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Michael (Miklos) Csuzdi, P. Eng. (Electrical)
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Michael Csuzdi devoted a great deal of his life in private research studying weather and geophysical phenomena. He applied electrical engineering theory to explain super nova storms; cyclones and anticyclones; earth currents, geomagnetic fields and their reversal; and finally displacement of the continents.

These physical phenomena he concluded were all based on the well observed flow of electrons from the earth's molten magma core out to space. This thermionic emission he fully modeled with the well established equations related to electrostatic charge and vacuum tube technology. He concluded it is the immense volume of the earth's combined oceans and continents that makes these small electrical forces of nature grow exponentially into the force of nature of our planet. In later years he applied the same mathematical modeling to explain the continental positions on the earth's moon and the planet Mars based on observed data of the time.

His body of work based on thermionic emission is best understood by the pure physics community rather than the geophysics community that has consistently applied mechanically oriented explanations to observations on Earth. This has limited it's understanding and acceptance. This need not be the case as the concepts and equations are straight forward and easily understood with an open scientific mind.

You have entered this web page based on a key word search that is tied to a subject and explained by Michael Csuzdi's theories. It is hoped that the following chapter taken from this published work with spark interest in the proposed explanation and drive curiosity in reading the complete document. Only then can the wholeness of his thermionic emission theory be fully realized as complete and scientifically accurate.

The goal of this website is to drive further independent review and scientific debate on the theories proposed by Michael Csuzdi. If they can be corroborated then the potential for better weather prediction, earthquake prediction and an unlimited source of clean energy harvesting could be realized.

Please feel free to share any of these documents and links with others as you see fit. The more review and dialogue the better.

1. The Geopower Plant.

Ask an electrical engineer to work out a preliminary design of a simple electron tube, a diode. Even if he is not a specialist in this field, he will understand and interpret the related chapters in books on electronic engineering principles, as in [4]. Specify the dimensions as follows: the tube is a vertical cylindrical concrete and glass structure of 300 metres (1000 ft) high, and its diameter is 100 metres (300 ft). The cathode is a flat, horizontal, and circular metal surface occupying the entire cross-section of the tube, and it is at the bottom near ground level. The anode plate is of the same size, and it is at the top of the tube. The material for the cathode is one of the following metals: tungsten, molybdenum, tantalum, or nickel. The operating temperature of the cathode is 2500, 3000, or 3500 kelvin (2227°C, 2727°C, 3227°C). Some of the metals may be molten at these temperatures, thus forming a pool. The anode voltage is 30,000 volts. A certain degree of vacuum is to be maintained in the tube.

The design starts with the Richardson-Dushman equation:

$$J = A_o T^2 e^{-\frac{b_o}{T}} \qquad \text{amperes/metre}^2 \qquad (1\text{-}1)$$

This equation has been in use in this form since 1923, and its validity has been proved by millions of electron tubes manufactured. It establishes the available current density, J, in amperes per metre² of the cathode surface area, as the function of the material constants and the temperature of the cathode, T, in kelvin. A_o and b_o are constants for the selected cathode material, their values having been established by theoretical and laboratory work.

	A_o	b_o	Melting Point (kelvin)
Tungsten	60.2 x 10^4	52,400	3655
Molybdenum	60.2 x 10^4	50,900	2895
Tantalum	60.2 x 10^4	47,200	3300
Nickel	60.2 x 10^4	32,100	1725

Table 1-1

With these constants the current densities, and for the specified cathode's 7854 m² surface area the available current, I, can be calculated (Table 1-2). J is in amperes per metre², and I is in amperes.

		Tungsten	Molybdenum	Tantalum	Nickel
2500 K	J	3.0×10^{3}	5.4×10^{3}	2.4×10^{4}	4.4×10^{6}
	I	2.3×10^{7}	4.2×10^{7}	1.9×10^{8}	3.5×10^{10}
3000 K	J	1.4×10^{5}	2.3×10^{5}	8.0×10^{5}	5.4×10^{7}
	I	1.1×10^{9}	1.8×10^{9}	6.2×10^{9}	4.3×10^{11}
3500 K	J	2.3×10^{6}	3.5×10^{6}	1.0×10^{7}	3.4×10^{8}
	I	1.8×10^{10}	2.8×10^{10}	8.0×10^{10}	2.7×10^{12}

