Phys. Scr. **T131** (2008) 000000 (13pp)

Evidence for an intense solar outburst in prehistory

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Received 10 June 2008
Published 5 December 2008
Online at stacks.iop.org/PhysScr/T131/014048

Abstract
A past intense solar outburst and its effect on Earth was proposed by Gold (1962 *Pontificiae Acad. Sci. Scr. Varia* **25** 159) who, along with others, based his hypotheses on strong astronomical and geophysical evidence. The discovery that objects from the Neolithic or Early Bronze Age carry patterns associated with high-current *Z*-pinches, as would result from an intense plasma impinging Earth, provides a possible insight into the origin and meaning of these ancient symbols produced by humans. Peratt (2003 *Trans. Plasma Sci.* **31** 1192) dealt with the comparison of graphical and radiation data from high-current *Z*-pinches to petroglyphs, geoglyphs and megaliths. Peratt (2007 *Trans. Plasma Sci.* **35** 778) focused primarily, but not exclusively, on petroglyphs of some 84 different morphologies; pictures found in laboratory experiments and carved on rock. These corresponded to mankind's visual observations of ancient aurora as might be produced if the solar wind had increased at times between one and two orders of magnitude, millennia ago (Gold 1962 *Pontificiae Acad. Sci. Scr. Varia* **25** 159). In Peratt (2007 *Trans. Plasma Sci.* **35** 778), the data were given on the source of light and its temporal change from a current-increasing *Z*-pinch or dense plasma focus aurora. Orientation and field-of-view data are given as surveyed and contributed from 139 countries, from sites and fields containing several millions of these objects, the latest data coming from a 300 km survey along the Orinoco river basin in Venezuela. In this paper, we include additional petroglyph figures derivable from experiment and computer. This information allows a reconstruction of the auroral form presumably associated with extreme geomagnetic storms and shows, based on existent geophysical evidence, relativistic electron flow inward at Earth's south polar axis and hypervelocity proton impacts around the north polar axis.

PACS numbers: 52.58.Lq, 52.65.Rr, 52.35.Py, 52.77.−j, 94.05.−a, 95.90.+v

(Some figures in this article are in colour only in the electronic version.)

1. Introduction

The discovery that objects from the Neolithic or Early Bronze Age carry patterns associated with high-current *Z*-pinches provides a possible insight into the origin and meaning of these ancient symbols produced by humans [1]. This work dealt with the comparison of graphical and radiation data from high-current *Z*-pinches to the images of petroglyphs, geoglyphs and megaliths.

This reference focused primarily, but not exclusively, on petroglyphs of some 84 different morphologies; those found in laboratory experiments that are similar to those carved on rock. As the same morphological types are found worldwide, the comparisons suggest a type of single visible source. The striking similarity of petroglyphs to plasma experiments would indicate that they are reproductions or parts of reproductions of intense electrical phenomena, an obvious high-energy visible source that would be external to

the Earth, such as the solar wind aurora we observe today. However, laboratory experiments, when compared to ancient recordings, suggest the occurrence of an intense aurora, as might be produced if the solar wind had increased between one and two orders of magnitude, millennia ago.

A past intense solar outburst and its effect on Earth were proposed by Gold who, along with others, based their hypotheses on strong astronomical and geophysical evidence [2].

According to Gold,

> *The question I would like to tackle is whether solar outbursts of the present day are representative of all that has happened in geologic times or whether much greater outbursts have occurred from time to time. Our evidence that nothing very violent has taken place in historic times is concerned with such a short span of time only that it cannot answer the question.*
>
> *For one big outburst every ten thousand years, for example, . . . The earth's magnetic field could clearly not hold up the incoming gas, and it would indeed drive down to the atmospheric level . . . This breakdown would be in the form of a series of sparks, burning for extended periods of time and carrying currents of hundreds of millions of amperes. One might search whether there is any geological record of surface fusing and vitrification of rock or sand which cannot be accounted for by volcanic or meteoritic events.*

The answer to Gold's question seems to come from an unlikely source: magnetized plasma from intense solar discharges striking the Earth's space environment as recorded by mankind in antiquity.

In [1], direct comparison was made of some 40% of data carved on rock to that recorded in laboratories and in high-explosive, high-energy tests with current magnitudes similar to that found in auroras today. The sources of these patterns were magnetohydrodynamic (MHD) instabilities from intense Birkeland currents, a *Z*-pinch, flowing to the Earth [3, 4]. Other patterns could be attributed to, and found to replicate Rayleigh–Taylor instabilities as found experimentally and in computer particle-in-cell (PIC) simulations when a relativistic electron beam (REB) impacts the upper atmosphere [3].

2. Salient properties of an intense aurora

In an intense aurora, the giga-ampere current flow and concomitant strong magnetic field produces a major change in the auroral-height profile. Because of the intense plasma flow and strong longitudinal magnetic field, the plasma forms a thin but dense sheath or plasma column in its propagation toward Earth. Hence, the in-flowing plasma is a *Z*-pinch, and as a result, *Z*-pinch instabilities form as well as intense radiation from the relativistic electrons. The intense radiation consists primarily of x-rays and synchrotron radiation in the visible. The synchrotron radiation is that of well-known *Z*-pinch instabilities in the plasma column [1]. Mankind in antiquity accurately recorded this colorful display of bright lights in many ways. Here, we shall concentrate on the petroglyph and pictograph data recorded worldwide from fields containing about 4 million markings. Unexpectedly, of those petroglyphs accurately surveyed and GPS logged, it was found that the light was observed totally from the direction of the south axial pole of Earth.

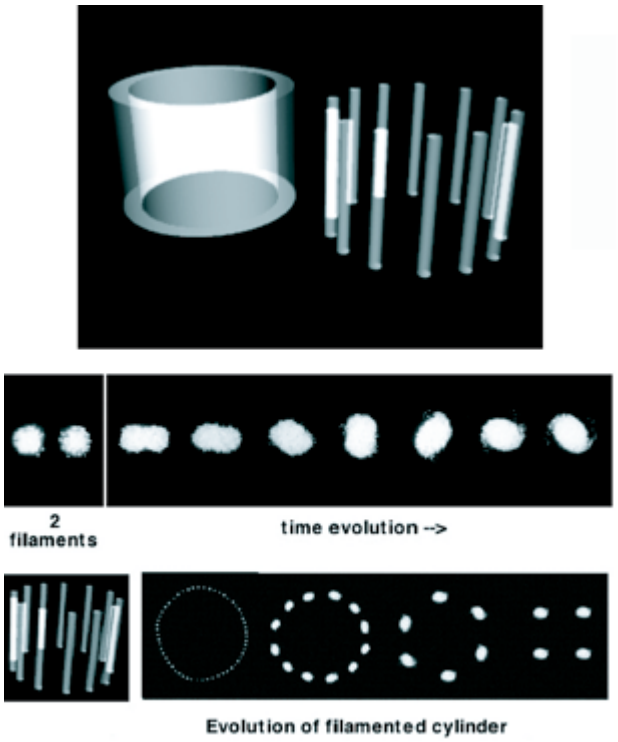

Figure 1. Top: basic characteristic of a very thin plasma sheath of relativistic electrons and ions flowing along a longitudinal (vertical) magnetic field; the sheath filaments into 56 current elements. Center: PIC time evolution of two adjacent filaments, as shown by the cross sections of the plasma. Bottom: rendition of 56 filaments converging to 28, 6, 5 and 4 as current increases.

