Journal of Scientific Exploration, Vol. 27, No. 2, pp. 227–246, 2013 0892-3310/13

RESEARCH ARTICLE

Geometry of an Intense Auroral Column As Recorded in Rock Art

Marinus Anthony van der Sluijs
mythopedia@hotmail.com

Robert J. Johnson

Submitted 10/7/2012, Accepted 1/3/2013, Pre-published 4/25/2013

Abstract—In 2003, Peratt demonstrated that rock art images worldwide bear a remarkable similarity to high-energy plasma discharge formations. In later papers, Peratt located the plasma discharge column in which all of these would have occurred at the Earth's South Pole. This article accepts the relation between the rock art images and the plasma formations, but concludes that the geometry of the reconstruction is incompatible with the global occurrence of the rock art images. As a corollary, the finer details of the reconstructed column must also be called into question. In particular, the reconstruction of the top cusp, the two upper plasmoids, and the filamentary sheath in a single column at the South Pole cannot be reliably deduced from the data as presented by Peratt. All evidence points to a worldwide distribution of the phenomena.

Introduction

Between 2003 and 2008, the American plasma physicist Anthony Peratt published three articles presenting evidence for a high-energy–density aurora as recorded in prehistoric rock art around the world.

In the first article, Peratt established a remarkable correlation between rock art image types and similar forms arising in high-energy plasma z-pinch discharges recreated in the laboratory and in particle-in-cell computer simulations of the same discharges (Peratt 2003). Peratt demonstrated that the rock art image types have similar forms worldwide, suggesting that these images were not random doodles or abstract carvings, as often is assumed by archaeologists, but representations of events visible in the sky above prehistoric man. The case Peratt made for the association of worldwide rock art and high-energy plasma events is impressive and entirely consistent with a similar suggestion, apparently unknown to Peratt, made by George Siscoe in 1976 (Siscoe 1976).

Peratt further observed that the millions of examined rock art figures share a preferred orientation. Using holographic computer software, this enabled determination of the likely location of the plasma events in the sky that inspired the ancient artists. The outcome of the initial stages of this research was presented in the second paper, wherein Peratt for the first time located his colossal plasma column of complicated morphology at the rotational South Pole (Peratt et al. 2007). Although Peratt presented this object as a straight, cylindrical structure extending into space from the Pole, he hinted that ongoing research revealed a significant easterly bend in the column (as seen from Australia), thereby explaining its worldwide visibility.

In the third article, Peratt reproduced the straight south-polar column from the previous paper, together with additional survey evidence for the postulated southern location, again hinting at evidence for a bend in the column (Peratt & Yao 2008). He also promised that further aspects of the column's evolution would be published elsewhere, but as no further papers have as yet been forthcoming, this remains, in brief, the situation to date.

The current article accepts the correlation between plasma events and a portion of rock art, but questions whether the proposed reconstruction of a single south-polar column as the event that inspired the worldwide rock art can be supported by the data presented in Peratt's published works.

Although Peratt conducted rock art surveys with a team, some of whom—including van der Sluijs—appeared as his co-authors, he was the actual author of all relevant publications and was solely responsible for the analysis of the data and the laboratory experiments. For convenience, Peratt's team will accordingly be referred to as Peratt.

Peratt's South-Polar Column

According to Peratt, rock art sites were surveyed in 139 countries. For each site or panel, photographs of the images themselves were supplemented with measurements of the geographic coordinates (latitude, longitude, and altitude) as well as the field-of-view (FOV) and the angle of inclination off horizontal of the southern—and sometimes eastern—skyline as viewed from the site. Peratt combined the survey data with the rock art images themselves to create a series of 'pixels', which were processed using holographic software to regenerate the original formation of which the images were supposedly accurate views from the locations concerned.

Peratt presented the results of the reconstruction in the form of a diagram showing a single plasma column with complicated morphology (Peratt et al. 2007:802, Figure 66; Peratt & Yao 2008:9, Figure 10; compare with the more generic diagram in Peratt 2003:1193, Figure 4).

In brief, the reconstructed column contains the following features:

- The column is located above the Earth's south rotational pole.
- A tall, narrow stem supports a wide cusp at the top. The tentative dimensions of the cusp are given as 50,000 km wide; the column is 701,000 km high (Peratt 2003:1211, Peratt et al. 2007:802). The cusp therefore subtends an angle of circa 4° for an observer on Earth. The stem of the column is clearly seen as being much narrower than the cusp, subtending a smaller angle at the observer's position.
- Below the cusp, but still in the upper part of the column, two "egg-shaped plasmoids" some two to three times the diameter of the narrow stem bulge out from the stem itself.
- Below the prolate plasmoids, the lower part of the stem surrounds nine small toroids in collinear arrangement along the axis of the stem.
- The whole column, including the top cusp, is contained within a funnel-shaped sheath formed of longitudinal filaments, which bulge out as they pass each of the upper plasmoids. These filaments are identified as Birkeland currents.

An adjacent diagram shows a conceptual view of the Birkeland currents flowing around the Earth (Peratt et al. 2007:802, Figure 67). The filaments form a narrow hollow cylinder extending into space above both the Arctic and Antarctic regions; the filamentary cylinder bulges out as it passes around the Earth itself.