Table 1-2

An enormous amount of electric current is available from any of these cathodes. 23 million amperes from the tungsten cathode at 2500 kelvin, 2.7 million-million amperes from the nickel cathode at 3500 kelvin. However, the actual current is limited by two factors. One is the negative space charge around the cathode. Space charge is the electric charge caused by the stationary electron cloud which surrounds the cathode when the anode voltage is below a certain critical value. The space charge partially negates the attractive force of the positive anode voltage, and thus reduces the rate of electron emission from the cathode. The other factor is the distance of the anode plate from the cathode. The effect of these limitations is described by the Langmuir-Child equations (1913):

$$J_s = 2.34 \times 10^{-6} \frac{E^{\frac{3}{2}}}{h^2} \quad \text{amperes/metre}^2 \qquad (1\text{-}2)$$

where E is the anode voltage in volts, and h is the distance between the cathode and the anode, in metres. For the above specified electron tube this limited current density, J_s, is 1.35×10^{-4} amperes/ metre^2, and the total current is 1.06 amperes. This is very much lower than the "available" current calculated by the Richardson-Dushman equation.

However, you can specify the injection of gas into the tube. Gas-filled electron tubes are widely used devices in high power industrial circuits. The design of these circuits is such that the gas is in an ionized state in the tube. An engineering handbook describes the operating principles of such tubes:

> "Positive ions are heavy, and for a given amount of energy, their velocity is low. The ions remain in the space of the tube much longer than the high-velocity electrons and, consequently, for a given number of electrons or a given current, there may be more positive ions in the space at a given instant than there are electrons. The positive ions then produce a positive space charge which successfully neutralizes the negative space charge due to electrons, and even replaces it with a positive space charge. An electron near the cathode then is accelerated, rather than opposed, by the space charge. The neutralization of space charge is the major reason for using gas in electron tubes."[4]

If the increasing emission current is not limited by some means, it can end up in an electric arc which is a powerful demonstration of the very high current. Nature's electric arc, the lightning, belongs to this category. Here a positively charged cloud neutralizes the Earth's negative space charge, and this initiates the increase of the Earth's emission current. Its short duration is due to the limited amount of these charges in the cloud which quickly recombines with the electrons arriving in the arc, into electrically neutral molecules, mostly water molecules.

One possible way of producing an ionized gas in the specified electron tube is to inject water on the high temperature cathode. This thermal ionization breaks up the water molecules into positive hydrogen and oxygen ions, and into free electrons. The ionized gas neutralizes the negative space charge, and improves the current-efficiency of the electron tube. There is a very large range for this improvement from the one-ampere current of the complete space charge to the several million amperes of the zero space charge.

Suppose, we take a tungsten cathode at 2500 kelvin, and reach 1% current-efficiency by the proper application of the gas. This is 230,000 amperes. The electrons of this current are accelerated by the anode voltage, their velocity increases while moving towards the anode. This is an energy transfer from the source of the anode voltage to the electrons. The electrons arrive at the anode with an energy given by

$$W = E\,e \quad \text{joules} \tag{1-3}$$

where E is the anode voltage, and e is the charge of the electrons. The rate of arrival of energy, or the power delivered to the anode, is

$$P = \frac{W}{t} = \frac{E\ e}{t} \quad \text{watts} \qquad (1\text{-}4)$$

The term e/t, or charge delivered per second, is the current flowing, so that

$$P = I\ E \quad \text{watts} \qquad (1\text{-}5)$$

For the above example

$$P = 230{,}000 \times 30{,}000 = 7 \times 10^9 \quad \text{watts} \qquad (1\text{-}6)$$

If this electron tube has a physical anode plate in the path of the electron flow, as in most electron tubes, the electrons transfer their kinetic energy to the plate by their impact. This is a conversion of kinetic energy into thermal energy, and the 7 x 10^9 watts heat up the plate. How much is this energy? An average thermonuclear plant produces 1000 Megawatts, or 10^9 watts. Thus the calculated electron tube would produce power equivalent to 7 nuclear plants. The same tube with tantalum cathode would be equivalent to 57 plants, and with the nickel cathode, to 10,000 plants.

For this very large electron tube there is no need for an anode plate. If the tube stands vertically, along its 300 metres height the electric field of the atmosphere reaches 30,000 volts at the usual 100 volts per metre atmospheric field strength. This voltage accelerates the electric charges emitted by the cathode exactly as an anode voltage on an anode plate does. Nevertheless, the energy transferred to the charges by the electric field is available at the top of the tower for conversion into some other forms. A metal plate would convert this energy into heat as anode plates do. But there are other means, too. Nature serves the best examples. All violent storms, cyclones, hurricanes, tornadoes, typhoons, get their energies by this process. In these cases the cathode is the surface of the molten rock interior of the Earth which occasionally comes in direct contact with the water of the ocean. The water rapidly breaks up into an ionized gas which partially neutralizes the Earth's negative space charge, and a strong emission current starts. This current also drags along water molecules, and this stream rises into the atmosphere under the accelerating force of the electric field.