Figure 2. Red auroras were considered a sign of ill omens during medieval times and pilgrimages were organized to avert the wrath of Heaven. Brilliant displays have frightened people as recently as this century in regions where aurora sightings are rare (courtesy of S-I Akasofu, Institute for Geophysics, Fairbanks, Alaska).

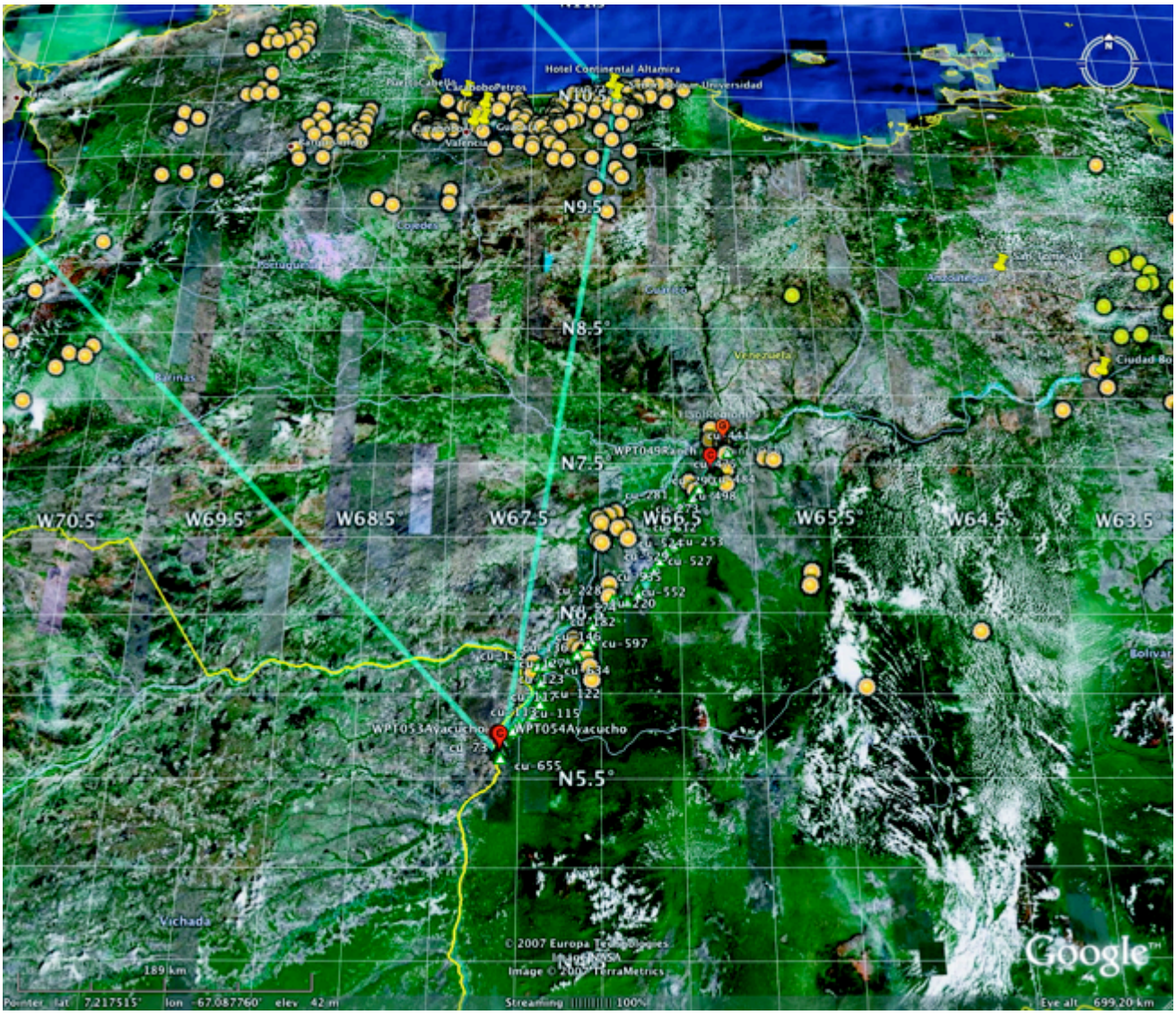

Figure 3. Partial marking of known petroglyphs/pictograph sites in Venezuela. Top center: Caracas. Top left: San Estaban National Park. Top right: unprocessed petroglyph sites. Center right: Canaima. Center: Orinoco river from Puerto Ayacucho (lower red marker) to Caicara del Orinoco (upper red marker) (figure 4). The straight blue lines are our airplane routes flown.

Experimentally, the tendency for very intense charged particle beams flowing along a magnetic field to 'hollow' into a thin cylinder [5] then filament into 56 currents is a characteristic of the plasma produced in multi-terawatt pulse-power facilities [6, 7]. Both experiment and three-dimensional PIC simulations verify this phenomenon. For example, interactions between various numbers of current filaments as a source of electromagnetic radiation sources have been studied [8].

Figure 1 is a mixture of conceptual and recorded evolution of a multi-filament REB with increasing current conducted. Because of the Biot–Savart force law, the currents can come together in twos or threes, on their way to forming a 28-filament structure as found worldwide. Thus, filamental patterns as carved on rock may have 47, 39, 33, etc, rays. By far the most prominent rayed pictographs and petroglyphs show 56, 28, 7, 6, 5 and 4 rays or filaments.

Bright filaments running across the sky are rare, but not unknown phenomena, having been recorded for centuries and even millennia from all parts of the Earth (figure 2). '*Swords*,' '*spears*,' '*white vapor*,' '*like glossed silk penetrating it*,' '*candles in the sky*,' were terms used to describe the aurora during an intense-corona outburst.

