



CHRONOLOGY & CATASTROPHISM

REVIEW 2016:2

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FORUM: The Battle of Kadesh

REFLECTIONS ON THE NEWS by Phillip Clapham

BOOK REVIEW – *Extraterrestrial Sand*

Plus **SOCIETY NEWS** and **LETTERS**



The top part of a colossal statue of Rameses II from the Ramesseum, near Thebes in Egypt, now in the British Museum



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CONTENTS

SOCIETY NEWS	2
ARTICLES:	
Anomalies in Ancient Descriptions of the Sun-God by Ev Cochrane	3
A Geomagnetic Approach to Traditions of <i>Axes Mundi</i>, Part I by Marinus Anthony van der Sluijs	13
The Writings of the Historians of the Roman and Early Medieval Periods and their Relevance to the Chronology of the First Millennium AD, Part IIb by Trevor Palmer ...	28
Alalakh and Chronology by Barry Curnock	36
A Note on Plasmoids on the 100th Anniversary of the Birth of Winston H. Bostick by Robert J. Johnson and Marinus Anthony van der Sluijs	43
FORUM: The Battle of Kadesh	47
REFLECTIONS ON THE NEWS by Phillip Clapham	56
BOOK REVIEW: <i>Extraterrestrial Sand</i> reviewed by Laurence Dixon	57
LETTERS:	
Walter Peters	59
Peter Fairlie-Clarke	59

A Geomagnetic Approach to Traditions of *Axis Mundi*

Marinus Anthony van der Sluijs

Part I

Creation Mythology and the *Axis Mundi*

The preferred methodology for a study of creation myths should be that of a systematic mythology. The origin of creation myths can only be identified when a sufficiently large inventory and thorough analysis of the traditions themselves have been made. The Judaeo-Christian mindset with which European explorers of earlier centuries approached newly discovered cultures inspired them to look for familiar themes high in drama, such as a time of ‘paradise’, a ‘fall of man’ and a worldwide deluge. As a result, it is widely known – especially among readers of Bible commentaries – that such traditions are remarkably widespread. However, what is rarely realised even today is that these are only a few examples cherry-picked from scores of globally recurrent themes revealed by an unprejudiced comparison of global myths, themes which themselves are tightly interlinked in an organised system [1].

Many scholars had reconstructed parts of a global creation myth, but their contributions often still represented only a limited selection of motifs, depended on secondary or tertiary sources instead of primary ones, included doubtful comparisons or did not strictly separate the raw source material from the interpretations. A systematic study of global creation mythology to a satisfactory standard was not yet available. In order to fill the gap of a comprehensive database, I collected and analysed sources from a wide array of disciplines in the humanities – including archaeology, anthropology and the history of art, of science, of religion and of literature – in a long-term and ongoing project currently in its 16th year, complementing library research with a modest amount of fieldwork. Aware that breakthroughs in scholarship often arise upon the examination of a sizeable set of new data, I added hundreds, if not thousands, of mythological and other traditions to the limited selection of often familiar examples upon which theories of myth, notably catastrophist theories, had hitherto been based. Following a rigorous comparative method, I was able to confirm that the mythology of creation comprises numerous specific and salient traits which are remarkably uniform among the respective branches of mankind, despite their anomalous content. It was possible to reconstruct a systematically-derived and universal template, initially based on 425 themes arranged in a rough chronological order, upon which the creation myths of individual cultures could have been based [2]. Most of these are densely interconnected and internally consistent. If an explanation for any of these motifs is to be sought, let alone a physical one, it ought to be coherent with the entire structure.

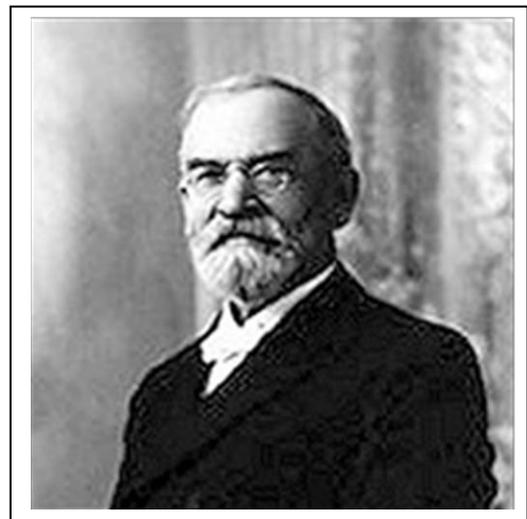


Figure 1: William Fairfield Warren (1833-1929), the spiritual father of studies in *axis mundi* mythology.

It is found that human traditions from virtually every culture and period recalled an ‘era of creation’, a ‘time of beginnings’, a ‘golden age’, a ‘time when the gods lived on Earth’ or an ‘age of myth’ – an epoch at the dawn of remembered human history characterised by the remarkable activities of supernatural beings, perfect bliss and harmony, and a series of extraordinary events transforming former worlds into the sky and the earth as they appear today. Many traditions allocate a central place to a stupendous stationary column which served as the focal point of creation or the abode of mythical beings, such as deities or ancestors; purportedly joined the respective regions of the cosmos on the vertical as well as on the horizontal planes; and emitted a dazzling radiance at a time when the Sun, the Moon and the other stars were not seen. Anthropologists habitually refer to it as the *axis mundi* – the ‘axis of the world’ or ‘cosmic axis’. The successful reconstruction of such a global blueprint for traditional cosmologies constitutes a milestone in the history of comparative mythology. Additionally, it challenges interdisciplinarians to explain why such a complex nexus of often absurd beliefs should be encountered worldwide. The purpose of the present study is to identify a plausible source for this motley but curiously structured set of ideas.

The Astronomical *Axis Mundi*

The mental image conjured up by the term '*axis mundi*' is usually that of a single, straight and stationary column running through the perceived centre of the cosmos on the horizontal plane. The perception of the traditional 'sky pillar' as a single, straight and stationary column is certainly adequate for countless individual traditions. Moreover, several ancient societies had explicitly situated it at the centre of the earth or the sky (§§125-128). In some cases, they specifically identified this centre or the apex of the pillar with the celestial pole (§§129-135), whose motionlessness they perhaps intuitively related to the fixed station of the pillar. In converting these archaic notions to a realistic astronomical situation, the default interpretation has long been the rotational axis of the Earth, extending towards the celestial poles. In 1881, the American theologian William Warren (figure 1), who was also the first president of Boston University, set a paradigm for comparative mythologists when he interpreted a plethora of mythical mountains, trees, pillars, ropes, spears and other cosmological 'connectors' as sundry expressions of the Earth's spin axis [3]. By virtue of these views, Warren qualifies as the 'founding father' of studies in *axis mundi* mythology, perhaps more than anyone else.