The energy of these storms is represented in three forms. One is the electric energy resulting from the charge separation which takes place when the water breaks up on the surface of the cathode, and during the

velocity-ionization in the ascending cloud. The other is the static mechanical energy resulting from the lifting of the mass of water to an altitude. The third is the kinetic energy resulting from the velocity of the mass in the cloud. During the life of the storm there is a continuous conversion between these forms of energies. The electric form is manifested in magnetic fields or in lightning, the static mechanical form in the existence of the mass of the water at an altitude, and the mechanical kinetic form in the wind of the storm. Two or all three forms of the energy sometimes combine into a single phenomenon. The cyclone-type cloud combines all three where the electric energy develops a local magnetic field in which the static energy converts into a downward spiralling wind by the deflection of charged particles. The estimated power in a severe storm is about 10^{25} ergs/sec [3], or 1000 thermonuclear plants.

The very large electron tube discussed above can confine and maintain an artficially generated storm, and extract its energy for human use. Since its energy originates in the Earth's interior, this electron tube can be called a "geopower plant". The natural weather storm does not develop under optimized conditions, thus its current-efficiency is very low. It occupies hundreds of kilometres in diameter and tens of kilometres in height when its power equals 1000 thermonuclear plants. The geopower plant can be optimized in its performance since all its functions, except its anode voltage, the atmospheric electric field, are controllable. After adequate research and development the power output of a single geopower plant should reach and surpass that of a thermonuclear plant.

The geopower plant receives its energy input through the atmospheric electric field, therefore this is the most important element in its operation. The existence of this field is well known, but its origin, its permanency, and its power have not been appreciated. A scientific encyclopedia describes the Atmospheric Electric Field as follows:

> "A quantitative term, denoting the electric field strength of the atmosphere at any specified point in space and time. In areas of fair weather, the atmospheric electric field near the earth's surface typically is about 100 volts per meter, and is directed vertically in such a sense as to drive positive charges downward to the earth."[22]

This definition of the polarity means that negative charges, that is, free electrons, are driven upward from the surface of the Earth in the vertical direction by the electric field. This is the same effect as if there was an anode plate over the entire Earth, above the atmosphere, and the positive terminal of an electric power source was connected to it, and the negative terminal was connected to the ground.

> "In areas of fair weather, this field decreases in magnitude with increasing altitude, falling, for example, to only about 5 volts per meter at an altitude of about 10 km. Near thunderstorms, and under clouds of vertical development, the surface electric field varies widely in magnitude and direction, usually reversing its direction immediately beneath active thunderstorms."[22]

This paragraph implies that in all areas of fair weather the field exists, everywhere on the Earth. This is not a short-lived phenomenon which is observable, say, only after a thunderstorm where the surface might have been charged by lightning bolts, and gets discharged afterwards causing the field to diminish. In fact the electric field exists at full strength also over areas where there has been no storm for several months. Moreover, the field over the oceans is typically about 200 volts per metre, and it is also unrelated to the frequency of storms. Meteorologists should realize that this is the negative space charge of the thermionic cathode of the Earth. The quoted paragraph correctly observes that the direction of the electric field usually reverses immediately beneath active thunderstorms. The thunderstorm carries the ionized gas, the ionized water particles, and the overall charge of this gas is positive.

> "In areas of minimum local disturbance, a characteristic diurnal variation of electric field strength is observed. This variation is characterized by a maximum that occurs at about 19 hr Greenwich Mean Time (GMT) for all points on the earth..."[22]

The diurnal variation of the field confirms the global nature of the electric field. Indeed, this diurnal, and its superset, the seasonal variation of atmospheric and telluric fields have been the first leverage I am using to analyze the electric operation of the Earth. I discuss these variations in subsequent chapters in more details, in the "Supernova storms" and in the "Earth-currents". Meteorologists' explanation for the electric field is given by the following article:

> "It is now believed that thunderstorms, by replenishing the positive charge in the ionosphere, provide the supply current to maintain the fair-weather electric field in spite of the continued flow of the air-earth current which tends to wipe out that field."[22]

According to my thesis the thunderstorm is the consequence, and not the cause, of the electric field. The electric field is the consequence of another cause: thermionic emission. All these phenomena, together with many others, are in a chain of causes and effects between two major phenomena: the radioactive decay of unstable elements, and the expansion of matter in the universe.