In the strong coronal mass ejection event of 1859, observers reported '*figures in the sky as if drawn with fire on a black background*'.

Here, it is important to delineate between the various auroral phenomena that mankind has seen in the sky. When an intense coronal mass ejection occurs (10^{17} g, 400–1000 km s^{-1}) near the center of the solar disk and its strong magnetic field is oriented southward, the power of the solar wind–magnetosphere generator may exceed 10 TW. Simultaneously, the magnetic field produced by the auroral discharge current produces an intense geomagnetic storm ultimately heating Earth's upper atmosphere. When oxygen atoms collide with heated atoms, the atoms emit a dark red light (the 'red glow') seen high in the aurora curtain, generally 250–1000 km in altitude (figure 2).

Thus one has a high-altitude red plasma glow, white bands overhead that are Birkeland currents wrapping around

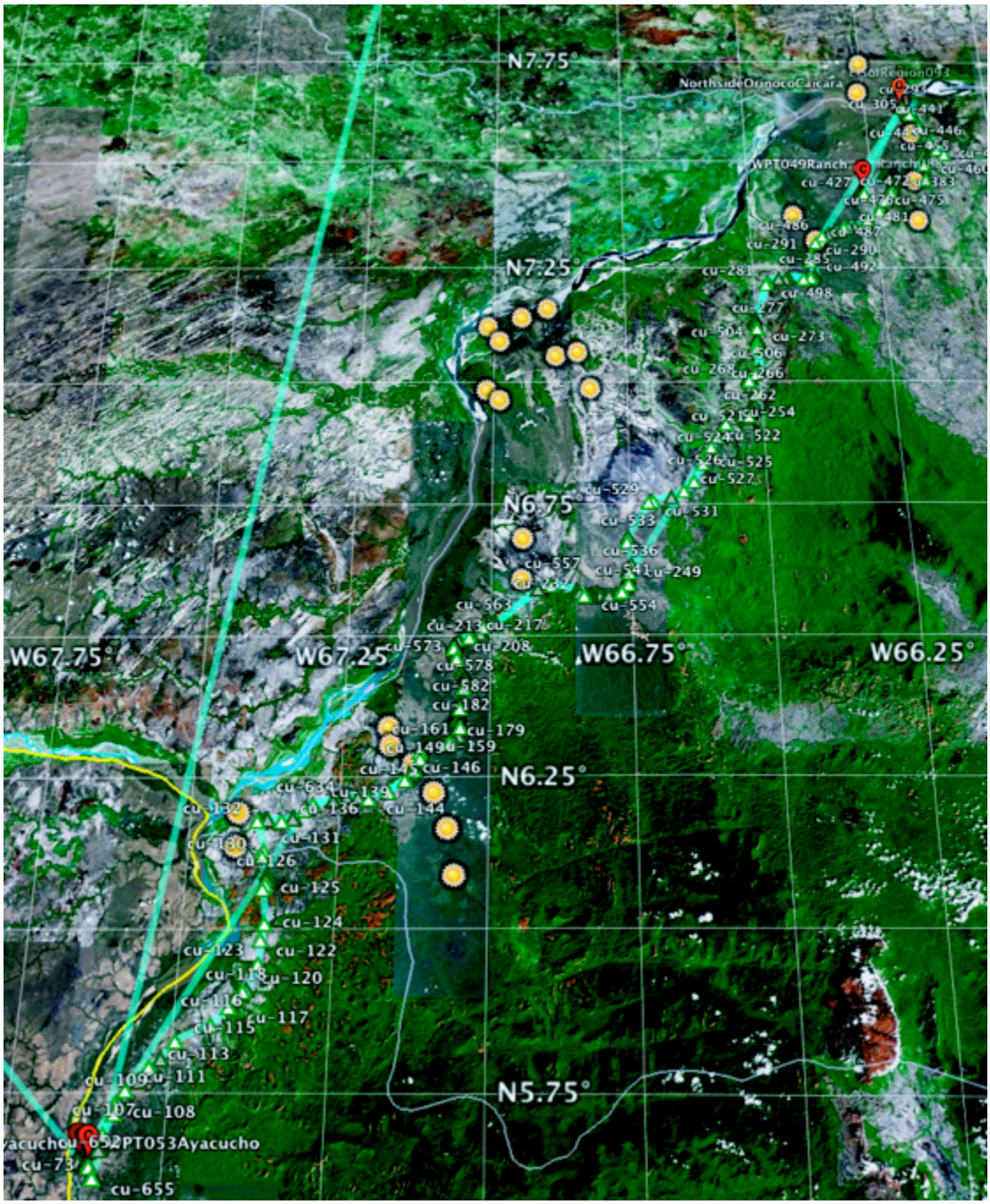

Figure 4. Survey region, Puerto Ayacucho (bottom left) to Caicara del Orinoco (top right). The 'cu' symbols mark the road between the two towns, through the savannah to the right of the Orinoco river.

the Earth, and finally, for stronger auroras, fiery plasma instability figures usually in association with the incoming plasma current column. Because of the latter's orientation at the south axis, all archaic petroglyphs have at least one polar south viewpoint.

The properties of intense aurora appear to be similar to the properties of a column of plasma conducting giga-amperes of current rather than mega-amperes [2]. It is to these current magnitudes that [1, 6] pertain.

To verify the occurrence of an intense aurora millennia ago, we reinvestigate petroglyphs in the Orinoco River basin where they were first discovered in the Americas (by Europeans) as a topic of importance in natural philosophy.

3. A survey of the Orinoco river basin

Among the first of the Europeans to treat petroglyphs as a topic of scientific inquiry was the Prussian explorer and naturalist Alexander von Humboldt, who between 1799 and 1804 explored much of Central and South America. In the Orinoco river basin, Humboldt, studying electricity, is credited with discovering the first animal that produces electricity, *Electrophorus electricus*, the electric eel.

Von Humboldt mentions in his *Reise in die Aequatorial-Gegenden des neuen Continents*, his discovery of a petroglyph from the region of Caicara on the Orinoco, *el Sol* [9, 10]. This was one of only two petroglyphs known

Figure 5. Black basalt close to the Orinoco river.

to archaeologists and ethnologists in this specific region until the early 1900s.

Located at the geographic core of continental Venezuela, the Middle Orinoco area contains one of the largest concentrations of rock paintings and petroglyphs in northern South America (figure 3). Petroglyphs are present throughout the country wherever suitable rock formations and orientations are found. Currently over 1000 rock art sites are known; a small fraction of what is most likely to be present given the lack of visibility of deeply carved petroglyphs on dark granite and forage overgrowth.