There is no doubt that the singular cosmic column of myth was identified with the Earth's rotational axis in a few scattered works of ancient scholarship. Typically, this concerned learned adaptations of pre-existing myths to geocentric cosmologies in which the celestial bodies revolve around a motionless earth and axis [4]. The celestial poles are relatively easy to discover for an Earth-bound observer without any prior knowledge and were widely known around the world. However, they can only be meaningfully associated with the rotational axis if there is an understanding of a matching terrestrial pole – which, in turn, requires the notion of a circular or a spherical Earth. An observer stationed on the Earth who naively assumes that the earth and the oceans lie on the surface of a large horizontal plane may imagine that the Earth has a centre directly below the heavenly pole, found by drawing an imaginary vertical line between the celestial pole and the horizon. Yet although that line would optically coincide with the Earth's rotational axis due to perspective, it would not correspond to it in three-dimensional space and the observer would be unaware of the overlap. The correlation between the apparent altitude of the celestial pole and latitude could only be made on a spherical theory of the Earth. Accordingly, the concept of the astronomical *axis mundi* was first formulated by Greek philosophers championing spherical and geocentric models of the cosmos [5]. All known examples of an incontrovertible identification of a mythological *axis mundi* with the astronomical one belong to cultural contexts which had absorbed classical influences – Old World civilisations of the past 2500 years.

Crucially, because the notion of the astronomical axis requires that of a rotating Earth, it cannot shed much light on the genesis of more archaic traditions, which proliferated in innumerable settings beyond Graeco-Roman sway and long before the idea of a spherical Earth with a rotational axis was conceived. Warren erroneously imputed belief in the globular shape of the Earth to numerous cultures for which this has not been demonstrated or has indeed been ruled out. Subsequent generations of mythologists followed suit in this hazardous assumption. Since the late 19th century, a lineage of scholars, some much more respected than others, continued Warren's investigation of the *axis mundi* in comparative mythology. The roll call opens with the largely unprofessional and uncritical writings of Gerald Massey, Isaac Newton Vail and John O'Neill, and continues in the early 20th century with the more careful studies of the classicists Wilhelm Heinrich Roscher and Arthur Bernard Cook, the orientalist Peter Jensen, Alfred Jeremias, Arent Jan Wensinck and Adriaan de Buck, the ethnographer Uno Harva alias Holmberg, and others. The development of this early research into the *axis mundi* was summarised elsewhere [6]. Warren's unfortunate legacy among these researchers as well as modern anthropologists has been the loose employment of the concept of the 'world axis', including the Latin phrase '*axis mundi*', for cosmological notions which are thought but often not proven to reference the rotational axis; ones in which the term 'axis' is only understood in the mere sense of a connector, without a connotation of rotation; and ones of any 'sky pillar' in general. While the strict astronomical significance of the term increasingly receded into the background, especially within the community of folklorists and comparative mythologists, it is hard to put a finger on the exact origins of the trend of such liberal usage.

In conformity with what is now entrenched conventional usage, especially as popularised by Mircea Eliade, it seems reasonable to continue using '*axis mundi*' in the anthropological sense of a significant 'sky column' which is not necessarily related to the rotational pole. But to what extent is the *axis mundi* of the traditional, mythological cosmologies identifiable with the one of the scientific cosmologies at all? It is a bewildering question. In an article published in 2005, I argued that there is no evidence, on the strength of historical sources, that anyone with a concept of the Earth's rotational axis associated it with the mythological *axis mundi* prior to the 6th century BC at the earliest, when the Earth was first conceived as a sphere [7]. Identification of the top of the mythological column with the celestial pole, which does not presuppose the astronomical sophistication of understanding the Earth's axial rotation, is possibly attested as early as the late 3rd millennium BC – in the funerary literature of ancient Egypt, which seems to locate the sun god and perhaps also his ladder or pedestal among the circumpolar stars [8]. However, a column crowned by a celestial pole does not equate to the Earth's spin axis and is not documented in cultures at lower latitudes, where

the poles appear relatively low above the horizon, so that a pillar reaching up to them would hardly impress; a 'ladder to the sky' it might be for them, but not one to the 'pinnacle of the sky', from the viewpoint of an archaic 'sheet cosmology'. Moreover, in many traditions the celestial column is located in the east or west instead of the direction of the pole, or it is presented in a context suggestive of the contemporary sky rather than the distant time of 'creation'. In such instances, the zodiacal light springs to mind as one source of inspiration more plausible than any phenomenon gracing the rotational axis [9]. Indeed, if ancient sources correctly asserted that the pillar of the time of 'creation' manifested in a dark sky, when no stars or planets could be discerned (§§6-7, 53-65), and itself furnished the first remembered light (§§148-156), the observers' inability to detect the apparent diurnal revolution of all celestial bodies around the pole would have prevented them altogether from determining the position of the column in relation to the stars.

As noted, ancient identifications of the mythological world axis with the astronomical one always seem to have been secondary. Perhaps they were, in some cases, motivated by an earlier association with the celestial pole, without a corresponding terrestrial pole. Could it be that other mythological sky pillars were unwittingly related to the rotational axis in a similar vein, insofar as an imaginary vertical line between the pole and the horizon visually coincides with the rotational axis? Or was the original reference to entirely different natural phenomena? Does the perception of the traditional *axis mundi* as a single, straight and stationary column even accurately reflect the full set of pertinent data? These probing questions were never pondered by recognised specialists in comparative mythology. It is at this point in the investigation that research on the *axis mundi*, hitherto conducted within a uniformitarian framework, benefits from a catastrophist approach.