Scale

Plasma configurations are scalable in principle, but it is unclear how Peratt determined the scale of his intense aurora. Today's aurorae are formed at heights above the surface of between 80 and 1,000 km, where the Earth's upper atmosphere interacts with inflowing electrons. Peratt offered a figure of 701,000 km for the "farthest limit of the reconstruction" (Peratt et al. 2007:802). The sheer scale of such a column militates against its interpretation as an aurora, exceeding the average upper limit of the Earth's ionosphere by a staggering factor of 700; it even dwarfs the magnetosphere, averaging circa 64,000 km in thickness, by a factor of 10.[1] Simply labeling the phenomenon 'intense', 'enhanced', or 'high-energy density' provides insufficient justification for the necessary expansion of the Earth's atmosphere, which raises a batch of other questions in itself. Peratt has stretched the application of the term *aurora* to extremes, for no stated reason.

Global Visibility of a Single Stationary Straight Column

Peratt postulated that a single auroral column coming into the Earth at the South Pole "was universally seen"; "what could be observed would depend on the observer's location on Earth and whether or not the entire column was visible or illuminated, or some portion of it, as in auroral displays today" (Peratt 2003:1203). Observers at northern latitudes recorded primarily the upper portions of the *z*-pinch; those in the far north, upwards of 50°, saw almost nothing of the plasma activity. In his published diagrams, Peratt modeled this column as a straight, cylindrical object, of varying though generally modest width (e.g., Peratt 2003:1193, Figure 4, Peratt et al. 2007:802, Figure 66 and Figure 67).

Like other art forms, rock art representative of instabilities in the inner shaft is apparently attested worldwide. A petroglyph showing a classic squatterman image—the so-called Pippi Stone—was found as far north as 69°, at the northernmost known prehistoric rock art site in the world.[2]

Yet even before addressing the question of what parts of the column were or could be seen from individual locations on the Earth, the global visibility of a single stationary column per se presents an insurmountable problem. It is inconceivable how a straight column located at the Earth's rotational South Pole could be discerned worldwide (Figure 1). A south-polar column must intersect the local horizon or it cannot be seen. It would not be visible from anywhere in the Northern Hemisphere, unless there was a negative angle of inclination of the southern skyline with a magnitude in excess of the northern latitude of the observer. Conversely, neither would such a column be visible from the Southern Hemisphere from any location where a positive angle of inclination with respect to the view exceeded the southern latitude of the observer. For magnetic south, the situation differs somewhat on account of the displacement of the geomagnetic poles from the rotational poles. Even so, a phenomenon occurring above magnetic south is visible only from viewpoints in that hemisphere of the Earth in which magnetic south forms the Pole.

In order to be visible at all from mid-northern latitudes, the cusp of the south-polar object would have to be enormously wide, extending so as to intersect the visible horizon for the latitude—and even then, the center of the column would remain invisible. Peratt never suggested that the column or any part of it extended to such width; as seen above, if the "dimensions" of the outer cusp region, presumably its diameter, measured 50,000 km, and the column attained a height of 701,000 km, this would subtend an angle of a mere 4° or so. A slim column such as Peratt envisioned, no matter how tall, could never be discerned from the Northern Hemisphere.

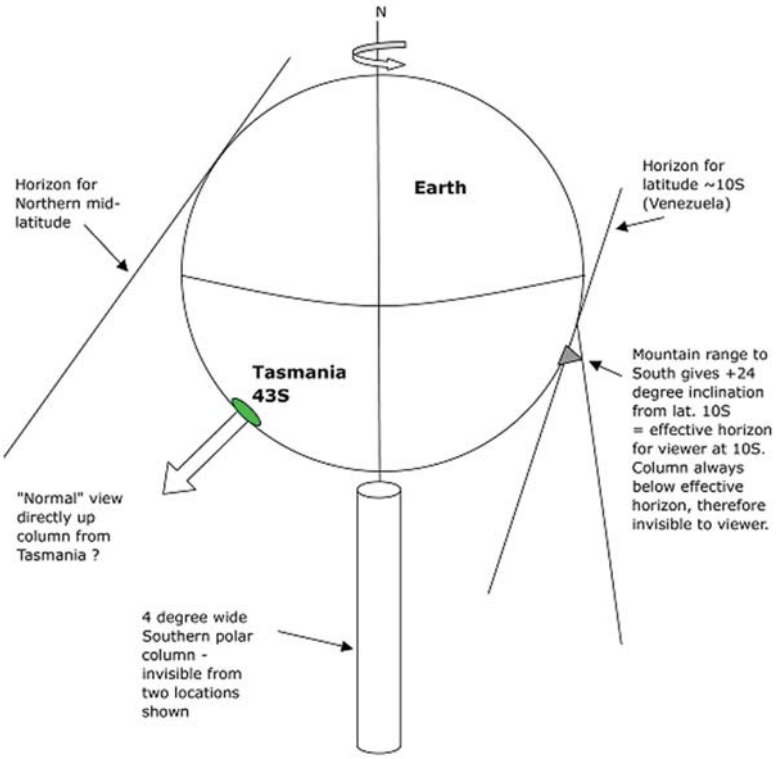

Figure 1. Visibility of a south-polar column relative to the horizon. There can be no visibility of anything below the horizon, or effective horizon, where there is an angle of inclination to a cut-off. Tasmania (43° South) apparently had a view directly up the column. © R. Johnson

In sum, Peratt's notion of a single, straight, and stationary column visible worldwide is untenable. If it is irreconcilable with the worldwide distribution of the pertinent rock art images, do Peratt's conclusions regarding orientation, perspective, and inclination fare any better?

Orientation

Other geometrical problems become apparent upon inspection of the southern orientation Peratt claimed for the column.