From the Columbian border to the south and across the river at Puerto Ayacucho, the Orinoco river in Venezuela runs primarily through quaternary sedimentary rocks to Caicara; the savanna forest along the river transitioning to the east by Paleozoic–Mesozoic igneous and metamorphic rock. This region defines the northwest extent of the Guyana shield, a Precambrian geological formation underlying Guyana, Suriname, French Guiana, and parts of Colombia, Venezuela and northern Brazil. To the east of the Orinoco is an overwhelming landscape of black granite in all sizes, from boulders, to hills, to mountains. Along the Orinoco the basalt is primarily gray and black granite (figure 5). Thus the region consists of pocked gray rock, usually unsuitable as petroglyph palettes, to smooth texture gray and black granite ideal for deep petroglyph carving but often difficult to see.

Because of the plethora of petroglyph-suitable basalt (palettes) found everywhere, petroglyphs are spread throughout the Orinoco basin (as well as in Caracas, a Mesozoic metamorphic rock region). Canaima is located in a Precambrian metamorphic region with many rivers and waterfalls, again with gray granite palette rocks. Rock art is found in a variety of contexts ranging from isolated boulders in the river or shores of the Orinoco river, on hilltops and large walls, on the face of granite hillsides, and in rock shelters of all sizes created by the superposition of large boulders.

When rediscovered in 1908–1909, Bendrat remarked about *el Sol*, 'The figure is deeply carved in a comparatively hard granite rock that rise about four feet above the ground and is entirely hidden from view by dense undergrowth' [9]. Today, the town of Caicara del Orinoco has surrounded *el Sol*. Because it weighs many metric tons, *el Sol* has not been moved and therefore retains its valuable orientation data. Other petroglyphs mentioned by Bendrat are gone, most likely crushed or removed for housing development. Currently *el Sol* is protected in the backyard of a small museum built adjacent.

Up a dirt road four hundred meters south of *el Sol*, lie several other petroglyphs deeply carved in bedrock. The orientations and angles of inclination are identical to that for *el Sol*, determined by the height of the same mountain ridge further south shielding observers from the intense synchrotron light from polar south (figure 6).

Figure 6. Top left: *el Sol.* Top right: orientation of *el Sol.* The black needle points magnetic-south (magnetic declination 11°24 E, 21 September 2007). Bottom right: inclination of *el Sol* (25.7°) taken standing on the boulder with the top of the gauge sighted onto a ridge polar south 1 km distant (ridge not seen in photo at this camera placement). Bottom left: digital enhancement of *el Sol* reveals that it belongs the family of 28-ray, three-point, accented nose and eyebrow facemask petroglyphs found in large numbers worldwide (figure 16).

Unknowing of intense auroras, Bendrat, as did von Humboldt, attributed the nature and construction of the petroglyphs to a once more advanced civilization in South America. He also connected them to similar carvings in Nubia, Abyssinia and northern Asia. But neither explorer could foresee that growing populations could endanger such large monuments. Venezuela's first national monument, *Monumento Nacional Alejandro de Humboldt* near Caripe, is the largest cave in Venezuela and among the most important in the world. *El Sol* is likely Venezuela's least recognized 'national monument' of archaeological and space plasma importance.

While most rock art is found along basalt escarpments or carved on boulders, rock caves are particularly desirable in determining with high accuracy the field-of-view (FOV) of the rock artist (provided such a view is available) as the location of petroglyphs and pictographs tend to be located just inside the entrance of a south-facing cave. Petroglyphs and pictographs within the cave are marked on ever decreasing areas aligned towards the light at the cave entrance, ceasing entirely where the view outside no longer exists. Cave sites surveyed in our study include Lava Beds National Monument in California, several in Idaho, along and close to the Columbia river in Washington state, and others throughout the southwestern portion of the United States [6].

Because the boulders along the Orinoco are overlaid, caves with openings in all directions and inclinations are found along the length of the river. But as is the case of caves at higher northerly latitudes, petroglyphs were found only in those with a well-defined FOV within a few degrees of polar south. In addition, information about light-shields, their necessary inclination or vertical blockage of intense synchrotron light, was recorded. Figure 7 shows the location of several petroglyph and pictograph caves at *Laguna Los Tres Cerr* along the Orinoco.

About a dozen deeply carved petroglyphs were found in the cave shown in figure 8. The separatrix-type, an instability that occurs in an intense *Z*-pinch column (figure 21 of [1]) is carved just inside the cave entrance on the west wall aligned 179.5°. The entrance to the cave is blocked by a large boulder such that the FOV within the cave is a 'square window' with an inclination off horizon of 27.4°. The extent of the FOV is about 1.5° centered on polar south ending about 5 m into the cave.

Ten meters east of the cave shown in figure 8 is a smaller enclave, a natural hole at the side of the basalt

