinian dynamics. Yet these models are so deeply entrenched that the present fashionable dark matter and dark energy concept is introduced and sought vigorously.

Alternative concepts, such as Modified Newtonian Dynamics, are completely ignored, or banned. There is little progress, or none, without a correct model.

LENR

LENR (low-energy nuclear reactions) is in a similar situation but in a more twisted manner. Experimental results (and theoretical models) are banned in mainstream journals. No editors of these journals accept papers from this field. None of

them is interested that continued use of fossil fuels has already led to vanishing glaciers and melting ice cover of Antarctica and Greenland. Also, it doesn't matter that experimental and theoretical physics have not yielded any major useful results in the last two generations, since the 1960s.

During the previous two or three generations, physics was a continuous source of inspiring discoveries. It is a dead field now; few young talented people are attracted to it. Though investment in experimental physics is much higher in the last two generations than anytime before, it is counter-productive.

The more money poured into it, the less results obtained. The reason? The theoretical foundation, the framework of ideas, is exhausted and inflexible. Our “official” perception about nature, particularly about physics, and consequently about technology, is wrong.

No contesting experimental evidence and theoretical model is allowed for consideration or discussion.

To our gravest peril, the tiny field of LENR is in the same grave situation.

The purpose of this paper is to reflect upon this situation, to call the attention of the small group of LENR researchers to forgotten inventions and experiments (like the Oshawa transmutations), which are of utmost importance for us. That is, the LENR community should not ignore high mass transmutation, like the mainstream ignores LENR in general.

Therefore, the experimental evidence and theoretical implications are heresy within a heresy. Some researchers in low-energy nuclear reactions reject the possibility of transmutation of elements like C, O, N into Fe, Ni, Zn, Cu, etc. Nevertheless this can be a potential breakthrough area. It is worth considering these findings because they are the road to producing electrical and mechanical energy and some expensive metals as well, in a renewable, inexpensive way. Researchers in this area must know the field's own history.

Transient Dusty Plasma

The very idea of this paper was inspired by the history book of S. Krivit about the long forgotten early LENR transmutation experiments.¹

The lost history of early LENR transmutation effects is related to a single, small area: transient dusty plasmas.

Most gas discharges involve electrodes, whose metal surfaces are slowly degraded due to ion bombardment. This is called sputtering, and it generates fine dust.

The degree of erosion of the electrodes depend on the pressure, the discharge current (temperature) and the materials of the cathode and the bombarding gases. Nevertheless, *there is no gas discharge without the slow erosion (or sputtering) of surfaces*. Even in a high vacuum there is a moderate surface erosion. This has been the limiting factor of the longevity of the early incandescent light bulbs and radio tubes.

Significant experimental effort has been devoted to reduce this metal erosion, which turned the surface of light bulbs and vacuum “valves” opaque after awhile, due to an accumulating deposit of electrode materials—dust on the inner glass surface of vacuum tubes.

Lighting and radio were the driving force behind the “second industrial revolution,” which created big companies like GE, Philips, Telefunken, Tungsram, Osram and Westinghouse.

Of course, transistors were also invented and investigated as early as the 1920s by J.E. Lilienfeld, but transistors were shunned by the above-mentioned industrial giants. (See U.S. Patents 1877140 and 1745175.)

In order to reduce electrode erosion, high vacuum and quasi steady-state conditions were sought for the industrial applications.

However, already in the 1900s some researchers noticed something strange: helium and neon were detected by various researches in the atmospheric discharge of hydrogen filled discharge tubes, that is, transmutation took place. (More about it later.)

As early as 1902, Russian scientist V. Mitkevich noted that there was a counteracting force (reverse electromotoric Voltage and current) in transient arc discharges for a short period, right after the arc was disrupted. He published his careful investigations in 1905 in *Izvestija* (St. Petersburg Polytechnical Institute, Vol. 4, pp. 40-69).

He investigated the voltage/current characteristics with an early oscilloscope, the Brown tube, with a rotating mirror. The essential result was the following: When a high-current atmospheric arc is disrupted, there is a negative (counter acting) current directed from the anode to the cathode at the very moment of the disruption. However, not all electrode pairs have shown this feature.

