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Lichtenberg Figures and Crystal Dendrites Creation Using Iron Nanoparticles, Prussian Blue Stain and Catalase in the Absence of High Voltages Discharges: Implications in Paleontology

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Abstract

The development of a solution mixing fine iron particles with Diamagnetic Potassium Ferrocyanide in Prussian Blue Stain (PBS Fe_2) or Paramagnetic Potassium Ferricyanide in Prussian Blue Stain (PBS Fe_3), allowed for the detection of Lichtenberg figures imprinted on a glass slide. Materials and Methods: Fine iron particles were mixed in deionized water. Aliquots of the iron solution were combined with both types of the aforementioned Prussian Blue Stain (PBS). Two types of the PBS and fine iron particles were developed, the first with diamagnetic properties (Potassium Ferrocyanide) dubbed (PBS Fe_2) and the second with its paramagnetic counterpart Potassium Ferricyanice dubbed (PBS Fe_3). In separated slides drops of each solution were allowed evaporating at room temperature in the absence of high voltages discharges. Photomicrographs of the dry fields and video-recordings during evaporating were obtained for further analysis. Results: During evaporation, flashes of light in some areas of the slides were recorded. Afterwards, distinctive images showed formations resembling Lichtenberg figures that were randomly documented in the dry fields of both solutions tested.

Keywords

Lichtenberg Figures, Prussian Blue Stain, Potassium Ferrocyanide, Potassium Ferricyanide, Iron Particles, Electromagnetism, Electron Transfers, Iron Flowers, Ancient catalase, Fossils

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1. Introduction

The purpose of this manuscript is to introduce the formation of Lichtenberg figures in the absence of high voltage discharges (at room temperature (74°F) and in the presence of intrinsic electromagnetic forces (EMFs). These EMFs triggered by the interaction of diamagnetic (repulsive forces) and paramagnetic (attractive forces) interacting with fine iron particles of 2000 nanometers in diameter in a glass slide. It is well established that fine iron particles have paramagnetic properties [1]. Lichtenberg figures are named after the German physicist Georg Christoph Lichtenberg who in 1777 reported the effects of high voltage discharges that created branching dust figures [2]. If this branching continues is then labeled a tree and is now considered fractal in nature [3]. Lichtenberg described this branching phenomenon to representing a sign of electrical fluidity motion. The utility of these figures formations has gradually increased in importance from a pictorial electrical fluid demonstration to the modern use of forewarning failures of insulated electrical cables [4]. These figures if found In the plastic cover of electrical cables is a major cause of the deterioration of the polyethylene material caused by electrical discharges and identified by the presence of Lichtenberg figures patterns.

The recent development of a solution with electromagnetic properties by utilizing Prussian Blue Stain, mixed with iron

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nanoparticles of 2000 nanometers in diameter [5] was used as a model for this presentation. Two types of solutions solution were prepared, the first using Potassium Ferrocyanide ($K_4 Fe_2 CN_6$) with diamagnetic (repulsive properties), and the second solution using Potassium Ferricyanide ($K_4 Fe_3 CN_6$) with paramagnetic properties (attractive forces). The anisotropy of the paramagnetic and diamagnetic solutions in the presence of iron particles creates a propitious niche for the causation of an electromagnetic environment on a glass slide. During evaporation, crystallization of the Potassium Ferrocyanide and Ferricyanide iron laden solutions ensued and electromagnetic energy in light form was displayed (Fig 1). Lichtenberg labeled his experiments as an example of electrical fluidity, the experiments presented in this manuscript support an electromagnetic fluidity present in our preparation. Energy exchanges noticed during evaporation are pictorially presented.