The operation of the geopower plant is as follows. The temperature of the cathode is raised to the operating level, and a certain degree of vacuum is established in the tube. At this point the Langmuir-Child type space charge current of about one ampere starts flowing. Water is injected on to the high temperature cathode. A thermally ionized cloud develops at the surface region of the cathode. The positive charge of the cloud neutralizes the negative space charge in the vicinity of the cathode, and a more intensive electron flow moves upward in the cloud. These high velocity electrons collide with water particles which have not been ionized yet, and induce a velocity ionization on them. This type of ionization becomes increasingly effective the farther the water is from the cathode. For example, at 10 metres above the cathode an electron will have gone through 1000 volts of acceleration, its energy will be 1000 electron-volts in the 100 volts per metre electric field. Thus velocity ionization takes over the maintenance of the cloud from the thermal ionization by the cathode.

The injection of the water continues at the rate optimized for the energy output of the plant. The cloud expands upward on the drive of the emission electrons, and its velocity increases with elevation. During this startup of the plant an external energy input is necessary to heat the cathode and to produce vacuum in the tube.

By the time the cloud arrives at the upper region of the tube, it will have gone through 30,000 volts of acceleration, and it will consist of a highly ionized gas of hydrogen and oxygen moving at very high velocity. The electric energy of this gas is in the separated states of its positive and negative charges. The charges are evenly mixed in the gas which shows no overall charge from the outside. There is a strong electric force, Coulomb's attractive force, which causes the free electrons to recombine with the positive ions, but the high velocity of particles prevents this. The magnetohydrodynamic (MHD) principle makes it possible to extract the electric energy content of this gas. A strong magnetic field is placed at right angles to the direction of the gas flow. In the same magnetic field the positive and the negative charges are oppositely deflected, thus the gas flow is separated into two beams of charges. These beams are then intercepted by electrodes. The free electrons move through the negative electrode to the external circuit, outside the geopower plant, where they do work, and deliver useable electric energy to consumers.

The positive charges collected by the positive electrode are not able to move through the solid metal conductor because these charges are actually positive ions whose size is nearly identical to the size of the original water molecules. Only free electrons can move in metals. These ions wait at the surface of the positive electrode for the free electrons which arrive here from the negative electrode through the external circuit. Here the positive ions and the free electrons recombine into the original molecule: into water.

The mechanical energy of this water is utilized by its controlled flow back to the ground. Suppose, that the design of the plant calls for the injection of 100 m^3 water per second. When this water returns to the ground from the height of 300 metres, its energy is 300 Megawatts-second, that is, its power is 300 Megawatts. This energy is converted into electric energy by a conventional turbine-generator equipment, and added to the power-line grid. Part of the total energy output of the plant is retained to operate the cathode heater and the vacuum pumps.

The reality of the above described geopower plant can be appreciated only after studying evidence of the Earth's electrical properties which I am presenting in the rest of this study. However, it might be informative to quote meteorologists about thunderstorms because the elements of the geopower plant can be recognized in their observations.

> "Such clouds may be initiated in a variety of ways. Some early studies often indicated that convective clouds and thunderstorms were started as a result of excessive warming of certain surface areas. The temperature differences were attributed to differences in the colour and hence the absorption properties of various soils and rocks. Sometimes thermals may be traced to such hot spots, but evidence indicates that most thunderstorms are set off as a result of organized lifting of the air."[3]

It is necessary to visualize the Earth as a thermionic cathode of 12,600 km diameter with a red-hot surface, but this surface is enclosed by a relatively thin, 20 to 60 km wet rocky layer, the crust. This layer, together with the negative space charge, reduces but does not completely inhibit the cathode's thermionic emission. If all other factors are equally favorable for a greater than average space charge current, then the area with the greatest surface temperature (hot spot) will produce the greatest space charge current. The ascending thermionic electrons in this current then might set off a positive feed-back by increasing the mean free path between air molecules. If so, these electrons will be fast enough to ionize air and water molecules in the atmosphere, and the resulting positive ions will start neutralizing the negative space charge. This is then followed by a rapid buildup of emission current and ionization, ending in a stormcloud. However, the hot spot is not necessary for the storm outbreak when, for other reasons, a sudden emission outburst takes place on the surface of the magma cathode. The best evidence of this are the storms developing over the oceans, during the night, where surface conditions are uniform, and hot spots are out of the question.