Mitkevich tested different materials such as graphite, a graphite rod with a cavity, copper, aluminum, iron and mercury electrodes. He measured several Volts of "counter voltage" depending on the pair of materials. When the anode was carbon with a 9 mm diameter and the cathode was of a different material, he measured the following values: carbon/carbon: 12 V; carbon with cavity/carbon: 7 V; carbon/5 mm copper: 5 V; carbon/5 mm diameter aluminum: 8 V, with 8 mm iron anode: 10 V, with a mercury anode: 11 V.

Mitkevich speculated on the physical nature of the mysterious force which drove the electrons in the reverse direction, but he never investigated the quality or chemical nature of the gases. He did not describe the discharge in detail but it is apparent from figures in his paper that he used ambient atmospheric air, mixed with vapor.

Moreover, not all electrode pairs yielded the "reverse kick," or as he termed it, "the reverse electromotoric force of voltaic arc." He noted that he always found the reverse kick when the anode was a carbon rod, but when it was mercury, the reverse kick appeared only with the carbon cathode, not with the other cathode materials.

There were good results with identical cathode/anode pairs, like copper/copper 8V, alu/alu 16V, iron/iron 16V. The highest measured value was recorded for the copper/iron electrodes, 17V. He realized that electrode sputtering was necessary for the reverse electromotoric force to appear.

Gas discharge research was in its teething years in 1905. Results widely scattered, as quality control was difficult. There were no reliable methods to measure the composition of gases and electrode materials. Impurities were not controlled for decades to come. Nevertheless, this transient, energetic "reverse kick" kept on returning for the handful of researchers, like Ayrton, Eglund, Duddel, Blondel, Stark and Mitkevich, who was perhaps the most devoted researcher of the transient arc discharge.

Yet the Mitkevich effect, this anomalous, powerful reverse burst of electromotoric (driving) force, or potential, was not

caught up by mainstream science. At that time physics underwent a major shift of paradigm. The year 1905 was the "Annus Miserabilis," when Albert Einstein published his seminal papers about the photoelectric effect and special relativity.

Mitkevich's paper, written in Russian, published in Russia, was doomed to oblivion. (There was only one Russian paper at that time which ever made it to the mainstream—Anyiskov's paper about cholesterol in 1913.)

Mitkevich's careful investigation of the arguably LENR-driven reverse electromotive force effect had no explanation. To put it simply: it had no chance for survival in the highly competitive market for scientific attention. It did not even get to the increasing "data bank" of the "to be solved problems" of mainstream science. No textbook ever mentioned this effect about arc discharge, not even in Russian.

In fact, even steady-state arc discharge was not understood for decades to come. The disrupted arc effect had no chance for "survival," being short-lived, hard to observe, anomalous, discovered by a Russian and published in Russian.

Even radioactivity had to fight for decades for acceptance, as the research was done in France and by a woman!

It is a wonder that Mitkevich and some other researchers observed this anomaly at all, as the simple cathode ray tube (Brown tube) was their only tool. They did not experiment with arc in a vacuum tube, as for example carbon cathodes reached a temperature of 2700°C and anodes reached 3500°C, far above the melting points of their glass materials.

There is a further problem, a very tough one: the transient "reverse kick" effect is very complicated. It is relatively easy to make, like the Oshawa carbon arc transmutation, but hard to explain even now, more than a century later.

Scientists prefer to solve puzzles, but do not like to admit failure. Better to overlook it.

Electrode sputtering, transient dusty plasma and LENR (the essential ingredients for the solution) were not available. Even the very nature of matter, atomic and nuclear structure, was completely unknown then.

In principle it should not have been a hindrance for at least the acceptance of the problem. Jenner's method of inoculation with cowpox in the 1790s saved the life of millions from deadly plagues, yet it had no explanation for nearly 200 years!

Mitkevich's reverse kick effect has been rediscovered in several forms, always by accident, over and over again by several lucky (and unfortunate) inventors, and independently of mainstream science. Science as a collective enterprise of cooperating researchers failed again, to our shame. (The Mitkevich effect will be discussed in the Appendix by the dusty plasma initiated LENR model.)

Another aspect of transient arc discharge—transmutation of hydrogen into helium and neon—was observed by several British researchers, notably William Ramsey, J. Normann Collie, H.S. Patterson, all in 1907. They noticed the appearance of the distinct emission line of the He and Ne. Later J.J. Thomson, Orme Masson and G. Winchester made the same observation.¹

However, the mere idea of transforming (transmuting) hydrogen into helium seemed to be dangerously heretical. Instead, some of them (Thomson) thought these gases were trapped (occluded) in the electrode material, and released by hydrogen ion/proton bombardment. However, melting the electrodes and analyzing the gases did not support this

hypothesis. Nevertheless, accepting the possibility of transmutation became a heresy.