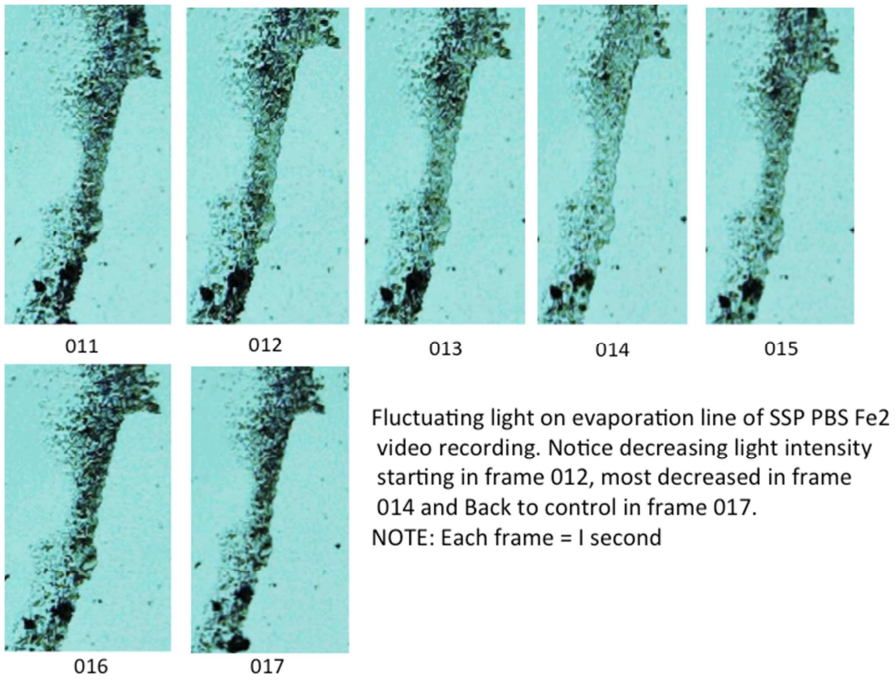

Figure 1. Video-recording sequential frames microphotographs demonstrating electromagnetic energy in the form of flashing lights during evaporation of a SSP PBS Fe_2. X 4 magnification.

2. Materials and Methods

Utilizing as a guide a most recent published method for the detection of biomagnetism in living plants and animal tissues, two types of Prussian Blue Stain (PBS) mixed with iron nanoparticles of (2000 nanometes in diameter) were prepared. The first PBS by mixing one part of ($K_4 Fe_2 CN_6$), one part of 2.5% HCl and two parts of 2000 nanometers iron particles in solution (2K). This solution was dubbed PBS Fe_2. for the manuscript. The second PBS by mixing one part of ($K_4 Fe_3 CN_6$), one part of 2.5% HCl and also two parts of 2000 nanometers iron particles in solution. This preparation was dubbed PBS Fe_3 for the manuscript.

PBS Fe_2 slide preparation:

Two drops of the PBS Fe_2 solution were pipetted onto a clean 25x75x1mm glass slide and allowed evaporating.

PBS Fe_3 slide preparation:

Two drops of the PBS Fe_3 solution were pipetted onto a clean 25x75x1mm glass slide and allowed evaporating.

The single slide preparation (SSP)

Is a technique when one or two drops of the PBS Fe_2 or PBS Fe_3 solutions were placed on a clean 25x75x1 mm glass slide and allowed unimpeded evaporation.

Ancillary Testing:

- PBs Fe_2 solution and dehydrated catalase

Powdered catalase was hydrated with distilled water and allowed to evaporate. A smooth surface was created. The dry surface was then rehydrated with one drop of PBS Fe_2. Placed at the edge of the field.

- Distilled water and dehydrated catalase

Powdered catalase was hydrated with distilled water and allowed to evaporate. One drop of distilled water was then placed at the edge of the field.

Video recording equipment:

All microphotographs and video recordings were

documented during and after evaporation of the liquid the specimen and viewed and still pictures or videos made in the normal mode at X4 magnification with a video microscope (Celestron LCD Digital Microscope II model #44341 Torrance California USA).

3. Results

Lichtenberg figures were documented on glass slides in the absence of a high voltage discharge and at room temperature (74°F). This was accomplished after the evaporation of SSP PBS Fe_2 and PBS Fe_3 solutions (Figs 2, 3). Crystals dendrites were documented in the same slide when bioelectromagnetic forces were present (Fig 5).

During the evaporation of the above solutions, electromagnetic energy was detected expressed as intermittent flashes of light. It is worth noticing that the present paradigm supports the notion that Lichtenberg figures as caused by high voltages discharges [6].

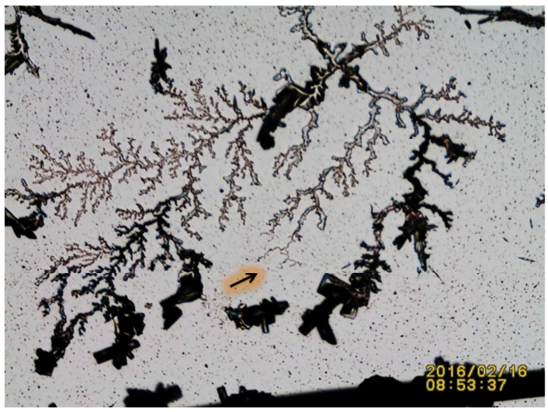

Figure 2. Lichtenberg figures shown on a glass slide surface after evaporation of a SSP preparation of PBS Fe_2 solution. Please notice the lack of closely intergrown, rounded acicular branches typical of crystals dendrites (arrow). X4 Magnification.