The *Axis Mundi* as a Visible Physical Object

Since the inception of the discipline of comparative mythology in the mid-19th century, the conventional *modus operandi* has been to account for mythical tales of creation in terms of familiar and common natural experiences, psychosocial abstractions or free symbolism. Yet inevitably, exponents of this school must assume excessive doses of imagination on the part of the original myth-makers; cannot make sense of the near-universality of many counterintuitive themes, such as the former lowness of the sky or the need for the sky to be supported; and are at a loss to explain why so many traditional societies contrasted the present era with an 'age of creation', whatever they called it, during which singularly different conditions pertained than at present. Catastrophist mythology can be viewed as a subset of naturalist mythology distinguished by the added opinion that myths are primarily concerned with rare and often hazardous events. The celestial poles do not have any physical substance and do not correspond to any 'real' objects in space. They are imaginary points that lose their significance from an extraterrestrial perspective. Just as the poles of heaven are immaterial concepts, so the cosmic axis is just an imaginary mathematical line, without any substance, that does not answer to any material entity. Pre-modern scholars recognised the invisibility of the Earth's axis even if they believed that the celestial poles correspond to genuine locations on the surrounding sphere of the cosmos [10]. Yet as soon as myths and other cosmogonical traditions on the world axis are taken into account, this simple observation poses considerable conceptual difficulties.

Those who examined the mythology of the world axis often seemed surprisingly indifferent to questions of its physical reality. They rarely confronted the enigma that cultures worldwide and across the ages could so passionately, so consistently and in such exquisite detail portray an elusive object such as the Earth's rotational axis as a visible object of complex morphology. For, except perhaps for its central location, hardly anything in mythical descriptions of the *axis mundi* is comprehensible in terms of the familiar sky. As the astronomical axis is invisible by definition, there is no obvious reason why expressions such as trees and mountains should be chosen to represent it. Nothing in the insubstantial axis even remotely suggests a tree, a mountain, a giant man or a ladder to heaven and it would have sufficed for ancient myth-makers to use the more abstract terms of a 'line' or 'link'. Mere visibility aside, hardly any other aspect of the mythical sky pillar can be recognised in the imaginary construct protruding from the Earth's rotational poles. Global mythology describes the world axis – both in the astronomical and the liberal, mythological sense – in vivid detail as an entity passing through various stages. The traditions suggest a prototype in the form of an evolving phenomenon with a specific morphology and a reconstructable history, including a distinct beginning, a sequence of developing forms and a definite terminal phase. What sort of natural phenomenon could have evoked the widespread traditions of a radiant pillar, symbolised as a tree, a mountain, a giant and much else, that lifted up the sky by its rising, became encoiled by a 'serpent' and was eventually displaced under catastrophic circumstances? And why of all things was this imagery in many cases linked to the astronomical axis?

The *Axis Mundi* as an Auroral Column

The apparent universality of the theme of the *axis mundi* in many of its colourful expressions drove Warren to postulate diffusion from a common ancestral homeland, but his polar interpretation required the conclusion – now bizarre – that it was in the Arctic regions that the ancestors of all of mankind had at some time resided, observing polar conditions they

would commemorate in the course of their subsequent migrations [11]. Their exposure to the *aurora borealis*, commonly known as the ‘northern lights’, would have informed aspects of their mythology [12]. Tilak was one of a string of researchers who were inspired to advocate similar ideas, but confined themselves to the ‘Aryan’ race. He remarked in passing that Mount Meru, a classic Hindū expression of the mythological *axis mundi*, which late texts – as seen – unequivocally portray as the astronomical axis, must have possessed an auroral quality [13]. However, Tilak neither cared to explain how the aurora might be shaped like a mountain nor developed this insight into a universal theory of the *axis mundi*; his was no more than a fleeting vision that would not surface again until the present generation.

On an atomic level, the polar aurora results from the bombardment of the Earth’s upper atmosphere with charged particles from the solar wind. The solar wind, the Earth’s magnetosphere and the regions of its atmosphere above the ionosphere – some 80 km above the surface – are plasmas, that is to say, they are in the fundamental state of matter defined by partial ionisation and electrical conductivity due to the presence of free electrons. From an electrical point of view, the solar-terrestrial current system (figure 2) facilitates an electrical discharge with a permanent supply of electrical charge – conveyed by electrons as well as a smaller amount of ions – in a gaseous or rather plasma medium. The cathode from which the particles arrive is the Sun or the solar wind, the anode the Earth or its ionosphere. Electrical engineers grade low-pressure or ‘cold’ direct-current discharges according to three regimes of intensity, which “can be distinguished by their luminescence and also by their current-voltage characteristic, current density, and breakdown voltage” [14]. The *Townsend dark discharge* produces a relatively weak current and “there is no luminosity in the discharge gap.” The *glow discharge* contains a stable plasma and “shows various luminous regions which fill the gap.” And even stronger currents produce an *arc discharge* [15], which “will lead to a destruction of the target.” [16] The aurora involves a combination of dark and glow discharge modes, but – as will be argued below – can sport arc discharges under extreme circumstances.

Beginning with the late Frederic Jueneman in 1974, several neocatastrophist researchers, inspired by the ideas of Velikovsky, explored electromagnetic and plasma-physical interpretations of the global mythological theme of an enduring cosmic pillar [17], often allowing an aurora-like aspect [18]. Their shared contention that the plasma tube in question manifested on an enormous scale as a form of “interplanetary lightning” [19], aligned with the Earth’s rotational axis, may be superfluous if a natural candidate for a ‘cosmic axis’ – as understood according to a more thorough source analysis – is readily available in the Earth’s direct electromagnetic environment. Writing in 1987, Ashton and Zysman, followed by others, were the first to contemplate the notion of a proper auroral column contained within the Earth’s magnetosphere, requiring a scaled-up version of the ordinary aurora [20]. While the models of all of the above writers differed considerably between each other, the association of the *axis mundi* with the Earth’s rotational as well as its magnetic axis was a joint feature in all. They did not lead to scholarly publications and suffered from countless shortcomings, including a very crude and limited grasp of the worldwide mythology of the *axis mundi*, largely derived from Eliade and his predecessors, who addressed only a subset of relevant source material. Nevertheless, the electromagnetic – and specifically the auroral – approach to mythology which they pioneered deserves to be acknowledged as an important stepping stone to the present thesis.