> "At maturity a local storm may be composed of intense updrafts and downdrafts side by side."[3]

An updraft converts into a downdraft where the electric energy decreases to zero in the storm. The electric energy is represented by the separated state of the charges. In the natural storm the charges recombine into their original form of water molecules in an unorganized way, nevertheless, they do work in the process. This work is the violence of the storm, the violent wind, the lightning, the thundering, and the physical damage done to objects on the ground. When the recombination is complete the storm is said to have exhausted itself and the electrically neutral water molecules fall back to the ground. The path of the returning water molecules is the downdraft. The geopower plant utilizes the capacity of the storm to do electric work by organizing the path of charges on their way to recombination. When the work is done the recombined water returns to the ground also in an organized way: inside of a conduit, and through a turbine-generator.

> "Updraft speeds measured by the Thunderstorm Project ranged to a maximum of 26 metres per second (m/sec) but usually were less than half that much. They increased with height and averaged 5.0, 7.3, and 8.4 m/sec at altitudes of 1.5, 4.5, and 7.6 km, respectively. At the same altitudes, downdraft speeds were 4.6, 6.1, and 7.3 m/sec, respectively. At greater altitudes, higher updraft speeds have been measured by aircraft and radar and have been inferred on theoretical grounds. Updrafts exceeding 20 m/sec are not considered unusual in the upper parts of large thunderstorms. Airplanes flying through them at altitudes about 10 km have measured updrafts exceeding 30 m/sec. The strongest updrafts have been observed in severe organized thunderstorms which often are many tens of kilometres in diameter."[3]

20 m/sec updraft speed is 72 km/hour or 45 miles/hour velocity, 30 m/sec is 108 km/hour or 67.5 miles/hour velocity in the vertically upward direction.

The significant observation here is the increasing velocity with height. There is a positive feed-back in the updraft speed when the driving force is inside the draft. As the electrons are accelerated individually by the electric field, their collision with molecules increases the mean free path between molecules. This, in turn, allows a greater acceleration in the longer path which results in greater kinetic energy of the electron, thus it makes the next free path even longer. There is a critical minimum rate of increase which must be achieved, otherwise the effect does not occur at all because the electric field rapidly decreases with height. Thus the increasing updraft speed with height is a powerful indication of the electron-caused increase in the mean free path. The increasing mean free path, that is, the increasing distance between molecules, can also be expressed as "low pressure". Meteorologists mistakenly attibute the entire updraft to the "greater buoyancy of the low pressure air", and

the low pressure to an increase in its temperature. This is based on the Boyle-Mariott, Gay-Lussac laws of gases, where heating of a gas results in its expansion, and the expanded gas is lighter. The lighter gas then ascends as a bubble. However, the same laws allow that if the gas is expanded by (non-thermal) mechanical forces, then its weight decreases together with its temperature. This form is used for refrigeration. Meteorologists have not recognized the electron-caused expansion, therefore, they insist upon the heating form. Under this impression they call the cumulonimbus cloud a "hot tower" [5], even though its internal temperature can be as low as -39°F [23], and hailstones fall from it. Such a stormcloud would be better called "refrigerator tower". The geopower plant not only recognizes the role of the ascending electrons in making the cloud expand, but also optimizes their effect for maximum energy yield. The means for this is the control of the particle density, that is, the degree of vacuum, in the tube. By ensuring an adequately large mean free path, velocity ionization can occur at the surface of the ground where the atmospheric electric field strength is maximum.

> "...many authorities are convinced that in such thunderstorms the updraft is tilted from the vertical."[3]

It is. The upward moving charges are moving in the geomagnetic field, and this rotates the charges around a horizontal axis. Closer examination of such thunderstorms reveals that there are two tilts across the storm as the positive and the negative charges are deflected oppositely. This tilt must be at right angles to both the direction of charge movement, and to the direction of the magnetic field. Since the magnetic field is in the south-north direction the tilts are in the east-west direction. The negative electrons tilt to the east while the positive ions tilt to the west. These two tilts represent the separation of the charges into two beams. Therefore, the rains are not falling uniformly around the storm because the conditions for rain are different on each side. The heaviest rain falls always from the west side because the positive ions, the very mass of the water molecules, are concentrated there by the magnetic separation. The geopower plant utilizes the beam separation to its fullest extent by generating a carefully designed magnetic field for this purpose. The separated charges are then collected by electrodes, and their energy is utilized in an external circuit before they are allowed to recombine into water. This is the main energy output of the plant.