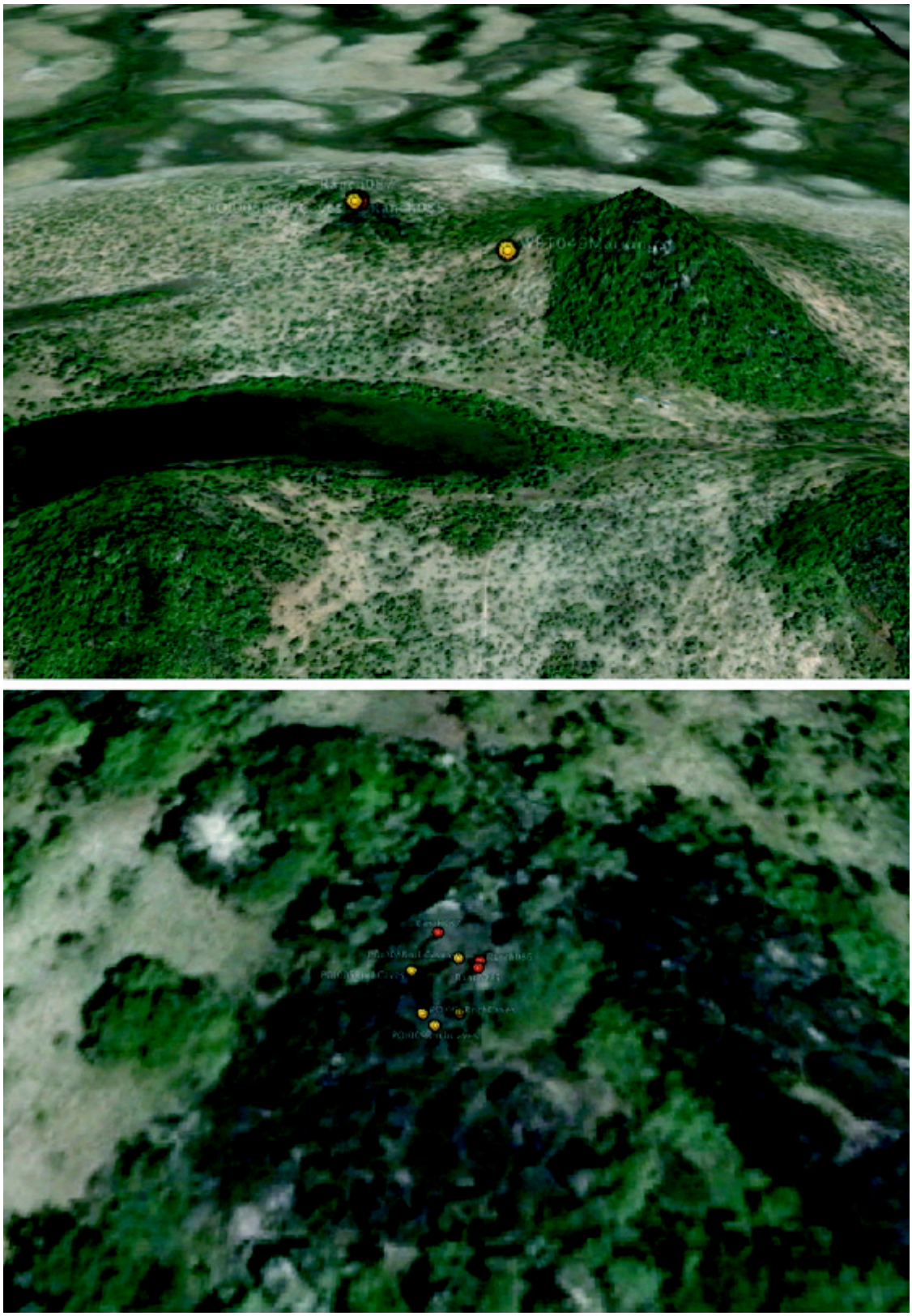

Figure 7. Distribution of petroglyphs and pictographs in polar south openings of the caves at *Laguna Los Tres Cerr.* (Quickbird satellite photos.) Top: view of the *Tres Cerr* area. Bottom: close up of the petroglyph/pictograph cave locations.

hill with pictographs painted on the back wall and ceiling. Figure 9, top left is a picture of one of the authors taking measurements where the original artist had drawn the pictures. Each petroglyph/pictograph surveyor carries two varieties of GPS receivers. Forestry quality compasses and inclinometers are preferred where the terrain makes accessibility to a site difficult. For greater accuracy, mining transits and clinometers mounted on tripods are used where portability is less of an issue. Laser range finders are used to measure and mark the insides of caves.

Figure 8. Petroglyph cave at *Laguna Los Tres Cerr.* Upper left: outside view into cave. A number of petroglyphs are located slightly inside the opening of the cave and at the far back wall. Upper right: separatrix petroglyph at cave entrance on right looking out. Lower left: 27.4° inclination off horizon measurement. Lower right: FOV, east wall, 181°. FOV, west wall 179.5°.

A number of computer applications, commercial and proprietary, are used to map the measured data onto two-dimensional and three-dimensional areas of the Earth. Generally, data are taken every 1 m along a wall panel or boulder covered with petroglyphs. In order to resolve this information, color digital orthophotos of the survey area of interest on a nominal scale 1 : 10 000 with a pixel resolution of approximately 1 m at ground level, are obtained when they exist. For other areas, Quickbird satellite, color, cartographically corrected, 0.6 m resolution imagery is utilized.

While figure 9 has a FOV 70° wide determined by boulders in front of the enclave, the pictographs are centered on polar south (180°)with an inclination of 26.5°.

4. Computational results; the Nazca-Palpa plains in Peru

At a compass reading of 214° and 2660 km across the equator S-SW of Caicara, Venezuela (7.64°N, 66.17°N), lie the lines and geoglyphs on the Palpa/Nazca plains of Peru (14.24°S, 75.58°W). There could hardly be more difference between the two locations; Caicara located alongside a large river in a savannah setting and Nazca located on a desert plain, the driest location on Earth.

However, because of these differences and with other recordings around the globe, an example of which was shown in section 3 of this paper, when treated as symbols with different exact FOV information, large computational resources make it possible to reconstruct the shape of the south axial current pinch [6]. As shown in figure 10, the reconstruction shows two egg-shaped plasmoid pinches at 206 000 km and 306 000 km, respectively, while the plasma column flares out as shown, 701 000 km from Earth.

With this information on a digital Earth, it is possible to reconstruct what mankind saw in antiquity with regards a coronal mass ejection of Gold's magnitude. Figure 11 illustrates the synchrotron light seen looking obliquely up into the plasma column. Our southernmost data suggests that the column bent, swinging around the Earth as if a mill-handle, making images such as these visible to most places on Earth. The details of these observations will be published in another paper.

The intense synchrotron light from the Birkeland filaments cast white light onto the ground surface. These lines come together at human-constructed mounds rising above the plain called 'line centers'.

The Nazca-Palpa lines, by their orientation, contain significant data. In chapter II '*Order in the Nazca Lines*' Aveni reports [11]: '*Line Centers consist of one or several natural*

Figure 9. Pictograph enclave. Top left: one of the authors recording FOV information where the pictograph artist(s) worked. Bottom left: inclination measurements. Inclination 26.5° at left-of-center towards polar south. Right: enclave pictographs.

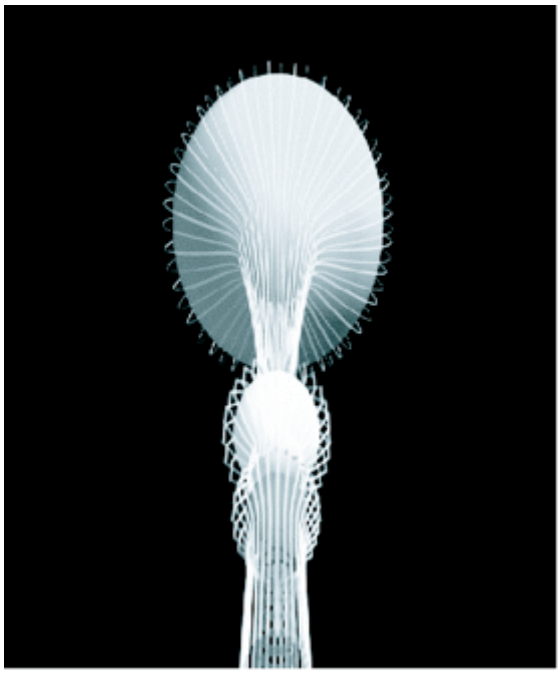

Figure 10. Virtual image of the intense auroral plasma column as determined from FOV directivity, viewing angle of inclination, and GPS surveys of petroglyphs worldwide, treated as 'pixels' in this reconstruction. The column base is directed towards Antarctica. Not to scale.

hills or mounds topped by one or more piles of boulders from which several lines of various widths eminate'. '*All seem to be situated on quite prominent headlands from which one can see a considerable distance*.'