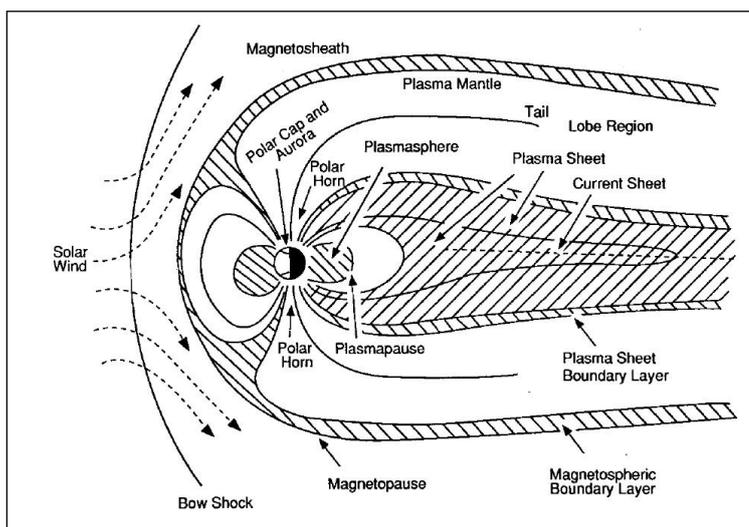


Figure 2: The Earth’s electromagnetic environment: the solar wind distorting the magnetosphere

The above-mentioned researchers did not dwell on the question of whether the auroral light emitted at the base of such a column remained firmly tethered to a geomagnetic pole in the vicinity of a geographical pole or was capable of wandering. Although the ordinary aurora at geomagnetically quiet times always manifests itself to observers at inhabited latitudes in the direction of the nearest geographical pole, its occasional migration to lower latitudes makes it possible for it to appear above other parts of the horizon or at altitudes well above the celestial pole. To relate the *axis mundi* of myth to the terrestrial aurora is, therefore, a fundamentally different matter than aligning it with the planet’s rotational axis, unless the geographical movements of the aurora comprising the column are radically constrained. The terrestrial aurora has been regarded as “without question the most fascinating and mysterious of nature’s displays.” [21] The search for direct or disguised references to auroral displays in human records – ranging from myths to chronicles –

is a fruitful one. Folklorists have long noted superstitions attached to the aurora both in places where it is a relatively common occurrence and in ones where it is rare enough to be perceived as a disquieting portent. The aurora seems a suitable category of natural phenomena to make sense of the multifaceted mythology of the *axis mundi* [22], but in order to prove an auroral – or any physical – hypothesis for the origin of this mythology, the researcher faces the double challenge of explaining both the phenomenology and the global visibility of the axis' numerous expressions.

As far as morphology is concerned, the aurora assumes a wide variety of visual forms which morph easily into each other, defying any rigorous classification. Ever shapeshifting, it is certainly capable of presenting shapes befitting the *axis mundi* of myth. At the same time, the relatively tranquil aurora as we know it falls far short of an adequate account of the pertinent myths on grounds of duration and visibility. Whereas typical auroral displays last minutes to hours, the mythology of creation implies a degree of permanence or repetition requiring a few human generations at a minimum. And for all its grandeur, the aurora is only ever seen by a small fraction of the Earth's inhabitants. Contrary to a popular misconception, it is not restricted to the polar regions, but sporadically occurs at lower latitudes. However, the extreme magnetic storms during which this happens seldom last longer than a night or two, because the Earth's orbit around the Sun takes it outside the focussed beam of assaulting particles, and the lights are easily missed due to cloud cover, sleep or presence inside a dwelling. As a result, the majority of people live their lives without ever witnessing the aurora. This widespread lack of personal familiarity with the phenomenon is arguably the foremost reason why the northern and southern lights have been systematically overlooked in scholarly investigations into the nature and origin of mythology: how could such a restricted sight account for the universal mythology of the *axis mundi*?

The visual aurora, when seen in its entirety from above one pole of the Earth, is approximately circular. However, the auroral ring above each pole "is not always a single one, but consists generally of several, each having its centre in various points of the magnetic axis, and ... the ring is seldom perfect, but generally broken, and with many deviations from a symmetrical configuration." [23] A cross-section of the polar cusps shows an inner, poleward region called 'region 1', composed of a half-circle of inflowing electrons and an approximate circle of outflowing electrons, and an outer, equatorward region called 'region 2', consisting of another half-circle of inflowing electrons [24] (figure 3). 'Field-aligned currents' or 'Birkeland currents' are electric currents contained inside the Earth's magnetosphere, which join the solar wind to the ionosphere and are aligned with the direction of the geomagnetic field. Birkeland current systems on spatial scales larger than 50 km are called 'large-scale', just as ones below that threshold are 'small-scale'. There is mounting evidence "that the large-scale Birkeland current system is generated by the 'long-term' interaction of the solar wind with the Earth's magnetosphere, and that the small-scale system is associated with 'short-lived' plasma processes *within* the magnetosphere." [25] The stable patterns in the auroral zones, polar cusps and polar caps, formed when the interplanetary magnetic field (IMF) is oriented southward, are viewed as examples of large-scale systems and "appear to exist over a wide range of geophysical conditions, indicating that they are related to a fundamental coupling process between the Sun and Earth." [26]

The fleeting irregularities in the auroral circles are best understood from a plasma-physical perspective. Laboratory experiments involving instabilities in electron beams (EBs) suggested a compelling explanation for small-scale Birkeland current systems in the auroral zones. In 1950, Alfvén explained the familiar rippling of auroral curtains as a vortical plasma instability [27]. Afterwards, Webster observed the breakup of a thin hollow electron beam into the "surprising flow pattern" of "a discrete number of vortex-like current bundles" [28]. This process was subsequently called a 'sheet beam instability' [29] or a 'filamentation instability' [30] and was used to explain the vorticity in auroral sheets [31]. Buneman studied the same instability, which he called a 'diocotron instability' or 'slipping stream instability'. This is "observed in cross-field microwave devices in which vortices develop throughout a charged-particle beam when a threshold determined by either the beam current or distance of propagation is surpassed." [32] It typically occurs when "charge neutrality is not locally maintained, for example, when electrons and ions separate" [33]. According to Bostick, the Birkeland currents responsible for the Earth's aurora are vortical filaments in "a hybrid combination of ... two basic types (paramagnetic and diamagnetic)", "lined up primarily with an already existing background magnetic field" and "similar to the diocotron effect shown in the flow of electron beams (relativistic and non-relativistic) parallel to a background magnetic field ..." [34] Joining the dots, Peratt's group contributed much to the study of "configuration transformations" and ultimately "spirals" in the parallel columnar filaments of plasma beams as they rotate and collide [35]. Compared to solid, annular or sheet beams, the formation of vortical patterns is most pronounced in hollow magnetised cylindrical electron beams with thin sheaths, ranging across at least 12 orders of magnitude. Prompting "the sheets to filament into individual current strands causing the 'swirls' or 'curtains'" [36], these instabilities govern the typical folding and vortical deformations in auroral curtains.