As Peratt's model evolved, the hypothetical enhanced aurora tacitly but abruptly shifted from the magnetic South Pole to the rotational one, over Antarctica. Initially, Peratt proposed that petroglyphs were carved in locations with a "line-of-sight to the Earth's magnetic poles and highly

conducting regions on the Earth's surface," which are "the criteria of an intense aurora today" (Peratt 2003:1199). In other words, at this stage Peratt was still discussing the evolution of plasma events in relation to today's auroral phenomena, with the lines of the Earth's magnetic field defining the paths of the incoming electrons. Between April and October 2005, Peratt changed direction without further comment. From then on, he would invariably locate the reconstructed column at the rotational South Pole. For example:

> . . . the light was observed totally from the direction of the south axial pole of Earth. (Peratt et al. 2007:801, Peratt & Yao 2008:2, cf. 6,8,11; compare with Peratt et al. 2007:779–780,796)

In Peratt's diagram (Peratt et al. 2007:802, Figure 67), it is unquestionably the geographic pole, not the magnetic one, that is directly below the column. Moreover, from October 2005 on, Peratt would correct compass measurements obtained in the field for the local magnetic declination, but had apparently not done so previously. At that stage, the rotational pole dominates his discussion of the survey data and the reconstruction, while the column's association with the magnetic pole is quietly relegated to the few occasions where Peratt touched on the physics of plasma (e.g., Peratt et al. 2007:797,799,800, Figure 61, 805). No explanation for the discrepancy is given.

If Peratt's survey data suggested an association of the plasma events with the rotational pole, it is surprising that the phenomenon observed by the artists did not follow the normal plasma behavior with electrons guided by the magnetic field lines, unless it were assumed that the magnetic and rotational poles coincided during the era concerned. However, if the data acquired during the first few years of the investigation had so unambiguously pointed to magnetic south, one wonders whether Peratt ever corrected these for magnetic declination to verify whether they are consistent with true south as well.

Peratt's treatment of directionality in rock art is further compounded by his indiscriminate conflation of two types of south. On one hand, Peratt's texts liberally employ the terms *south pole*, *south polar axis*, *south axial (pole)*, *south polar horn*, *true South Pole*, *south(ern) axis*, *south seeking pole*, and *south(ern) magnetic pole*. These refer to the Earth's rotational axis, its rotational poles, and its magnetic poles, all of which are definite geographic *locations* relative to the surface of the Earth. On the other hand, Peratt frequently used phrases such as *true south*, *south field-of-view (SFOV)*, *south FOV (SFOV)*, *southerly direction*, *due south*, *southern sky*,

south-facing, and *southwards*. This group relates to a *direction of view* from an observer's location on the Earth, as in surveyed data, and may conveniently be referred to as local south. The two groups of geodetic terms must be carefully distinguished.[3] As noted above, the celestial South Pole is always visible from the Southern Hemisphere, but remains below the horizon for viewers in the Northern Hemisphere.

Peratt seems to have been oblivious to this crucial distinction. With his equivocal use of terms, he apparently committed the logical error of equating a view toward local south with one that includes the celestial South Pole. According to Peratt's prevaricating diction, the south-polar column was observed at sites around the world—including in the Northern Hemisphere—in a portion of the sky oriented to "polar south" (Peratt et al. 2007:78, cf. 796). For example, Peratt wrote with respect to the column:

> Because of the latter's orientation at the south axis, all archaic petroglyphs have at least one polar south viewpoint. (Peratt & Yao 2008:4)

This one simple mistake may underlie the entire set of problems in Peratt's texts relating to field-of-view, inclination, and the visibility of a southern column from the Northern Hemisphere.

Additional confusion is caused by Peratt's concept of a "Cage" formed by individual Birkeland currents flowing around the Earth in the fashion of meridians. Under the heading "*Observations from the Northern Hemisphere*," Peratt interpreted a number of images from the Columbia River Basin in terms of the south-polar column with its "egg-shaped plasmoids" (Peratt et al. 2007:802), but, as noted above, the plasmoids could not possibly be visible at all at this latitude, while the filaments constituting the "Cage" would appear overhead and all around instead of at true south. On the Southern Hemisphere, meanwhile, Peratt invoked the Birkeland currents surrounding the Earth in order to account for the Nazca lines and similar features, misapplying medieval European and Chinese descriptors of the aurora borealis such as "'swords', 'spears', 'white vapor', 'like glossed silk penetrating it', and 'candles in the sky'" (Peratt et al. 2007:804, Figure 71), to some of which van der Sluijs had originally introduced Peratt. Apart from that, Peratt further linked the filaments encapsulating the Earth to "Vertical striped petroglyphs or vertical white-striped pictographs," as found "worldwide" (Peratt et al. 2007:804). Although this is an interesting proposition, the global visibility of the cables and their ostensible depiction in rock art and geoglyphs sits uncomfortably with Peratt's earlier claims that, for all petroglyphs, "the light was observed totally from the direction of the south axial pole of Earth." If there is any validity in Peratt's hypothesis

of a filamentary "Cage" represented in prehistoric art, Peratt ought to have evinced more clearly that it concerns a separate class of striped images to which the putative southern orientation does not apply. Instead, Peratt explicitly stated that petroglyphs representing the "Cage" had been included in the data survey (Peratt et al. 2007:781, Figure 2, Figure 40, 802), adding: "The characteristics of the Nasca–Palpa lines and geoglyphs differ in no way from the parameters determined for petroglyph locations worldwide" (Peratt et al. 2007:804).

Perspective

Additional difficulties arise when, based on the faulty model of a single stationary column, a consistent match is assumed between the geographic coordinates of terrestrial viewpoints and changing perspectives on the column.