The data from our surveys of lines and geoglyphs on the Palpa and Nazca plains differ in no way from any other petroglyphs on Earth [6] (figure 12). All are located so that each has at least one south field-of-view (SFOV) with the constraint that no object to the south subtends an inclination off horizon to the observer of more than 31°; nearly all fall within the angles 24°–31°. The lower value assures that the bright synchrotron radiation at direct polar south is shielded from the observer's eyes. This can be a southern mountain range or a local boulder.

Figure 13 also shows that the 28 Birkeland filaments were not in strict synchronization with Earth's rotational velocity as they do not all fall at the same positions. Nevertheless, the synchronization lasted long enough for the synchrotron radiation lines shone on the Earth to allow kilometer long lines to be marked and constructed. Clearly shown is the convergence to four filaments, running approximately 238°–58° and 165°–342° (SW–NNE and SSE–NNW). A model of the final 4 current filaments flowing towards Antarctica is depicted in figure 14. Shown in the center of this picture is a representation of the constantly changing, quadrupole-trapped, plasma.

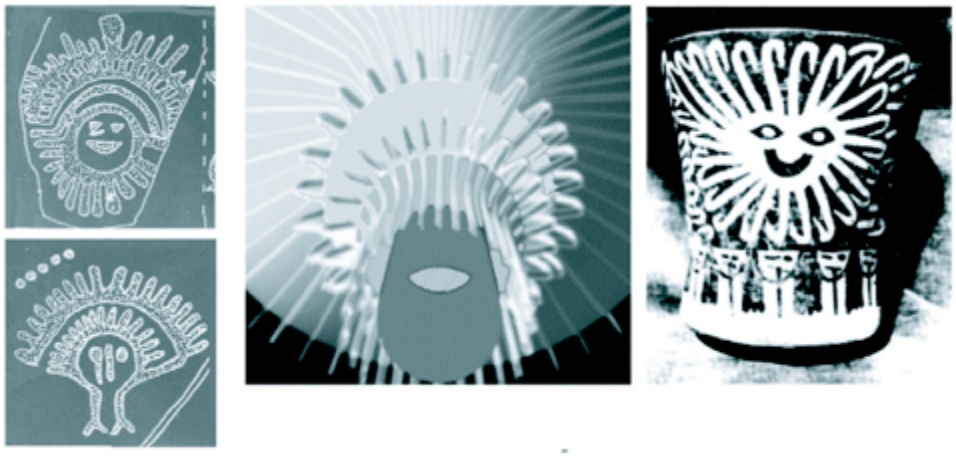

Figure 11. Left: northern hemisphere petroglyphs from the Columbia River Basin, 45.65°N, 121.95°W. Center: Oblique ground view into the plasma column. Right: often depicted picture on a ceremonial cup from Ica, Peru (date unknown).

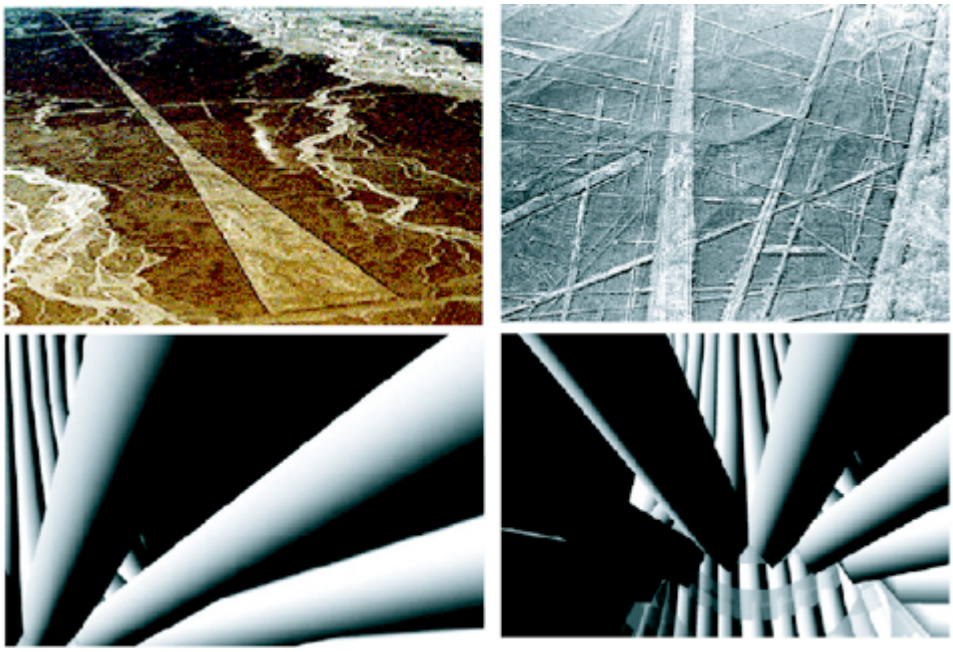

Figure 12. Top: trapezoids and lines of the Palpa and Nazca plains at 350–500 m altitude. Bottom: view upwards into the plasma column shown in figures 10 and 11 from a 'camera' placed at the surface of the digital Earth at latitude/longitude 14.24°S, 75.58°W (Nazca, Peru). Photographs by A Peratt.

An estimate for the currents in an intense aurora can be obtained from [12]. For a strong circular aurora of diameter 5000 km, the total current is about 7 MA. If this pertains to 28 filaments, each filament conducts 250 kA. Hence, the Bennett pinch criteria [1] are satisfied, and the currents remain as pinched filaments. A thousand-fold increase in current in Gold's catastrophic scenario is 7 GA, or for 28 filaments, 250 MA carried by each filament. When reduced to four filaments, each conducts 1.75 GA.