Because each large-scale Birkeland current system above the ionosphere is structured as an approximate funnel composed of parallel currents, just like the filamented plasma beams studied in laboratories, the question arises whether it can be analysed as a lasting filamentation instability in a single beam of a large radius. The two concentric partial rings above each pole are not an exact match to a perfect hollow electron beam. Whereas an experimental electron beam

is unidirectional, the auroral cones accommodate charged particles flowing in two opposite directions through a large-scale array of Birkeland currents driven by potentials in the equatorial plane and following geomagnetic field lines. The rings result from two separate Birkeland current systems, whose radii correlate with electrical potential in the polar caps [37]. The insulating property of the Earth's atmosphere prevents a direct discharge between the ionosphere and the crust, forcing the currents to close in the ionosphere. Nevertheless, Peratt proposed that each of the two polar cusps, of which the auroral ovals define the bases, can be modelled as a funnel composed of thin planar sheets of in- and outflowing particle streams [38]. Connecting the magnetopause with the ionosphere, he found the sheets to be "susceptible to two plasma instabilities": "hollowing of the relativistic electron beam to form the sheets" and "the diocotron instability", including filamentation [39]. Why it may be instructive to treat the field-aligned current system as the outcome of a hollowing instability in an originally solid 'column' will be seen below.

The *Axis Mundi* as Peratt's 'Intense-Auroral' Column

Under ordinary circumstances, the visible aurora is mostly restricted to the auroral ovals around the poles, extending vertically for no more than 1000 km at most. The giant plasma funnels above the ovals – defined by the field-aligned currents and confined by the contours of the van Allen radiation belts – remain in 'dark discharge mode'. But conditions need not always be thus, as Ashton and Zysman were among the first to point out. Specialists acknowledge that the intensity of the normal aurora can vary over more than four orders of magnitude [40]. If that is the case, there may be no theoretical reason why a higher order could not be attained on extremely rare occasions. Beginning in 2003, Peratt went further than any of his predecessors in determining the consequences of an aurora intensified by another 1 or 2 orders of magnitude. He calculated the expected current strengths for an enhanced auroral sheath composed of 56 discrete filaments:

An estimate for the currents in a strong aurora can be obtained from Alfvén and Carlqvist ... who find, for a strong circular aurora of diameter 5,000 km, a total current of about 7 MA. If this pertains to 56 filaments (before the ring is formed), each filament conducts 125 kA. Hence ... the currents remain as pinched filaments. ... A 1,000-fold increase of a concurrent [sic] aurora is 7 GA, or for 56 filaments, 1.25 MA carried by a filament REB. [41]

Peratt adduced two mechanisms by which an 'intense aurora' would increase in height and luminosity. First, he cited – but did not discuss – research according to which "oxygen plasma from the Earth's own ionosphere" is injected into the magnetosphere above in overwhelming quantities "in magnetically disturbed times, when strong electric currents flow between the Earth and outer space" [42]. As is well known, it is the collision of atmospheric oxygen and nitrogen with inflowing electrons which is responsible for the aurora. Consequently, at times of extreme geomagnetic duress the aurora may be expected to extend upwards from the ionosphere into the magnetosphere, following the magnetic outlines of the polar funnels. The resulting column would directly define the visual geometry of the enhanced aurora: "In the case of a strong aurora involving many tens of mega-amperes of current, most of the funnel would be visible in light emission and the individual filaments and vortices strongly visible. ... In addition, portions of the magnetosphere and its tail would also be visible ..." [43] This mechanism appears to be perfectly sound and is corroborated in more recent research, as will be discussed later.

Secondly, plasma physicists define the so-called pinch effect as a mechanism of self-constriction caused by a radially inward force on a single current or by the lateral electromagnetic attraction between parallel longitudinal currents, the latter producing "a bunching of currents and magnetic fields to filaments or 'magnetic ropes'" [44]. In a zeta- or z-pinch, the current flows in the axial direction. Magnetic flux ropes, common in planetary environments, represent a form of z-pinch. According to Peratt, a z-pinch, as modelled for some decades by plasma physicists, would be "the auroral form presumably associated with extreme geomagnetic storms" [45], causing a polar column to contract: "For an intense inflow of plasma, the aurora would be shaped by the strength of its own azimuthal magnetic field, i.e., a Z-pinch." [46] "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. 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 properties of intense aurora described by Gold (1962) appear to be similar to the properties of a column of plasma-conducting giga-amperes of current rather than mega-amperes." [47] The column would evolve along the lines of z-pinches in plasma discharge experiments and simulations.

The detailed model of an intense-auroral column which Peratt developed between 2003 and 2011 may conveniently be referred to as 'Peratt's Column' or a 'Peratt Column' (figure 4). Peratt argued that a colossal column of this type – far exceeding the dimensions attained by even the strongest aurorae of recent centuries – materialised at an unspecified time before the rise of civilisation anywhere, but probably between 10,000 and 2000 BC [48], if it was not a periodic phenomenon: "When (perhaps every 4,000 years) intense solar plasma currents occurred in the Solar System, the profile was the same as that measured in high energy density experiments in the laboratory." [49] Taking Talbott's idea of a correlation between rock art and the lost 'symbols of an alien sky' to unprecedented extremes, Peratt claimed to have

deduced that virtually all petroglyphs and rock paintings worldwide represent contemporaneous *in situ* recordings of the ‘super-aurora’.