It had already been firmly established (by chemists with their methods) that it is impossible to transmute materials for stable elements. (Decades later this rigid point of view has been somewhat modified for artificial radioactivity).

Consequently, the above-mentioned observations of transmutation fell into oblivion. Along with it, the possibility that in transient, high frequency dusty plasma there is a door to transmutation—and to producing electrical energy.

The Real Tesla Car

Nikola Tesla, a prolific inventor, stumbled into this area of transmutation/energy release quite early, in the 1890s, with his “carbon button lamp.” Nearly a generation later he showed his electric car in the summer of 1931, in Buffalo, New York. His fusion-powered electric car was far more sophisticated than today’s Tesla car, which is (in its physical principle) nothing new. But Tesla worked at a quite different range of parameters of transient discharges. It is very important to acknowledge that not all discharges are born alike. The parameters of discharge that Tesla mastered during decades of diligent work was far above what we can do today.

The technology of his contemporaries used Ruhmkorff’s induction coil, which was capable of reaching 20-40 kV at about 20 kHz repetition rate, with some milliamperes of mean current.

Certainly, it was enough for some transmutation (fusion) to take place but it was just barely noticeable. Ramsay, Collier, Thomson, Masson, etc. did just that. At these modest parameters the transmutation rate and the energy release has been modest.

On the contrary, Tesla’s experiments produced hundreds of thousands of Volts discharge voltage, at 20-50 kHz cycle repetition rate, and up to several Amperes of peak currents. The method is not a secret but a completely forgotten and abandoned technology. It is a “single wire” method for air core resonant transformers.

Today, we learn at school that any electric circuit must be closed in order to function. Not so. The Tesla single wire system is a sort of longitudinal electric pulse system, shown in Figure 1.

This system is superior to create a high voltage transient plasma discharge but not for transporting energy for long distances like Tesla’s AC system. For that, his previously invented system—alternating current machines (with rotating magnetic fields)—is more suitable.

Today, resonant, air-core Tesla coils are used only for entertainment—to generate long sparks at science shows—but Tesla used them for his special single wire method to run gas discharge lamps and for communication, for the early radio. It was not a Hertzian transverse wave system, but a longitudinal one. Today, no textbook mentions longitudinal waves of electrodynamics. The famous textbook of Jackson even denies the possibility!

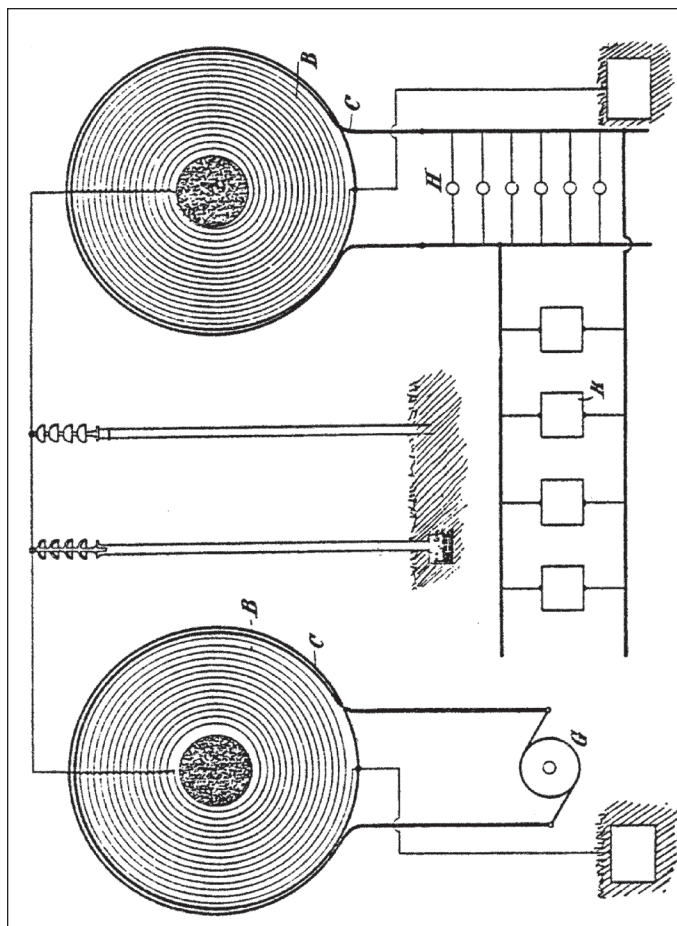


Figure 1. The high voltage, high frequency single wire Tesla system. See Figure 1, U.S. Patent 593,138 (November 2, 1897).