Figure 15 shows two frames from a three-dimensional PIC code whose geometry is that shown in figure 14. As the current increases, the self-magnetic field around each filament produces a quadrupole trap into which interstellar plasma is captured and heated (interstellar densities are given in [3]). The white dots are the intense synchrotron light sources. Time runs from left to right so that the 'concave four-pointed star' so recognizable to petroglyph surveyors, is shown to morph into another familiar shape, the 'dotted cross' quincunx at later time. Below are quincunx petroglyphs found almost everywhere on Earth. The quincunx is the most prolific symbol found in Meso-America.

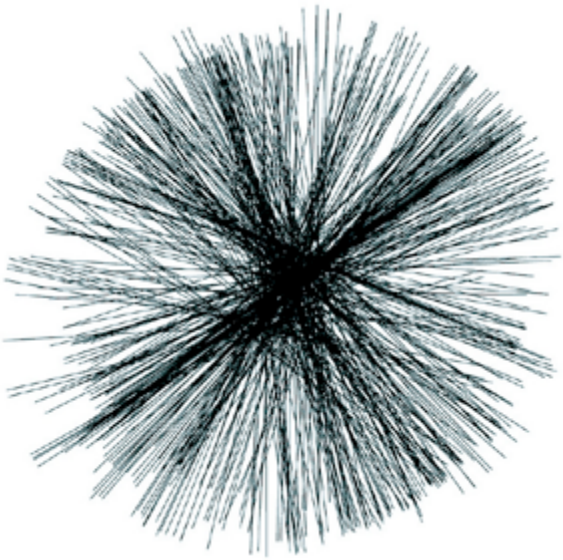

Figure 13. In this figure, over 300 Nazca lines out of a total dataset of 1500 have been collected from their line centers and overlaid at a single point. South at bottom.

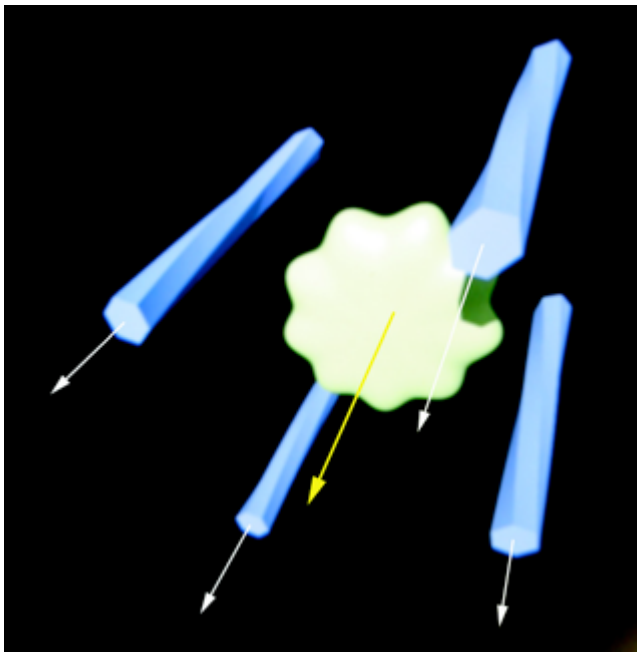

Figure 14. Model of the orientation of the four Birkeland currents whose self-magnetic fields produce a quadrupole trap that shapes, confines and heats interstellar plasma within. Electrons in the direction of the arrows; ions oppositely directed.

While it is unknown if the quadrupole plasma ever reached fusion temperatures, world mythology is replete with stories about a 'hero warrior' shooting an arrow (electrical discharge) to extinguish it, thus saving the parched land below.

Thus, we have an intense *Z*-pinch plasma initiated by a very large coronal ejection whose relativistic electrons entered Earth's south axial pole and hypervelocity protons impinging upon Earth's north axial pole [1, 6]. Like the laboratory and computer simulations, the hollowed *Z*-pinch filamented into 56 individual currents. Because of the Biot–Savart force law for currents flowing in the same direction, the 56 filaments converged to a quasi-static state of 28 thicker filaments. These wrapped around the Earth, eventually converging to four ([6], figure 67).

The four currents produced a number of petroglyph morphologies not discussed in [1] or [6], that is quincunx's, or in the simulation terminology, 4-point symmetric patterns.

While the PIC simulation was run for tens of thousands of cycles with some 32 million particles (scalable at some point to real time), totally unexpected was the transition of the 4-point symmetric patterns to recognizable 3-point symmetric patterns.

Figure 16 left, shows a photograph of an incised stone collected from a cache of others from a cave in the Nazca region. While only one of some dozen stones we have examined, it is noteworthy in several aspects. The incisions have repatined considerably indicating that the artwork is very ancient. Across the head (headband) are 28 vertical lines, the number that would have been seen at Nazca with its southern observation. The 'face' on the stone is that found in tens of thousands of artifacts from antiquity at locations around the Earth such as on the Orinoco river (figure 6). The face is often 'stylized' by the local culture and appears to be 'sacrosanct' as one crafted and purchased in the 21st century most likely has the same picture as one unearthed deep underground at an excavated temple site.

A comparison of a large number of these 3-point faces will be published elsewhere but all have the same characteristics: a triangular face (3-point) with long squinting eyes, and a very thin mouth (with or without teeth). Perhaps the most prominent feature is the unique nose shape. Variations include ears, a mouth either frowning or smiling, and a body, most usually of the Easter Island variety, and filaments or lines such as hair and beards.

With regard to concurrently occurring disruptions at the north axial pole; unlike the relativistic electrons tied to the Birkeland currents, the hypervelocity protons are not constrained and would shower the arctic region. While there is no geological reason to look for such impacts, the north faces of rocks in the arctic should show signs of this bombardment, the obliqueness of impact increasing as the northerly latitude decreases.

5. Conclusion

A survey of petroglyph/pictograph sites containing some 4 million pieces of rock art in 139 countries is found to show data concomitant with those seen in multi-giga-ampere currents such as would be produced if a coronal mass ejection 1 or 2 orders of magnitude of those measured today, as suggested by Gold, were to have occurred in antiquity [2]. Corroboration has been made with high-energy density plasma experiments and PIC computer simulations. Treating the worldwide surveyed data as pixels allows a reconstruction of the current form: an intense *Z*-pinch whose relativistic electrons were directed towards Antarctica and hypervelocity protons towards the Arctic.