Peratt’s hypothesis of an intense-auroral column elicited virtually no published response from the scientific community. Initially latching onto it quite uncritically, with only minor reservations discussed below, I extended it to include historical testimony from traditional cosmologies as additional devices used by ancient man to register their experiences of intense aurorae. Upon close inspection, an intense-auroral column provides an excellent model for the *axis mundi* as featured in human traditions: it would appear to evolve from the auroral ring, just as the *axis mundi* arose from a ring-shaped enclosure (§§17-32, 56-57, 64); it would be a magnificent, towering formation dominating the visible portion of the sky (§§70-77); anchored to a magnetic pole, it would present a stationary appearance to an observer on Earth; it would be bathed in bright light (§§148-156); the incessant dynamic changes in its anatomy and antics could render it seemingly alive (§§136-147); it would be hollow at least for a part of its existence (§§284-297); helical instabilities would occur in its surrounding plasma sheath (§§179-186); its nested, laminated sheaths would appear as concentric circles when viewed from below (§§178-179, 189, 191); and it would delineate multiple ‘heavens’ appearing as distinct strata with characteristic colours, due to the distribution of atomic and molecular nitrogen and oxygen in the atmosphere (§200) [50]. Even so, Peratt’s hypothesis cannot be accepted in its original form, but requires considerable nuancing and modification [51]. For one thing, Peratt’s presentation interweaves three threads so inextricably that no capable researcher could possibly disentangle them. These are his actual plasma-physical findings, obtained through experimentation and simulation; his application of these to the aurora; and his correlation of both data sets with prehistoric rock art. In the format in which the data were presented, none of these strands can be tested or judged on their own merits, so that a flaw in one impairs them all. Sadly, there is serious reason to suspect that the simulations conducted after 2002 may have been compromised by direct input of mythological data on several occasions, fuelling a form of circular reasoning that defeats the utility of interdisciplinary investigations. Secondly, although the auroral ovals exhibit the habitual folding of the diocotron instability, the analogy between the ordinary auroral sheets and filamentation of a plasma cylinder is not precise, as breakup of the sheath into discrete filaments is minimal. Peratt conceded as much with the words “56 filaments (before the ring is formed)” [52]. Perhaps auroral filamentation is on a continuum from a vast number characteristic for a quiet aurora to 56 and ever smaller numbers, conditioned by pressure or the strengths of current and magnetism. Thirdly, although the aurora features at both poles, Peratt postulated a single intense-auroral column. Up until mid-2005, he associated this with the Earth’s south magnetic pole, but in later publications he specified the south rotational pole as the location where this column connected with the Earth [53]. The aurora, needless to say, relates to the magnetic poles, but not necessarily to the rotational ones.

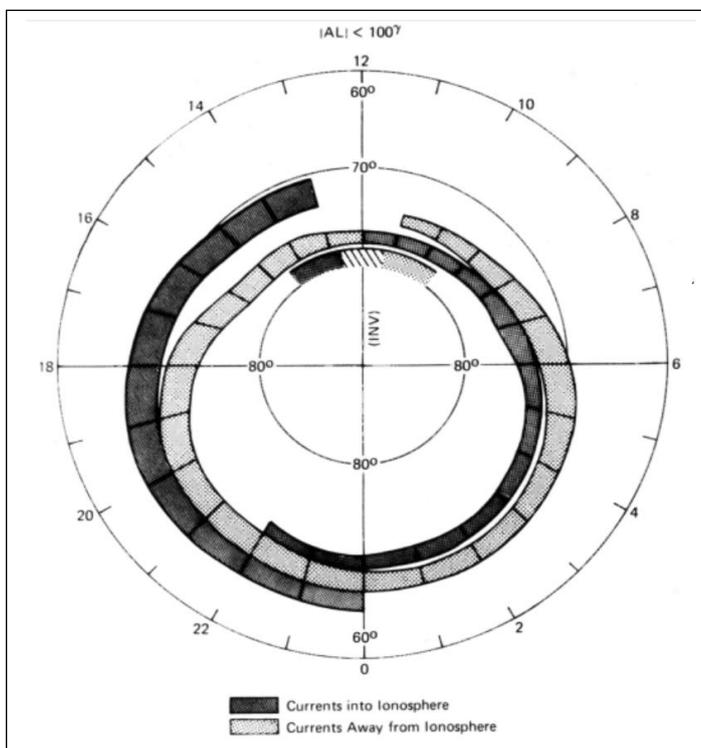


Figure 3: Distribution and flow directions of field-aligned currents into and away from the Earth’s ionosphere, with the North Pole facing up.

Fourthly, Peratt failed to clarify how the electrical circuitry of his intense-auroral model relates to that of the solar-terrestrial current system [54]. His earlier concept of an intense aurora with “both down-flowing and up-flowing Birkeland currents contained with [sic] two Concentric sheets” [55] may still be compatible with the roughly circular layout of the incoming and outgoing currents in the polar cusps, but seems at odds with a later statement: “During intense events, the current flow is true north-south, or for intense synchrotron light emitting relativistic electrons, towards true north from geophysical south.” [56] In later publications, Peratt extended the sheaths downwards such that they enveloped the entire Earth before flaring out again above the opposite hemisphere, unfolding into the original 56 filaments: “... the filaments flow over and past the rotating Earth.” [57] In addition, Peratt’s Column is a composite of hollow filamented sheaths surrounding a narrow solid core. The former may correspond to today’s field-aligned currents, but whereas the present-day sheaths connect in- and outflowing currents with the same magnetic pole, a z-pinch, being unidirectional, would either complete the circuit through another pole or discharge without a return current, as in a

lightning strike – as discussed below. Whilst the solid core must be a z-pinch, Peratt did not elucidate the fate of the return currents.