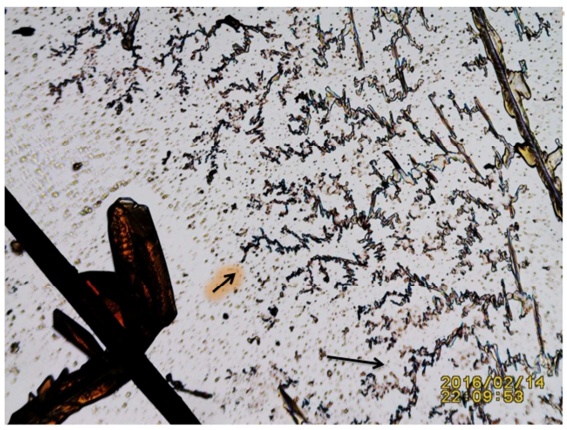

Figure 3. Photomicrograph of Lichtenberg figures (arrow) shown on a glass slide surface after evaporation of a SSP preparation of PBS Fe_3 solution. (Potassium Ferricyanide). Also in this photomicrograph notice the absence of closely intergrown, rounded acicular branches typical of crystals dendrites (arrow). X 4 Magnification.

Please compare the figures presented (see above) in this manuscript with an actual high voltage lightening strike produced Lichtenberg figures on the grass surface of a golf course (Fig 4 below) and as illustrated reference [6] figure 1 (not shown).

Figure 4. Example of Lichtenberg figures caused by a high voltage lightening strike. The result of a lightning strike at the South West Rocks golf course shared on Facebook by Ballina's Shelley Beach Golf Club Australia. Notice the lack of rounded acicular branches tips (arrows) that are typical of crystals dendrites.

4. Discussion

Two solutions were used in this research contain fine iron particles in a PBS solution. One PBS solution prepared with diamagnetic properties containing Potassium Ferrocyanide (K_4 Fe_2 CN_6) and the other PBS solution with paramagnetic properties due to the Potassium Ferricyanide (K_4 Fe_3 CN_6) present. Both preparations exhibit electron transfers [7, 8] which when reacting with the paramagnetic properties of the fine iron particles electromagnetic energy is created and visualized as light. There is precedence for similar energy/light findings ie: this has been previously reported in human hair follicles immersed in the PBS/iron solution [9]. Based on the evidence presented, it is hypothesized that the electromagnetic energy exchanges, such as the visualized flashing lights (Fig 1) aided in creating the Lichtenberg figures as seen in Figures 2 and 3.

It could be argued that the images identified as Lichtenberg figures could have been crystals dendrites originated from the crystallization of Potassium Ferrocyanide/ Ferricyanide in the SSP PBS Fe_2 and Fe_3 preparations.

One observation mitigating the crystals dendrites argument is the fact that our images did not show the typical crystals dendrites "closely intergrown, rounded, acicular branches" [10]. We have shown that this phenomenon of crystallized "flowery ends" was demonstrated in the same glass slide as the Lichtenberg figures. The difference being that Lichtenberg figures were formed in the absence of external

bioelectromagnetic forces (in the periphery of the slides), whereas crystals dendrytes presence was always noticed in areas where bioelectromagnetic forces were prevalent as seen in (Fig 5) below.

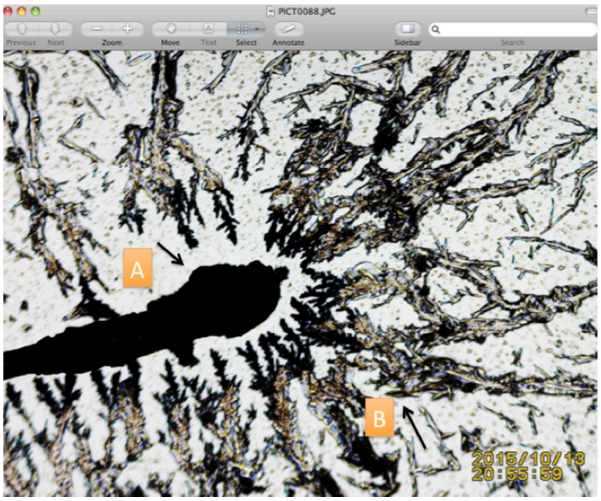

Figure 5. Human scalp hair attracting "flowery ends" crystal dendrites. A= Hair follicle B= Crystals dendrites.