Today, at a physics lecture we are taught that there are three types of waves in mechanics: transverse, longitudinal and torsional. All of them have different velocities in a given solid medium. Classes in electrodynamics do not even mention the feasibility of longitudinal and torsional waves—the subject is completely shunned. (There are speculations that the Russian military is using it for submarine communication, as it penetrates deeper into sea water than the established ultra long wave transverse signals.)

Tesla built his longitudinal wave transmitter tower at Wardencliff, Long Island, with the half-hearted financial support of J. Pierpont Morgan. This startup didn’t make money, due to cost overruns as a consequence of unpredicted inflation.

Commercial radio and mobile communication systems using longitudinal waves never succeeded. It is still a feasible, but never used, business venue. Afterwards there was only one successful replication of the longitudinal radio by C. Monstein and J.P. Wesley in the 1990s, but even that fell on deaf ears in the physics community.²

Tesla had another commercially feasible application of the single wire, very high voltage technology: lighting.

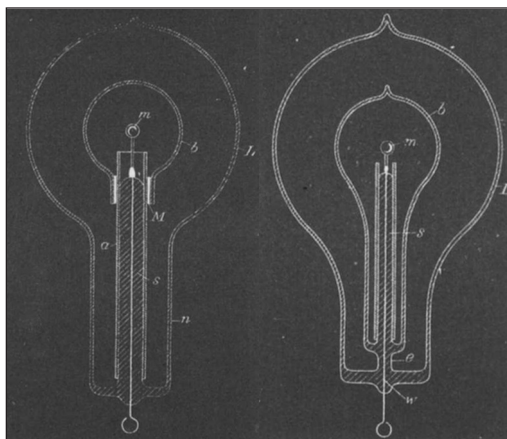


Figure 2. Tesla’s carbon button lamps.

His forgotten “carbon button” lamps³ are an unusual, but smart mixture of incandescent and gas discharge lamps. Figure 2 shows an example. The layout is deceptively simple. It is a small sphere made of carborundum in the middle of a spherical discharge cavity, filled with a gas.

When excited with a series of high voltage pulses, the gas radiates light, but the carborundum cathode is heated white hot, and also radiates a continuous spectra of solids. Tesla noted that the intensity of the light is much more intense than an incandescent light of equal electrical input. This unusually intense, bright light gave him a hint that there is something strange going on. He started to speculate openly about the behavior of ether. He surmised that ether can be somehow excited by resonance, and then energy is extracted and released from the ether. He considered resonant ether as a source of inexhaustible energy.

With hindsight, we can cautiously say it was the earliest successful LENR project. Perhaps it was the best because Tesla solved another crucial problem: to extract most of the excess energy in the form of electrical energy. There are some urban legends that he drove a “hacked” Pierce Arrow car (a luxury car of the day). Though this seems to be like a technical fairly tale, he was not alone.

In the 1910s a teenager, Henry Moray, stumbled into some similar effect in Salt Lake City, Utah. It took him several decades to develop his own system. He applied for a patent in 1931 but it was turned down. Yet some technical details, photographs and eyewitness affidavits remained. Moreover, some physicists stumbled onto an LENR effect again at about the same time, in the roaring 1920s.

Exploding Wires

The Wendt-Irion experiment is rather simple: A bank of batteries are suddenly shorted by a thin conducting wire. It is heated and explodes if the dissipated power is high enough within micro or milliseconds. In fact, a high density transient dusty plasma is created in an electric field.

The melting is not uniform. The wire explodes into a mixture of ionized metal vapor, and into metal droplets or dust. The vapor/dust ratio depends on technical parameters, like the specific power dissipation, ambient pressure, and wire material, etc.

The dust formation is helped not only by the heating/melting, but the long forgotten longitudinal Ampere forces, re-discovered by Peter Graneau.