The interpretation of individual rock art images and related art forms as local perspectives on a single celestial phenomenon requires a determination of scale, perspective, and temporal evolution. Peratt interpreted dotted circles and concentric circles as bottom-up renditions of a diocotron instability affecting the hollow outer sheets of the *z*-pinch (Peratt 2003:1209–1210,1212), while he derived 'ladders', 'caterpillars', 'birds on sticks', 'squattermen', 'Kokopelli', and many other forms from instabilities in the solid inner core of the lower segment of the auroral beam, viewed sideways or at an oblique angle (Peratt 2003:1193–1205). So far, so good—the matches between these respective instabilities and their petroglyphic correlates are indeed compelling. Problems appear when the geographic distribution of such designs is taken into account. If the hypothesized auroral column was stationary, as Peratt suggested, one would expect a geographic distribution of the two categories of 'hollow' and 'solid'-type instabilities, but both classes of perspective appear to occur wherever non-figurative rock art is found. Peratt determined that concentric designs—which are usually circular—occur between circa 59° North (as at Oslo, Norway) and 33º South (in South Australia), citing Stonehenge and petroglyphs from Australia, Arizona, and Oregon. At the same time, he adduced axial images from Australia, the southwestern United States of America, and "Europe", including Spain, Italy, and Tyrol. Indeed, illustrations of respectively an axial and a lateral perspective on Peratt's auroral column frequently appear at the very same sites, as could be demonstrated abundantly.

Peratt presumed that the worldwide concentric petroglyphs, geoglyphs, and related monuments represent views of one and the same phenomenon, with the viewing angle varying with latitude as one would expect. However, on closer inspection, this geometry is suspect. Peratt compared concentric

images from northern Arizona (35° North, 109° West) and the Columbia River Basin (45° North, 120° West) with Stonehenge (51° North, 10° West) (Peratt 2003:1209–1211). While the comparisons are impressive in themselves, calculations show that it is not possible to identify any location on Earth where the geometry of an auroral ring in even a greatly extended ionosphere would allow circular and tilted concentrics to be drawn in the places where they are actually found. Restricting the auroral ring to the South Pole, whether rotational or magnetic, simply exacerbates the problem. If concentrics indicate a local field-of-view up into a laminated column, they cannot all represent the same static column, wherever it be located, unless the dimensions of the Earth are ignored and the Earth is treated as a point particle. This hardly seems to be a realistic solution to the geometric puzzles.

Consistency in perspective would require that circular designs at locations directly below the assumed celestial phenomena give way to ovals in other places. Peratt expressly endorsed this when he professed that a petroglyph at the Columbia River Basin that shows rayed and dotted concentric circles, when compared with Stonehenge, "indicates a small obliqueness of observation as seen from the Columbia River" (Peratt 2003:1209–1210,1212). However, this statement is inconsistent with latitude: Stonehenge to the north may be more circular than the image from the Columbia River Basin, but so is the figure from Arizona to the south. As Stonehenge and Arizona are also separated by 99° longitude, it is impossible to find a single location for the column anywhere that can satisfy these geometries. Most certainly, a column at the South Pole cannot suffice.

Peratt also implied consistency in perspective when he compared an "ellipse" from Windjana Gorge (Western Australia; 17.6° South, 126.5° East, not West as Peratt stated) to a petroglyph from northern Arizona, for he "fitted" the ellipse to "the outer concentric of the Northern Arizona petroglyph" as he "digitally tilted" it "at an angle of 45.3°" (Peratt 2003:1209,1211, Figure 47). However, when the correct longitude of the Australian image is considered, the two sites are 128° apart on the great circle between them. A column vertically overhead at one site would not be visible at all at the other.

The expected neat geographic distribution of circular and oval designs is not found. Peratt's estimated distribution of concentric petroglyphs covers almost the entire inhabited part of the world and the southernmost limit may even have to be extended to 43° South, in keeping with what Peratt dubbed the "Tasmanian Paradox" or "why are the petroglyphs so dominated by circles," especially if this was "due to a geometry of FOV up into a concentric column" (Peratt 2003:797). As there is no known restriction on

ovals to the north or south of the boundaries for concentrics, it appears that ovals and circles both enjoyed a practically global distribution.

Peratt's claims on perspective founder in other respects, too. Peratt complemented the rayed circles from the Columbia River Basin with rayed concentric arcs from the same region (Peratt et al. 2007:803, Figure 68). A relationship of some sort between the latter two petroglyphs appears likely, but the differences must be accounted for, such as the omission of rays and the extension of the lowest circle into a 'neck' in the bottom image. As the images are geographically close, a different perspective on the same phenomenon is only plausible if they represent different stages in time for a moving—and evolving—object, but Peratt did not state this and insisted on a stationary column.

All of the above vitiates Peratt's proposed solution of a single stationary column. The only possible solutions to the distribution of the concentrics are that the auroral ring is allowed to change location over time and that there were different rings over a period of time.

Inclination

Based on in situ measurements, Peratt suggested that, between latitudes of circa 45° North and circa 25° South, there is always a cut-off in the direction of true south at an angle of inclination of +31°, above which no petroglyphs are found: All are located so that each has at least one south field-of-view 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 range of angles 24°–31° (Peratt & Yao 2008:9). Apparently, the column did not extend above the cut-off angle. A lower limit for angles of inclination is set by the carvers' apparent use of blinders. Blinders were required wherever the light of the column was too bright, that is to say, the lower part of the column. For latitudes between circa 45° North and circa 25° South, blinders blocked any light below an inclination of +24°: "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" (Peratt & Yao 2008:9).[4] Thus, for these latitudes Peratt defined three zones of visibility to the south: from 0° to +24°, where the column was seen, but too bright to be carved; from +24° to +31°, where the column was seen and carved; and above +31°, where the column was not seen (Figure 2).[5]

The geometry of the column becomes even more perplexing when these figures for a fixed inclination off horizon are taken on board. First, for any stationary column the zone of visibility, as defined by inclination off horizon, ought to vary commensurately with latitude, yet Peratt postulated the same rigid set of figures for all latitudes between circa 45° North and