Figure 1-1 illustrates the geopower plant in cross-section. WI is the water inlet where water is injected into the tube TU. Water molecules are represented by circles with a black dot inside. When the molecule is ionized, the black dot, representing one or more electrons of the molecule, gets outside, and the empty circle represents the positive ion. The first ionization takes place at the surface of the high temperature cathode, CA, which is sitting on an insulator material, IM.

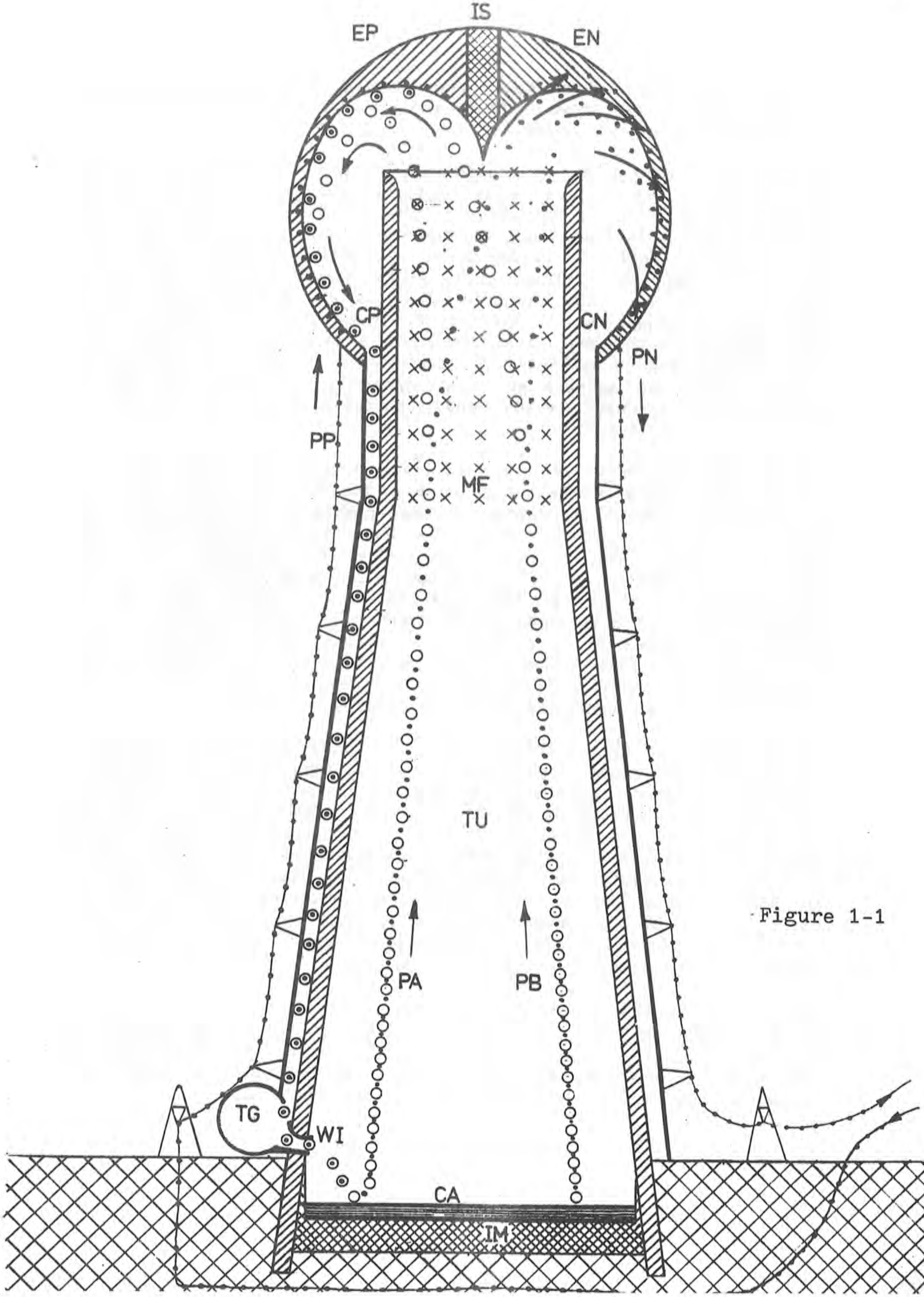

Figure 1-1

Velocity ionization, which takes place during the upward acceleration in the tube, is not shown. There are several circumferential water inlets, but only one is shown.