Wendt and Irion observed the appearance of a significant amount of helium gas in the residue.

Apparently part of the exploding molybdenum nuclei in the wire fell into smaller pieces, into the helium nuclei. This is fission but not the usual neutron mediated fission of unstable uranium-235 or plutonium.

Stable tungsten/molybdenum nuclei changed. Only helium was noted by Wendt and Irion; no other materials were detected—nevertheless the case is still open. Was it a form of spallation, when only fragments of the nuclei left the heavy molybdenum nuclei, or they fell completely into pieces?

Though Wendt and Irion repeatedly made successful transmutation/fission LENR experiments, those were not repeated by other experimenters. Only half-hearted unsuccessful experiments were carried out but with a large spark going between the metal wires. Thus the available heating

current, and the Ampere forces, were severely curtailed and therefore the failure was natural.

The spallation/fission type effect was not completely unique. For example: Miethe and Stammreich found some gold in mercury arc discharge tubes, that is via spallation a deuteron/tritium nuclei was removed from the mercury nuclei. A similar feat was achieved by Japanese researcher Hantaro Nagaoka with an arc discharge with tungsten and mercury electrodes under transformer oil. The technical parameters are sketchy again so it would be difficult to find the right set of parameters where this effect takes place.¹

The Earliest Research of the Nano World

Felix Ehrenhaft, a young private assistant professor of physics at the University of Vienna, published the first paper on the forces appearing in the submicron or “nano” world in 1905.

It was about a very strange new force, when a tiny, floating submicron particle is illuminated. It rushes toward the light source, or from it depending on several parameters. It was not within accepted, mainstream physics. Today, with hindsight, one may assume that it was due to resonant surface plasmon polaritons excited on the particle. The resonance created very high electric field density; thus it heated ambient air. The dust particles driven by heat flew like rockets, depending on the site of resonant amplitude. This resonant phenomenon was already known to Roman, and medieval glass makers. A tiny amount of suspended colloidal silver or gold in the glass made glass panels bright on cathedral windows due to a resonant excitation by light of submicron/nano-sized metal particles. Collective, high energy, resonant electron waves are generated on the surfaces of tiny dust/colloid/particles, as precursors to LENR phenomena. Do not forget that biological transmutations take place in such an environment, at low energies.

Ehrenhaft was the first to measure the e/m specific charge of electrons on small, floating dust particles. He discovered the magnetic monopole, not as an elementary particle, but as a topological charge. He mastered the study of forces on small individual particles, but found only a handful of followers. His paper of 1905 (“Die Diffuse...an kleinen Kugeln,” Akad. Wiss. Vienna, pp. 213-214) was ignored, though it paved the way for atomic theory.

The Unconnected Dots. . .

Summing up what was known by the end of the first decade of the 1900s, there is no doubt that the seeds of LENR research already existed, but did not yield a vast crop. The essential results were just different faces of LENR, and were not unified into a coherent set of data and models. To sum it up again:

1. Nikola Tesla discovered that his carbon button discharge lamps yielded an enormous amount of energy. He gave public demonstrations and worldwide lectures and then stopped. He spoke about artificial radioactivity and transmutation. He considered this group of discoveries as his most important ones. The technical solution was based on his single-wire, high-voltage device. Several high-voltage, high-frequency switches (disruptors) were patented in the

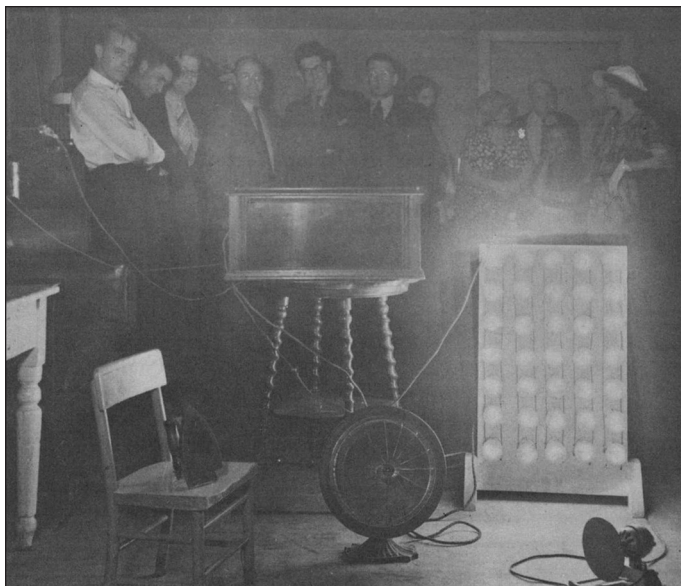


Figure 3. Demonstration of T.H. Moray's modified detector radio.

meantime. He publicly demonstrated his fusion driven electric car in Buffalo, New York, 1931. His theoretical idea about the nature of energy generation is wrong, however the need for resonances is apparent. There was no formal publication.