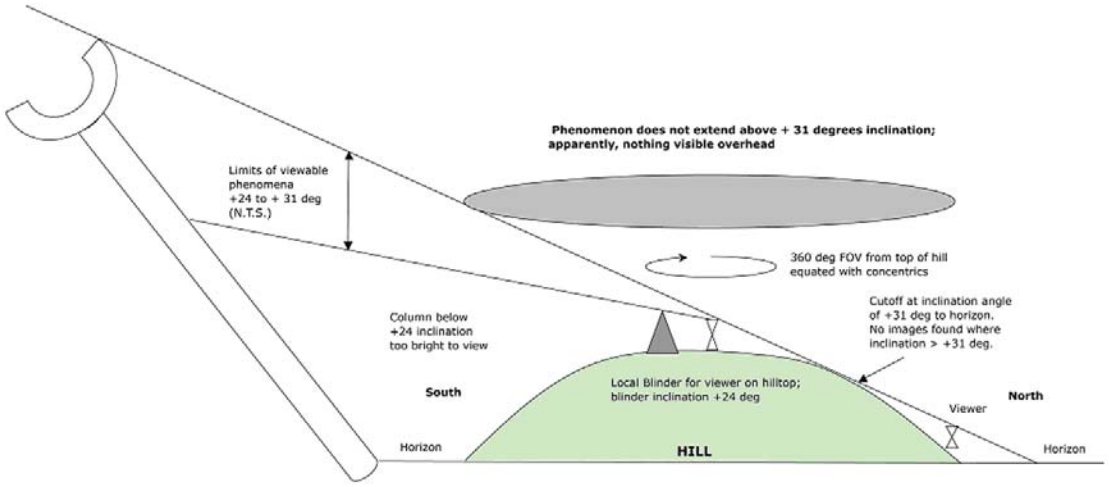

Figure 2. Effect of inclination cut-off on visibility.
Blinders and cut-off imply that all viewable phenomena were within +24° to +31° of the southern horizon. Concentrics are common on tops of hills, implying a 360° view within the above limits. © R. Johnson

circa 25° South. Second, if all petroglyph sites have a minimum inclination of +24°, no part of a narrow column of infinite length at the South Pole could have been seen at any latitudes to the north of 24° South, where most petroglyphs occur (compare with Figure 1). And third, in which portion of space were the phenomena occurring such that they never appeared at local inclinations above +31°, for observers between 45° North and 25° South (Figure 3)? Even if the top of the column was somehow visible at an inclination of +31° at any one northern latitude, the same point on the column would naturally appear higher than +31° at a more southerly latitude on the same meridian, and yet the same cut-off is still supposed to apply to the latter. This is inconceivable.

Summing up, it is impossible to find a single location for the phenomenon anywhere in space which can satisfy this geometry of visibility over the range of latitudes concerned.

In an enigmatic passage, Peratt explained how a rock artist's field-of-view on the celestial spectacle tends to change as one descends from a summit:

> Petroglyphs carved at the top of a hill or peak may provide a 0°–360° FOV, only one direction that the artist was sighting. . . . Well-drawn concentrics are often found in greater numbers at these locations, or high up on an escarpment.

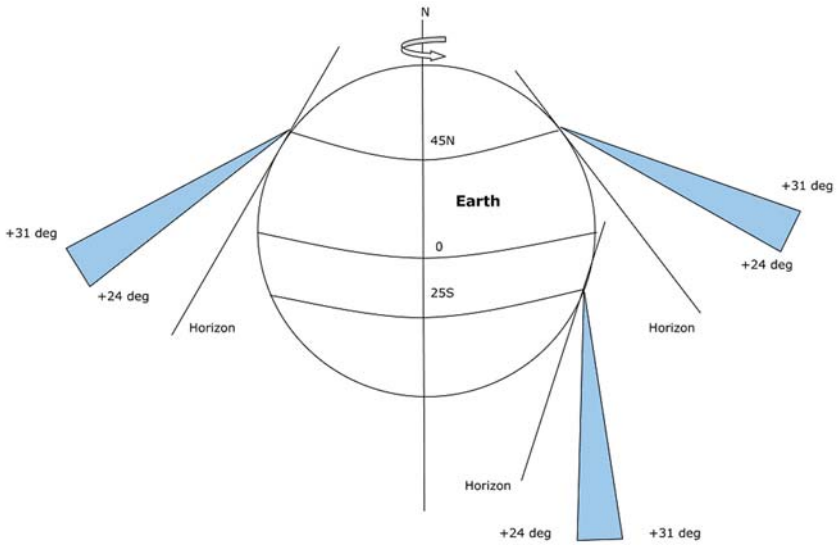

Figure 3. Limits of visible phenomena applied to different latitudes, using Peratt's window of inclination.
Not to scale. © R. Johnson

> Petroglyphs carved on the north side of a slope occupy an increasingly narrower portion of the compass with an FOV centered on 180° South as the distance from the peak increases. A null (void of markings) region is reached at an inclination of +24° to +31° downward from the peak whose location at which the artist used local blinders. This description is also applicable to petroglyphs carved on the east, west, or south slopes downward from the peak. (Peratt et al. 2007:796, paragraphing added) [all sic, MAS]

Typographical errors and confusing phraseology aside, this passage is riddled with obstacles.

The first few sentences seem to concern the *narrowing sector of the sky* visible from locations with petroglyphs as one descends a peak. At the top, the sky is visible in all directions; further down, the section of the sky visible from carved rocks occupies an ever narrower portion of the compass, closing in on true south. Because at lower elevations more obstacles block the view, the carvers were supposedly forced to select only those places where true south was still visible. Thus, petroglyphs at lower elevations are more diagnostic of the portion of the sky in which the column was seen than those at higher locations.