Human hair follicle mounted on a 25x75x1mm clean glass slide containing a Prussian Blue Stain solution + iron particles (PBS Fe_2 2K). Photomicrograph at x 4 magneification.

The implications hereby stated of crystals dendrites formation and biomagnetism may have a role in explaining the "iron Flowers" formations seen in fossilized rock. We can then hypothesize the presence of fossilized "Iron Flowers" in rocks were formed in the presence or both iron particles as well as the influence of biolelectromagnetic forces combined with the enzyme catalase.

The above discussion leads to a conclusion that Lichtenberg figures are present in a glass slide (at room temperature) containing fine iron particles and Prussian Blue Stain prepared with Potassium Ferrocyanide.

5. Conclusions

- Electromagnetic forces induced in a SSP preparation by diamagnetic and paramagnetic Prussian Blue solutions mixed with fine iron particles (2000 nanometers in diameter) generated Lichtenberg figures.
- When Bioelectromagnetic forces were present crystals dendrites ensued. This was done in the absence of high voltages discharges.
- When the enzyme catalase was mixed with iron particles, "Iron Flowers" crystals dendrites formed.
- Please refer to Figures 6 and 7

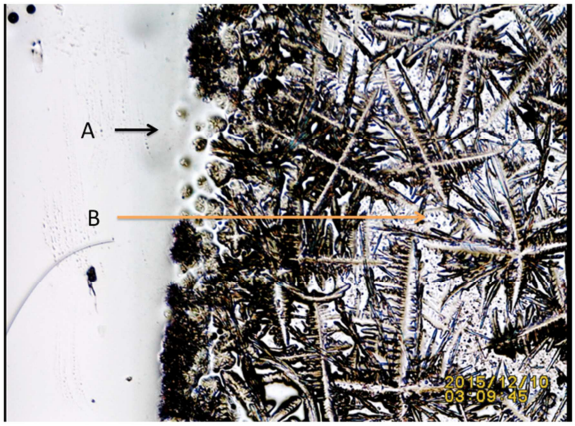

Figure 6. Rehydrated catalase with one drop of distilled water – No iron flowers seen. Notice crystals formation (arrow B). A= Evaporated catalase solution area. Black Arrow= Evaporated distilled water and dry catalase border. B= Orange arrow points at one of many unidenfied crystals like images created by the mixing of water and the dried enzyme catalase.

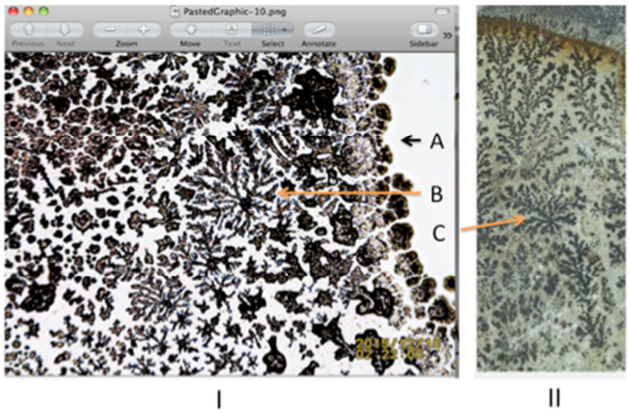

Figure 7. Showing Iron flowers formation from in vitro rehydrated catalase. PANEL I= Notice Iron Flowers. A= Rehydrated catalase iron solution border B= Arrow points at one of numerous "Iron Flowers" like images created by the PBS Fe2 mixed with the enzyme catalase, and PANEL II, C= Showing fossilized iron flower found in ancient rock. (Image credit of unknown origin).

6. Summary

Demonstrated is in our experiments:

When iron nanoparticles are mixed with Prussian Blue Stain Lichtenberg figures and crystals dendrites formations are governed by two different mechanisms

- Crystals dendrites formation takes place in the presence of biomagnetic influence.
- Lichtenberg figures do not form in the presence of biomagnetism.
- It can then be stated that Fossilized crystals dendrites were formed in the presence of first, iron particles second, the ubiquitous ancient enzyme catalase and third, bioelectromagnetic forces.

Limitations

Implications:

Learning from past experience, high voltages Lichtenberg figures importance has evolved from an original “electrical fluidity motion” concept [11] to a relevant tool used today in various disciplines ie: detection of safety issues in power cables insulation.

The finding hereby presented may open new areas of investigation and may help explain some of the fossilization processes in Palaeontology.

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