Two paths of the charges, PA and PB, are shown. The charges enter the magnetic field, MF, in the upper region of the tube. This field is represented by crosses, meaning that the lines of force are directed into the paper. In this field the upward moving negative charges, the black dots, are deflected to the right, the positive charges, the empty circles, to the left. (These rules are discussed in more details in Chapters 2 and 3). The magnetic field is generated by "deflection yoke" type windings, as in Figure 1-2, or by permanent magnets. In this respect the geopower plant resembles to a cathode ray tube where the electron beam is deflected by these types of coils to produce the raster. Permanent magnets are also employed, to deflect the emitted positive ions sideways, which would otherwise damage the screen by their high energy impact.

The magnetic intensity of the deflection coils are adjusted for the optimum positioning of the charge beams. The most important objective is to obtain maximum separation of the charges. The electrodes are located above the magnetic area. The negative electrode is EN, the positive is EP. The two are separated by the insulator IS. The electron beam enters the metal material of electrode EN since this flow is an electric current in the usual sense. A power line, PN, is connected to this electrode, which carries the electron flow to the ground level, where it is connected to a distributing network. This electricity is a high voltage direct-current power, optionally it can be converted to alternating current by suitable equipment. The return power line, PP, is connected to the positive electrode EP.

The positive ions of the deflected flow of charges enter the cavity of the positive electrode. These charges do not move into the material of the metal electrode because of their size. Rather, the returning free electrons which arrived on the PP power line, enter the cavity through the material of the electrode. There is a continuous lightning or arcing here, as the electrons rush to the positive ions, and recombine with them into electrically neutral water. The cavity should slow down the high velocity ions in order to make recombination possible. But it should not slow them down too much because they would block the entrance of the cavity for the oncoming charges. Also, an excessive slowdown would result in excessive thermal loss.

The arcing in the cavity is the concentrated action of a natural weather storm when a gathering dark stormcloud produces a lightning bolt first, followed immediately by a rainshower. In this lightning bolt negative charges, electrons, enter the positive-ion cloud, and recombine into water which starts falling immediately.