Apparently, Peratt then continued with a statement on *inclination*:

All petroglyphs occur in places where the local angle of inclination to the horizon is between +24° and +31°, but in mountainous terrain such places tend to be rarer at lower elevations. Thus, petroglyph fields often fizzle out toward the base of a peak in an area Peratt calls the 'null region'. On summits, blinders had to be distant mountain ranges, neighboring peaks, or a large rock on the peak itself (compare with Figure 2). Downslope, the peak itself might also function as a blinder.

With the final sentence, Peratt probably meant to say that the same two observations apply on all four sides of a peak.

If the above represents Peratt's views correctly, the following objections apply.

First, if a 'null region' is a petroglyph-free zone, one would not expect it to be *at* elevations where the skyline is inclined between +24° and +31°, but *below* such elevations.

Second, the argument that elevation correlates with restriction of petroglyphs to places with a view on true south is valid only on the assumption that the same stationary phenomenon was recorded in all cases. While this could be demonstrated more conclusively at lower elevations, it is hard to verify that the "one direction the artist was sighting" at peaks was always "180° south" when other directions were equally available. As the inclination was only ever measured for the southern field-of-view, it is not possible to compare data for other directions.

Third, Peratt's observation that "Well-drawn concentrics" concentrate on summits, if true, suggests that the auroral phenomenon was panoramic at such locations, being visible all around the horizon and up into the zenith. This meshes well with Peratt's contentions that such petroglyphs represent a view up into the hollow laminated column (Peratt 2003:1207–1212; cf. Peratt et al. 2007:797) and that the column formed a "Cage" surrounding the earth on all sides (Peratt et al. 2007:802, especially Figure 67). As the observer was situated 'inside' the cage, the filaments surrounding him or her would seem to converge at some latitude-dependent point in the sky, similar to the appearance of a 'starburst' pattern centered on the magnetic zenith as seen in an auroral corona today. For observers at latitudes between 31° and 90° South, the point of convergence would appear at a higher angle of inclination to the horizon than +31°, as Peratt seemed to allow. From vantage-points between 31° and 90° North, the convergence point above the South Pole would be invisible, below the southern horizon, but presumably the one above the North Pole would appear, again at inclinations exceeding +31° that *would* contravene Peratt's upper limit. And all observers, regardless of latitude, would see some filaments pass directly overhead, again contradicting Peratt's limits on inclination.

An alternative interpretation, apparently favored by Peratt, is that carvers at summits were only viewing south, sighting "only one direction" despite the panoramic views they enjoyed. The concentrics then also complied with the inclination limits of +24° to +31°, and Peratt's phrase "up into a concentric column" refers not to an appearance at the zenith, but to an oblique view into the column, whose base is directed toward the viewer. On this approach, the carvers' 360° field-of-view is not exploited, the enveloping "Cage" is rigidly distinguished from concentric petroglyphs, and the more general objection to visibility at northern latitudes, made earlier, applies: No part of a narrow south-polar column could have been seen at any latitudes higher than 24° South, including any concentrics. Moreover, as was also noted above, a perfectly circular perspective on concentrics can only be obtained for a wide range of latitudes if the column was mobile or if multiple columns existed.

No such considerations deterred Peratt from using the locations of concentric designs as 'pixels' in the reconstruction of a single south-polar column, as shown in several of his illustrations (e.g., Peratt et al. 2007:803, Figure 68; Peratt & Yao 2008:10, Figure 11).

And fourth, Peratt's statement regarding the application of the description to directions other than the north causes further confusion. In its context, the sentence makes no geometrical sense. Presumably, Peratt merely meant to say that the field-of-view at petroglyphs on the west, east, and south sides is also more narrowly oriented toward true south at lower elevations and that petroglyphs on these other slopes are also limited to places with a southern field-of-view within the stated range of inclinations from +24° to +31°. Even so, the sentence is awkwardly worded and easily induces the impression that each of the four sides offers a similar view on the south-polar column—which, of course, they do not.

In short, the extract quoted above epitomizes the apparent confusion about directionality and basic geometry that runs through all Peratt's papers.

Global Visibility of a Single Stationary Bent Column

Since December 2003, Peratt has been well aware of the complexities posed by perspective in relation to a straight column at the South Pole. Although he continued to portray the column as such in his diagrams, he also began to allude to a conspicuous bend in the auroral column, based on data to the south of mid-northern latitudes. For example:

> In South Australia, a bend in the plasma column far above the Earth was noted. Nearly normal to Antarctica, the column bends eastward as seen from Australia and presents an increasingly 'stretched' columnar profile for

> New Zealand and more so for South Africa. . . . At more southerly latitudes, the angle of inclination changes, as does the plane of the blinder, showing an eastward bend of the plasma column away from Antarctica. (Peratt et al. 2007:796,780)

Peratt did not conceal that the concept of this bend was introduced precisely to circumvent the problem of universal visibility and perspective-based distortion addressed above, for it concerned "a bend in the upper filament sheath that allows the upper plasmoids and column to be seen at northern latitudes" (Peratt et al. 2007:802), or rather "at the equator and both northern and southern latitudes" (Peratt et al. 2007:797).