Fifthly, how could the sheaths have coexisted with a z-pinch? If they were a part of the z-pinch [58], it is doubtful whether the pinch could sustain a filamentation instability concurrently with the sausage instability of ‘stacked toroids’ at the core, as Peratt suggested. Recent experiments confirm that a hollow column, broken up into filaments, can evolve into a solid one, through a rapid transitional stage during which the hollow phase and a solid core with toroidal instabilities briefly coexist; the outer sheath disappears while the inner stack undergoes further instabilities [59]. As long as it is unknown how this might scale up to the aurora, however, the hollow and the solid components of Peratt’s composite column are best separated spatially, temporally or both, with the filamentary sheets appearing before, after or above the ‘stacked toroids’. Sixthly, Peratt fudged the question of what is an ‘intense’ or ‘strong’ aurora by implying that the low-latitude aurora associated with the ‘Carrington event’ of 1859 was one [60]. Despite his assurance that two reports he cited concerning the latter “do not match what is seen during today’s auroras”, they do read like unremarkable impressions of the familiar auroral corona, lasting less than 2 hours as usual, except that they were seen at

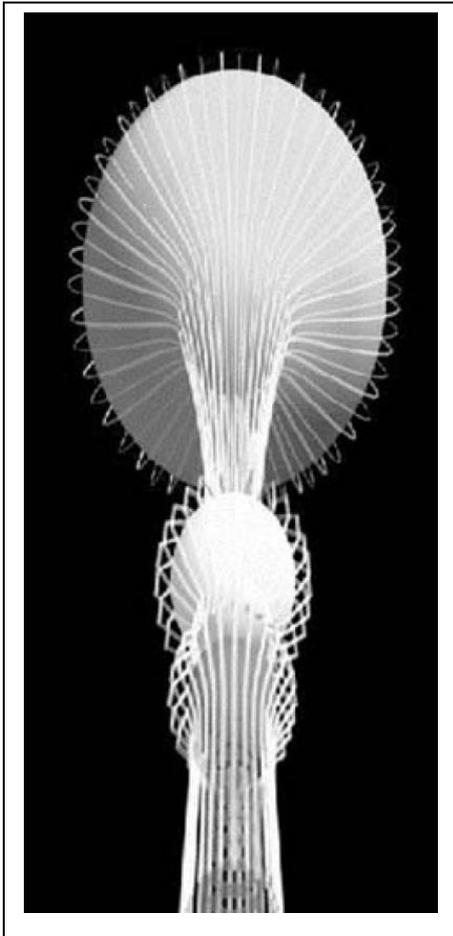


Fig. 4: Virtual image of Peratt’s intense-auroral column, as ostensibly determined from field-of-view directivity, viewing angle of inclination, and GPS surveys of worldwide petroglyphs.

lower latitudes than normally. Peratt’s suggestion that the Earth was enmeshed in a cage of Birkeland currents at the time seems incongruous. Reports of “Bright filaments running across the sky”, which have indeed been “recorded for centuries and even millennia” from many, though not “all”, parts of the Earth [61], and other historical accounts also appear to be adequately explained by observations of coronae, arcs, bands and related manifestations of the mundane aurora; Peratt’s text suggests a striking lack of familiarity with eye-witness descriptions of auroral exhibits. Clearly, an intense-auroral z-pinch would represent a phenomenon in an entirely different class than even the Carrington event.

Seventhly, one should think that a dramatic event such as Peratt’s or Zysman’s intense aurora would leave a specific geomagnetic imprint, retrievable from archaeo- and palaeomagnetic archives. However, Peratt and Zysman alike considered neither the latter repositories of information nor any connection with geomagnetic reversals and excursions, further discussed below [62]. Eighthly, the extravagant dimensions of Peratt’s hypothetical intense aurora [63] are unacceptable. These and inconsistencies in Peratt’s papers suggest that his overt model of an ‘intense aurora’, at home in the Earth’s atmosphere, really masked the more adventurous proposition of an interplanetary plasma column of the sort envisaged by the neocatastrophist writers listed earlier, encapsulating other planets besides the Earth. It seems that Peratt had an ‘axis’ to grind, but unfortunately the approach he took does not inspire confidence. A reduction of the immense scale of Peratt’s column to the far more credible proportions of a planetary magnetosphere restores meaning to the phrase ‘intense aurora’. Thus revised, Peratt’s thesis seems less preposterous than it was in the form in which it was originally presented. Whether the emergence of a ring of discrete filaments or a z-pinch effect provide valid criteria to distinguish aurorae proper from more energetic effects and whether ‘intense aurora’ is a suitable term for the latter are matters of definition beyond the current scope. Ninthly, Peratt confusingly implied that all inflowing electrons are relativistic, even in the present aurora. It would be more accurate to limit the involvement of relativistic particles to highly energetic flares and solar proton events.

In conclusion, Peratt’s hypothesis of an intense-auroral column presents a babe-and-bathwater situation. Which elements are the most feasible and in what ways must it be revised? In order to answer these questions, it will help to take a closer look at the geometrical aspect of an ‘intense-auroral column’. For the global visibility of the column presents another, insurmountable obstacle.

Not a Single, Stationary Column

As noted, anyone arguing for a visible, physical reality to the traditional *axis mundi* must confront the question of its global visibility, taking perspective into account as well. All those enumerated above envisioned the conspicuous sky pillar of myth as a single, stationary object associated with the Earth’s rotational axis, its magnetic axis, or both. In doing so, they implied that reports concerning a single column from different cultures were all based on a single

prototype in the real world, as if all people were referring to the selfsame phenomenon. Few paused to acknowledge that such an inference ought not to be made without extensive justification. Traditional cosmologies centred on a single pillar may not be reconcilable with a single rotational axis manifesting itself as a separate entity above the horizon of each hemisphere – or indeed with the geometry of the rotational axis at all.

Theorists postulating a single column fixed at one or both of the poles have grappled with the problem of its apparent global visibility without succeeding. As seen, Warren adopted the theory of an Arctic homeland of all mankind to account for the apparent universality of mythological interpretations of the astronomical *axis mundi* as seen in the circumpolar north. Vail attempted to explain how a constantly ablating aqueous canopy precipitating above the north pole in a column could have been viewed much further south by situating it “at the height of a thousand miles above the Earth’s surface, (and it must have been at least that high to account for these polar features as seen from latitudes of the N. Temperate Zone)” [64]. Zysman pursued a very similar line of thought, but could account for a much broader zone of visibility by elevating the canopy to a distance of some 65,000 km and identifying it as an atmospheric convex mirror [65], combining an isolated hint by Vail that the outer repository of vapours was icy [66] with Cyr’s argument of the “myriad of ice crystals” in the canopy “causing spectacular halos that were seen by ancient peoples.” [67] Yet however plausible this may sound, he did not produce an optical analysis detailed enough to prove that reflections of the column at lower latitudes would still produce a vertical image, concordant with the traditions. The feasibility of such an all-encompassing mirror dome, open above the poles only, remains equally moot. Ashton resorted to “a hologrammatic phenomenon of polarization of light of stratospheric particles which is manifested only at certain points in a series of intensities of solar radiation at harmonically related electromagnetic frequencies” [68], but again failed to deliver a workable model.