2. Henry Moray demonstrated a modified detector radio in Salt Lake City by 1910, which was run partly with a high-voltage discharge tube. He demonstrated several kW devices in the 1920s, when the cat's whisker detector was replaced by a novel high-voltage semiconductor. (See Figure 3.) Some drawings survive from a patent application. Several books on the subject survive but the technical details were never disclosed.

3. F. Soddy, T.D. McKenzie, U.K., 1907, observed transmutation in a hydrogen-filled arc discharge tube. Neon and helium appeared. There was only spectroscopic observation, no calorimetry, and no observation of current-voltage transients. Later others successfully replicated it but it was forgotten by the 1930s.

4. V. Mitkevich and Latchnikov, 1905, in St. Petersburg observed atmospheric arc discharge disruptions, mainly with carbon electrodes. The reverse kick was recorded—an energetic, counteracting anomaly. This burst appeared only with sputtering electrodes. There was no resonant oscillating circuit, no spectroscopy or chemical analysis of the sputtered residue. There was no calorimetry, and no theory. It was forgotten by the end of the decade.

5. Felix Ehrenhaft, in Vienna, in 1905 studied and discovered novel forces on individual floating particles of sub-micron size, but not in plasma. He discovered “photophoresis,” light driven forces on sub-micron particles, and later the specific electron charge and magnetic monopoles as topological charge in the 1930s. The high electric field intensity as a consequence of resonant surface plasmon polaritons was detailed only a century later but today his results are forgotten. (Mikhailov repeated the Ehrenhaft results in the 1970s.)

The concept of collective movement of resonant oscillat-

ing electron waves was applied by Widom and Larsen for LENR. This effect is the likely process behind biological transmutation in colloids. Ehrenhaft's colloid studies are applicable to dust plasma as well. It is the least understood behavior of nano-micron sized particles.

Two Paths to Success

1. All the above results were based on lucky incidents. The inventors/experimenters found something new in a correct setup at the right range of parameters. The effects were diligently improved by trial and error. No theoretical model is required. This is a path for few people.

2. On the other hand one may start from scratch, by knowing all the theoretical aspects of a promising phenomenon, and with proper technical skills, and financial support. Hence the importance of having the correct models. The aim of this paper is to open this path.

Without serendipity (luck and skill), or a sure theory, failure is inevitable, no matter how much money and time is devoted to solve a problem. See hot fusion as a disaster area.

Science as an organized institution is usually unable to deliver. A slim hope is offered by an economic application, but the above examples of Tesla and Moray are living proof that a nice economic solution is still not enough for success. Important achievements were (and will be) lost.

Correct Models of Nature and Open Eyes

Though Mitkevich was the first to publish about the reversal of electromotoric force in a discharge, the unstable oscillatory nature of hydrogen (or vapor) containing plasma crops up over and over again during the following decades.

Granovsky and Sujiken found extremely strong self-generating oscillations in a specially shaped tube, called a “stenotron” in the 1930s. Anisakov and Timosevsky found very powerful self-generating oscillations while testing a new type of plasmotron in the 1970s. Alexander Chernetsky also found powerful self-generating oscillations in hydrogen plasma, and he started to investigate them. (More about this in Part 2.)

Engineers usually try to mitigate powerful resonances or oscillations. Only a handful of them notice, or care, about the energy balances, or calorimetry. We are supposed to overlook these phenomena, not to assume transmutation and excess energy generation, as our “model of nature” rules this out. Few people dare “think outside of the box.”

I have found a number of papers about unexpected hydrogen arc oscillations in English from the 1930s.

C.G. Suits of General Electric (Schenectady, NY) remarked about hydrogen arc measurements: “It has been impossible to obtain electrical data satisfactory for measurement purposes in the 1 - 10 ampere range at pressures above atmospheric.” (“Some Properties of Hydrogen Arc,” *Journal of Appl. Phys.*, Vol. 10, Sept. 1939, pp. 641-650.) He describes wild oscillations in a discharge tube.