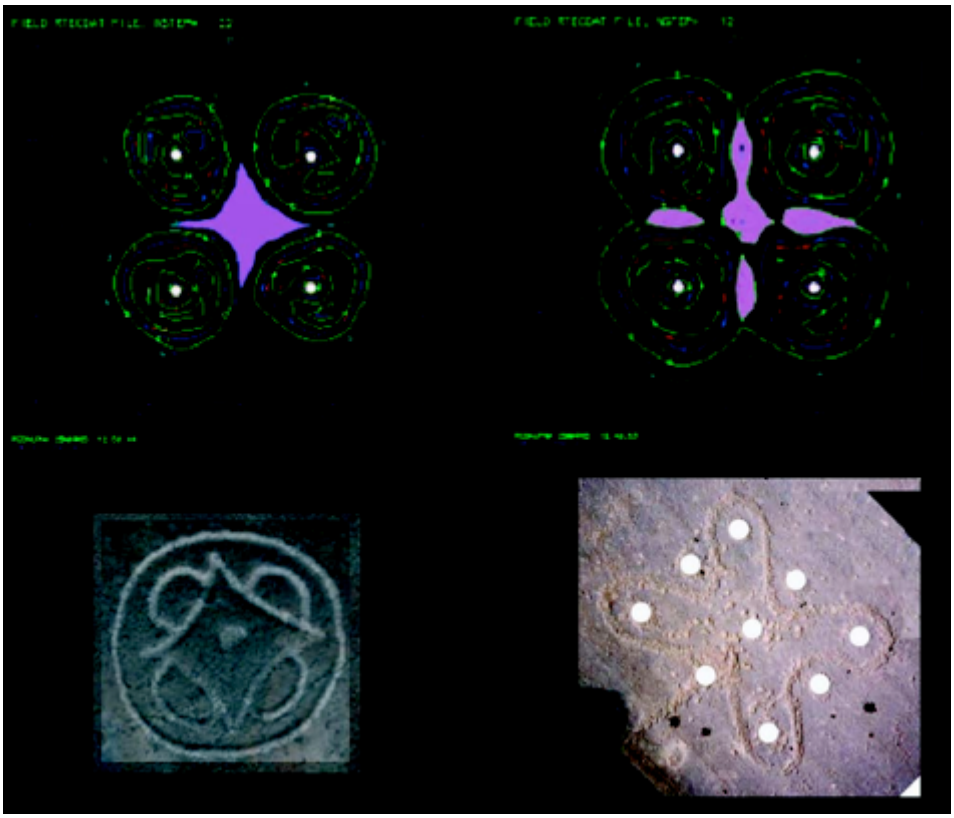

Figure 15. Top: interstellar plasma (center) confined within a quadrupole trap produced by four parallel Birkeland currents (white dots, synchrotron radiation from the four REBs directed outward). Time increases from left to right. The quadrupoles self-magnetic fields are faintly seen around each current. Bottom: associated quincunx's observed and carved by mankind in antiquity. The white dots on the lower right figure highlight the carver's indentations.

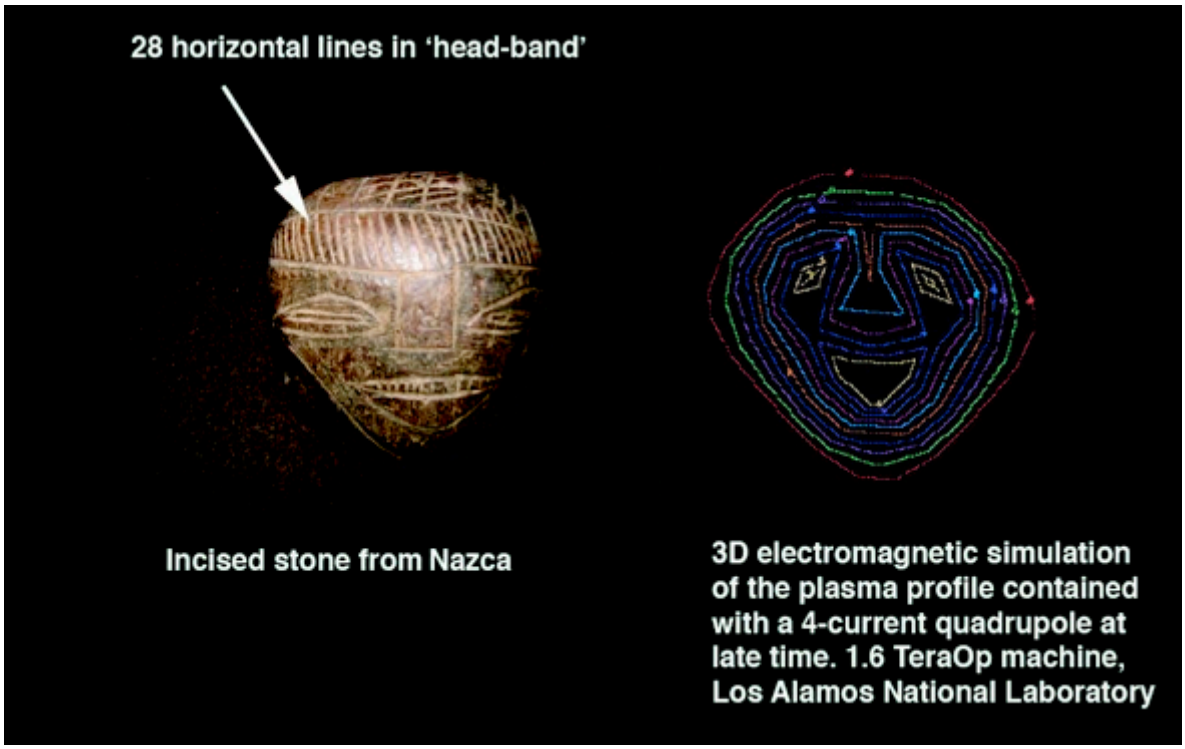

Figure 16. Left: incised stone found in a cave cache near Nazca. Right: 3D PIC simulation of the plasma contained in a magnetic quadrupole geometry at late simulation time. The contours represent isophotes of synchrotron radiation, the intensity denoted by color variance.

Acknowledgments

We thank the Mainwaring Archive Foundation, Bryn Mawr, Pennsylvania, in association with the Museum of Archaeology and Anthropology, University of Pennsylvania, for supporting portions of this research and to the United States Department of Energy, Defense Programs, for allowing access to energy sources of magnitude equal to that of an intense aurora and the computer facilities necessary to model it. We also thank Professors P Martin and J Puerta for their invitations to the VII and XII Latin American Workshops on Plasma Physics, Caracas, Venezuela, and their encouragement to write this paper. We also express our gratitude to A Chataing for twice making arrangements to travel to Bolivar and Amazonas states in eastern Venezuela to document petroglyphs/pictographs in the Canaima region and the Orinoco basin.

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