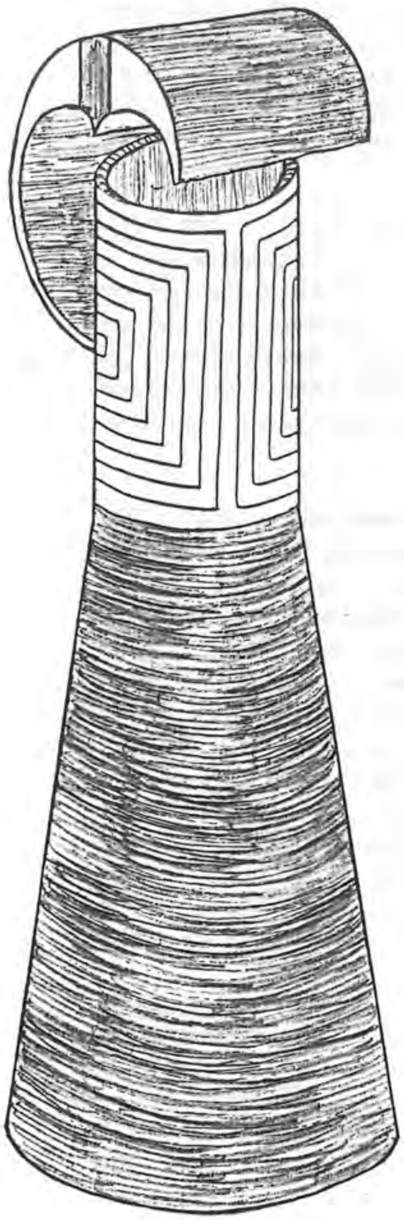

Figure 1-2

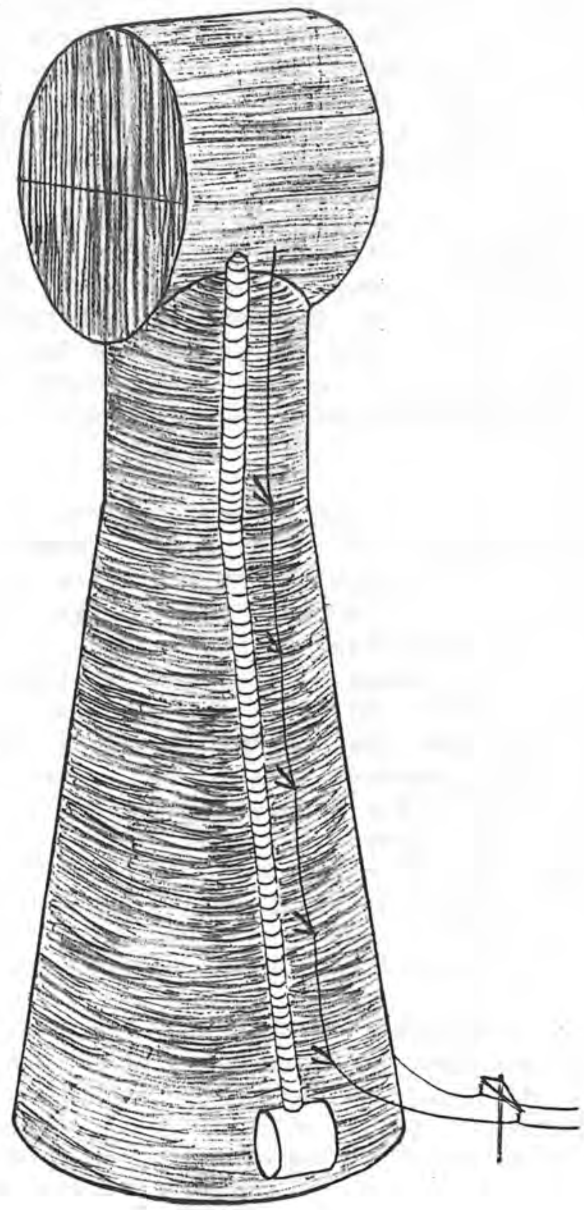

Figure 1-3

The produced water in the cavity flows into a conduit, CP, falls freely along the entire height of the tube, and enters the turbine generator, TG, at the base. This generator extracts the mechanical energy of the water, as in a waterfall. Then the water is injected on to the cathode again. A similar conduit is connected to the cavity of the negative electrode since a perfect charge separation can not be expected, and water forms here, too. The electric energy of this part of the charges is lost, but the mechanical energy is not. This energy can be utilized by either a separate turbine generator, or the two conduits can be interconnected using a single generator.

Figure 1-2 shows the windings of the deflection coil, and the electrodes with their covers removed. Figure 1-3 illustrates a complete geopower plant in its elementary form. This form can be modified to meet aerodynamic requirements since wind pressure could be significantly high on it. The barrel-shaped electrode housing can be modified into a sphere which would produce the minimum wind resistance from all directions. The cover picture shows the geopower plant in this form.

The heating of the cathode consumes a part of the generated energy. The greatest part of this energy goes to cover conductive and radiative heat losses which can be minimized by careful design. However, as in other electron tubes, the energy available at the anode plate (or at the MHD generator) is independent of the heating energy of the cathode: it is determined by the anode voltage - anode current product only. The temperature of the cathode is a parameter of the available anode current, but the heating energy is not. Thus, by increasing the height of the geopower plant the anode voltage and the output power are increasing, but the required heating power remains the same. This is an important conclusion for the first experimental geopower plant to be built which will be probably the smallest possible in size. This size should exceed the minimum value which is required to produce the "break-even" power where the generated output power equals the required heating power of the cathode.

The thermionic cathode - MHD generator - water return combination of the geopower plant promises the highest efficiency of operation because it extracts energy from all three forms of energy present in the system. (It is also useful to closely study this combination because weather storms operate in this way, therefore, these storms are the first evidences for the feasibility of the geopower plant).

However, for first experiments it is possible to construct a much simpler power plant, one without the MHD generator. This would consist of a cathode, a thick metal plate at the top of the evacuated tower for the anode plate, and a small amount of water for the ionized gas. This setup is identical to the gas-diodes used for rectification of high power alternating current. But there would be no electric cable

connected to the anode plate. This plate, at the end of the path of the accelerated cathode electrons, would serve to convert the kinetic energy of the electrons to thermal energy. This conversion takes place in all electron tubes: the resulting heating of the anode is called the "anode dissipation". The thermal energy of the anode plate then would be removed by an external water heat-exchanger. That is, cold water would be pumped up in a conduit, the water would flow through the anode plate, and the high temperature water (or steam) would return to the ground in another conduit to drive a turbine generator.

In my estimate the break-even condition could be achieved with a tube of 10 metres in diameter and 30 metres in height. The dissipative geopower plant which could supply the energy needs of a smaller community would have a diameter of 20 metres, and a height of 100 metres. This plant would run entirely on the atmospheric electric energy, would produce no harmful radiation or any other kind of pollution, and there would be practically no limit to the number of such plants which could be constructed.

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