Hsu-Yun Fan of MIT remarked in another paper on this subject that “disturbances start after a while. The discharge will change from a glowing to an oscillating arc.” He had to clean the electrodes in order to mitigate instabilities. It never occurred to him, or others, that surface erosion on the elec-

trode surfaces created sharp edges, which in turn created “nuclear active sites.” Researchers wanted to see nice, steady-state results, not wild, unstable behavior. Thus they threw out a more valuable effect (“The Transition from Glow Discharge to Arc,” *Phys. Rev.*, Vol. 55, 1939, pp. 769-775).

Hsu-Yun Fan remarks that sputtering creates sharp points and edges on the surface of the electrode. He realized that it leads to instability but never made spectroscopic tests, or calorimetry with the eroded surface for the different electrode materials and gases, which he examined carefully.

Maybe there were hundreds of such cases, when the discovery has been at arm’s length, but the crucial step was not taken, as it was “outside of the box.” I stopped researching this area after finding a dozen similar cases.

It’s the Economy, Stupid!

This was Bill Clinton’s winning slogan in his first election. All inventions are based on it.

Of course, making trace amounts of gold (or other expensive metals) via ordinary transient arc/glow discharge is worthless, as it is not competitive. A simple arc discharge has enormous heat losses. Without extensive use of resonances, this transmutation is not economic. In order to achieve that, at least the rudimentary foundations must be established for the transmutation effect.

Transmutation is feasible in three ways. Fusion of light elements, including that of hydrogen isotopes, fusion of medium to heavy nuclei (including the carbon-based Oshawa fusion chains), and spallation of heavy elements, like uranium, Pb, or Hg. In my humble opinion, all this can be achieved at an economic scale by the extreme charge screening effect, natural in resonant dusty plasma.

The charge accumulation on the surface of dust particles is a well-established fact for the handful of researchers of dusty plasma but they are interested mostly in the parameter range of interstellar plasma, thus at very low pressures and at low ionization density. Nevertheless their results are essential for economic LENR, and to understand the physical features of dusty plasma.

The term “economy” is important only for machines but LENR phenomena are more pervasive in nature (widespread). There is convincing evidence that some of the minerals on Earth (or on other planets) are formed by LENR. For example, deuterium is ten times more abundant on Earth than in deep space. So are helium and lithium. The possible processes are summarized in a mind inspiring book by J.P. Wallace *et. al.*⁴ Further, the age-old biological transmutation always crops up, with a fairly reliable set of observations. (See the comprehensive work of J.P. Biberian.⁵)

Yet most of the theoretical work on LENR (cold fusion) is done in the technical framework of electrochemistry with Pa, or Ni, Ti electrodes. Considerable theoretical effort has been devoted to explain why high energy nuclear fusion of light elements may take place in a very low energy environment. Dissolved hydrogen, metal lattice parameter and phonon formation are dealt with in these theories.

In an extremely hostile scientific environment, this is simply not enough. The usual road—published papers in mainstream journals, accepted patents—are unattainable, as daily practice has shown.

The only irrefutable evidence is a reliably working mass-

produced machine, and there the economy is crucial, so the other purpose of the paper is to show that transient dusty plasma oscillations are the “home territory” of economic LENR. Steady state plasma experiments are gaining ground, due mainly to the work of Rossi, Piantelli, Celani, Scaramuzzi, Violante, etc. (All of them are Italians.)

At 400-800°C, and high pressure (≈ 10 bar), there are some results, but yet far from economic.

There are further experiments with stimulation and ion bombardment but they are also uneconomic. From the academic viewpoint, they are interesting but have no imminent practical application.

As the first part of the paper has shown, early historical evidence for LENR was exclusively restricted to transient, dusty plasma.

In the second part of the paper, the inventions based on dusty plasma will be described, where only serendipity—but not theory—was the driving force behind the machines.

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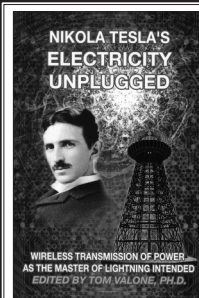
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**Part 2 of “Forgotten Inventions of LENR”
is scheduled to appear in Issue 135.**

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