Though "far above the Earth," the postulated bend must necessarily have been located beneath the "upper plasmoids and column" for them to have been rendered visible in the Northern Hemisphere. Thus, if computer models combining a particle-in-cell simulation with surveyed data had reliably dictated the morphology of the column as shown in Peratt's diagrams (e.g., Peratt et al. 2007:802, Figure 66 and Figure 67), the bend ought to have shown up there. Peratt conceded as much with his promise of a "higher resolution image showing the easterly curving of the auroral plasma column"; however, such an image would not be a matter of "resolution," as the bend would have manifested equally well in a low-resolution image. Arguably, said diagrams were generated by software programming that took the natural evolution of a plasma *z*-pinch into account, but not the measured orientation of petroglyphs.

Peratt presumed that the bent column was 'stationary' in space, while the Earth rotated underneath it. This inspired his comparison of the bent column to a mill-handle, the handle of a giant butter churn, and a giant spoon being stirred. For example: ". . . the column bent, swinging around the Earth as if a mill-handle, making images such as these visible to most places on Earth" (Peratt & Yao 2008:8). Rotation of the handle relative to the Earth is obviously necessary to allow the upper parts to be seen at opposite longitudes in the Northern Hemisphere. But this instantly invalidates the putative narrow orientation of *all* rock art to rotational or even magnetic south. To be sure, if an observer in the Northern Hemisphere would perceive the handle as the upper part of the hand of a clock sweeping around the southern sky from east to west, the movement of the hand might indeed with increasing latitude be restricted to an ever smaller section of the compass, centered on true south. However, someone in the Southern Hemisphere would see the handle as a giant arc passing overhead once a day and thus not only transgressing Peratt's boundaries for the angle of inclination, but also taking the column to positions all around rather than keeping it confined

to the south. Furthermore, the angle of inclination at which the top of any bent column would be seen should still be subject to the same latitudinal dependence as any other object in the sky; bending the column does nothing to salvage Peratt's rigid boundaries for the inclinations.

The only conceivable 'solution' to the widespread visibility of a bent column at latitudes ranging from circa 69° North to circa 46° South requires the sacrifice of all inclination data as well as the global restriction to true south and assumes that the top of the column was located at or above circa 21° South on the celestial sphere, so as to be visible above the horizon at circa 69° North. The visibility of the upper parts of the column would depend on the luminance relative to daylight, a point Peratt touched on inconclusively in 2003 (Peratt 2003:1194). On that occasion, he suggested that a scaled-up laboratory plasma might reach a peak luminance of 5 lumen per steradian per square meter, or 1/120th that of the full moon. Accordingly, the upper parts of the plasma column would have been visible only at night. This orientation of the bend, combined with its nocturnal visibility, suggests an association with the magnetotail in the same sector of the sky, whose dimensions are also more in line with the enormous scale of Peratt's column, at 701,000 km.

This scenario implies that the annual variation of the direction of the Earth's axis to the ecliptic must also be taken into account. Such variation might be supported by the coexistence of circular and oblique concentrics at the same locations, as noted above for the Columbia River Basin, which is otherwise inexplicable without recourse to a moving and evolving column. Yet the admission of annual variability in perspective precludes a straightforward use of survey data to recreate a single event from holographic pixels, as Peratt claimed to have made. Without knowing the time of year, the data are meaningless. The alternative, that the Earth's ecliptic plane was not yet tilted with respect to its equatorial plane, would require an intolerable degree of special pleading.

As an additional consideration, the notion of the column as a "mill-handle" seen to rotate around the Earth impairs the identification of the column with the mythological axis mundi. It apparently informed Peratt's repeated enquiries whether any human traditions presented the celestial column as an object moving along the horizon. The answer to that enquiry was far from straightforward; from the perspective of traditional cosmologies, the sky column was certainly not conceived as a cylinder passing along the horizon in the course of a day, but relevant recurrent themes might be the rocking of the nascent Earth prior to the fixative effect of the column (van der Sluijs 2011:I: 135–137), the comparison of the column to a spinning mill (van der Sluijs 2011:III:159–160), and the swaying of the

upper part of the sky column that preceded the final collapse (van der Sluijs 2011:IV:65,67–69,91,112). Although all such traditions impute some sort of repetitive motion to segments of the column, none portray the column itself as a mobile phenomenon, prone to the effects of the Earth's axial rotation.

Further details regarding the conjectured bend, as promised by Peratt, have never materialized. Perhaps this is because, upon reflection, no bend—of whatever magnitude or height—can resolve all the geometrical problems of visibility around the globe without completely undermining the detailed reconstruction of a southern column from the survey data. If the basic geometry of the reconstruction has to be modified to include a bend sufficient to allow the column to be seen around the world, how much credibility can be maintained for the claimed accuracy of the reconstruction of the straight column? In relation to Peratt's published diagrams and statements on the auroral column, this post hoc solution to the universality of the pertinent petroglyphs simply seems inadequate.

Number of Columns

Finally, in postulating a single south-polar column, Peratt repeatedly admitted that a corresponding plasma tube would be expected for the North Pole in theory, but the directionality he inferred from petroglyph data did not sustain that possibility (Peratt et al. 2007:797–798,805). Peratt predicted that the north-polar axis experienced impacts of hypervelocity protons—or protons moving at an extremely high speed—that were "not constrained and would shower the arctic region" at the same time that the Earth's south-polar axis was bombarded with a flow of relativistic electrons, tied to the Birkeland currents (Peratt & Yao 2008:1,11). No more information was supplied, but it is puzzling to find that one of Peratt's diagrams nevertheless complements the southern column with a northern one, the pair representing the incoming and outgoing segments of a single filamentary sheath enmeshing the Earth (Peratt et al. 2007:802, Figure 67). For the rationale for this, one searches Peratt's publications in vain, but the idea may have been that, aside from the "Cage" enveloping the Earth, only the southern column, formed of relativistic electrons, would have lit up, as only electrons—not protons—emit synchrotron radiation.

Conclusion

Peratt has made a very good case for identifying a large number of the images represented in rock art, geoglyphs, and other forms of art as high-energy density plasma discharges, such as might be seen if the aurora were increased by some orders of magnitude. However, the above analysis has

exposed some of the more salient geometrical discrepancies between Peratt's claimed reconstruction of a single plasma column located at the rotational South Pole and the apparent visibility of that phenomenon worldwide.

In summary, the postulated column above the South Pole would not have been visible in the Northern Hemisphere. It is not possible to find a single location on Earth or in the sky that satisfies the worldwide visibility of the phenomenon in accordance with the presented survey data. This undermines the entire claimed 'reconstruction'. The introduction of a bend in the column, hinted at in the later papers but never detailed, cannot resolve the geometric issues either and further calls into question the accuracy of the claimed reconstruction presented in the 2007 paper and duplicated in the 2008 paper.

If the location and the basic shape of the reconstructed column were not accurate, how much credence can the finer details of Peratt's reconstruction command? In particular, the top cusp, the two upper plasmoids, the internal toroids, and the filamentary strands in the reconstruction seem to be based on little more than approximations to various laboratory phenomena rather than on holographic pixels from which a single phenomenon can be deduced. It seems as though Peratt was not presenting a conclusion derived from a holographic reconstruction based on survey data, as he claimed, but rather a hypothesis which he could not, in fact, support.

The analysis presented here points unequivocally toward one conclusion: A large segment of rock art *was* inspired by high-energy *z*-pinch columnar plasma discharges, but these discharges must have occurred worldwide, not uniquely above the rotational South Pole, as Peratt declared. Building on the sound foundation of the similarities between many petroglyphs and high-energy density plasma discharge formations, the search is now on for an alternative interpretation of the sequence of events which could have inspired the creation of the rock art images worldwide.

A promising lead is the potential of *geomagnetic reversals and excursions*. The Earth's magnetic field is dominated by a dipole structure, but also includes weaker multipolar components, such as a quadrupole and even an octupole. During geomagnetic reversals and excursions, the dipole weakens while the north and south magnetic poles move to lower latitudes. As they approach the equator, the dipole field is superseded by the quadrupole. In reversals, the poles continue to wander until they have effectively swapped places; excursions, by contrast, may be seen as aborted reversals, in which the dipole regains strength and the north and south magnetic poles return to their original places.

Peratt had plausibly argued that each of the auroral ovals is actually the base of a column, defined by the funnel shape of the incoming magnetic

field lines and analyzed in plasma physics as a diocotron instability (Peratt 2003:1193, Peratt et al. 2007:798). His contention that enhancement of the aurora renders these columns themselves visible seems perfectly reasonable. Accordingly, geomagnetic reversals and excursions would be expected to feature visible plasma columns moving toward the equator along with the north and south magnetic poles. At a later stage, four or eight other columns would form above the quadrupolar and octopolar components of the field. Practically every part of the world would have a view of these moving and multiple columns at one time or other and from varying perspectives. The internal evolution of each column would follow the sequence of a plasma *z*-pinch, as modeled by Peratt and fellow plasma physicists. Dramatic weakening of the geomagnetic field, facilitating radical but temporary transformations in the structure of the field, thus seems to be a satisfactory key to the enigma of the distribution of plasma-related rock art forms. Whether such events and their causes can actually be identified in the palaeo- and archaeomagnetic records will be examined in a forthcoming study.

Notes

[1] Peratt's (2003:1192, cf. Peratt et al. 2007:797) indication that the magnetosphere at its widest measures 130,000 to 150,000 km exceeds the commonly cited figure of 10 to 15 Earth radii.

[2] Local museum at the rock art site of Hjemmeluft, Alta, Norway, personal observation by van der Sluijs, 26 March 2009.

[3] Ambiguous are *magnetic south*, *polar south*, and *axial south*, all used by Peratt, as well as the common terms *rotational south* and *geographic south*, as all of these are variously used with respect to the poles and in surveying contexts. The words *polar*, *axial*, *rotational*, and *geographic* are here used to indicate a contrast with *magnetic*.

[4] Compare with:

> At mid-latitude in the northern hemisphere, the angle of inclination for polar south at petroglyph locations will range from about +24° to +31°. . . . The southern hemisphere has the same inclination-blinder dependence as the northern hemisphere to about 25° S. At more southerly latitudes, the angle of inclination changes . . . (Peratt et al. 2007:780).

[5] At the northernmost latitudes, only the relatively feeble upper parts of the column were seen.

Acknowledgment

Van der Sluijs expresses his profound gratitude to the Mainwaring Archive Foundation for their support.

References

Peratt, A. L. (2003). Characteristics for the occurrence of a high-current, *Z*-pinch Aurora as recorded in antiquity. *IEEE Transactions on Plasma Science*, *31*(6), 1192–1214.

Peratt, A. L., McGovern, J., Qöyawayma, A. H., van der Sluijs, M. A., & Peratt, M. G. (2007). Characteristics for the occurrence of a high-current *Z*-pinch Aurora as recorded in antiquity, Part II: Directionality and source. *IEEE Transactions on Plasma Science*, *35*(4), 778–807.

Peratt, A. L., & Yao, W. F. (2008). Evidence for an intense solar outburst in prehistory. *Physica Scripta*, *131*, 1–13.

Siscoe, G. L. (1976). Solar–terrestrial relations: Stone Age to Space Age. *Technology Review*, January 1976, 26–37.

van der Sluijs, M. A. (2011). *Traditional Cosmology: The Global Mythology of Cosmic Creation and Destruction* (I–IV). London: All-Round Publications.