Did Peratt’s intense aurora solve the problem of global visibility? As it happens, I had expressed doubts about the possibility of a single stationary column observed worldwide as early as October 2002, before Peratt went to press with his first article on the subject. In a letter to the British cometary scientist Victor Clube dated 22 October 2002 I had written:

By far the largest difficulty is the following. An absolutely central rôle in the myths is occupied by the Axis Mundi. Featured under an impressive array of symbolical forms, including the cosmic tree, the cosmic mountain, the tower of the gods, the Milky Way, the divine sword, the archetypal lightning, the world serpent, and the pathway to heaven this peculiar form is systematically portrayed as a *stationary* object, marking the centre of the revolving dome of heaven. The axis does not move in the sky, but remains in the centre, even though its own shape is agile and unstable enough, spiralling like a writhing serpent. ... the stationary character of the axis is interpreted as an indication of the axis’ polar location: evidently, it connected the terrestrial and the celestial north poles with each other. One of the major weaknesses of this model is that the world axis could then only have been seen from either the northern or the southern hemisphere, whereas the mythical world axis features just as widely in Australian and South-American myths as it does in northern myths.

As I began to collaborate with Peratt the next year, I suspended my disbelief and – sinning against the true scientific spirit – deferred to Peratt’s authority, trusting that a respected scientist of his calibre would be well aware of basic geodetic principles and would eventually be able to silence the above concerns with a satisfactory solution. A subconscious desire to maintain the *status quo* of a superficially attractive model and the apparent lack of viable alternatives helped to sustain this state of cognitive dissonance, until my examination of traditional materials exposed so many cracks in the hypothesis that the bubble burst and a radical revision became inevitable. As mentioned, I published an article in 2005 concluding that identification of the mythological *axis mundi* with the Earth’s rotational axis on the basis of historical sources is beset with problems, but, for want of a better alternative, I provisionally continued to associate the former with Peratt’s column – a single intense-auroral column fixed at the Earth’s rotational pole.

In 2012, Robert J. Johnson and I revisited the geometrical aspects of Peratt’s hypothesis. Despite the remarkable similarities between an intense-auroral column above a magnetic or rotational pole and what is known about the mythological *axis mundi*, we concluded that Peratt’s specific concept of a single plasma tube perceived at practically all inhabited latitudes and longitudes dissolves upon closer inspection [69]. Simple geometrical considerations preclude the possibility that any stationary column above the earth that is straight and narrow in appearance could be discerned at once from both hemispheres. Likewise, for reasons of perspective no such column could meet the requirements imposed by petroglyphs if images of concentric circles are to be interpreted as direct bottom-up views inside and along the axis of the plasma tube: concentric petroglyphs occur at any latitude between c. 59° N and c. 43° S and could therefore not all have been carved in response to a single prototype that was fixed at one particular location and viewed at or close to the zenith. In addition, a bent column might seem to be vertical from some places, but would almost certainly appear as a band stretched out in the sky overhead to observers elsewhere. If it was ‘stationary’ in space while the Earth rotated underneath it, as Peratt presumed, it would certainly be seen to pass along the horizon in the course of a day, which violates the descriptions given of the *axis mundi* in traditional cosmologies.

If the base of the column was depicted as circular, the size of the auroral ovals forms an obstacle in itself. Peratt does not seem to have indicated a size estimate for the narrowest diameter of the column, but one of his diagrams suggests a diameter similar to that of the current auroral ovals [70]. Today's auroral ovals are too large or too close to the surface to be viewed in their entirety from any position on Earth. Accordingly, the eye never perceives them as complete circles, but they appear as arcs or bands, even when viewed from directly underneath. This compromises Peratt's solution of an intense-auroral column. Perhaps visibility of the plasma sheaths lining the funnels above the auroral ovals may occasionally allow higher cross-sections of the column to be observed entirely, but for the base of the column to appear as a complete circle the auroral oval must either be situated considerably higher above the earth or have a much smaller diameter than it does at present. Considerations drawn from comparative mythology point to the same conclusion. The universal parallels between the creation myths of different cultures present a similar puzzle to the one Peratt attempted to solve for rock art: how can a single set of transient phenomena in the sky or atmosphere have been recorded on all inhabited corners of the planet down to an extraordinary level of detail, without displaying much latitude-dependent variation in perspective? Because, for example, the specific features of the bottom segment of the *axis mundi* were reported globally (§§95-113), the prototype cannot have been single in number and fixed in space.

Such observations disqualify Peratt's specific model of a single polar column definitively. It is incompatible with the geographic distribution of observations, whether they be traditional-cosmological records or petroglyphs. Yet although I supplied Peratt with a copy of the article containing our objections as soon as it appeared, the revised edition of his textbook on plasma physics, which appeared afterwards, contains a poorly edited discussion of the 'intense aurora' which repeats the same claims, while addressing none of the flaws enumerated above.

Clearly, if an auroral explanation is to be given the green light, the geometry of the hypothetical prototype of the *axis mundi* will need to be carefully re-examined from scratch. Perhaps all of the above-mentioned mental efforts expended by earlier researchers were doomed to fail because some of the underlying assumptions concerning the *axis mundi* were invalid. The hypothesis of a single, straight and stationary column to account for many or all reports of the *axis mundi* worldwide really entails five assumptions, all of which have generally remained implicit but must now be questioned: that each observer saw only one column; that this was always the same column; that it appeared as a vertical object; that it was straight, like a cylinder; and that it appeared to be stationary, failing to wander. A question of numbers is raised: was the *axis mundi* of human traditions a singular phenomenon after all, as investigators from Warren to Peratt have always surmised? Given that the Earth's dipolar magnetic field facilitates two auroral ovals, is one to assume the existence of two columns, one for each hemisphere, which – in correct Latin – ought to be labelled *axes mundi*? [71] As determined on theoretical grounds, the only conditions that could have allowed observations of a stationary sky column worldwide are multiple columns, a moving column but at such a slow pace that it appeared to be motionless to human observers, or a combination of both possibilities. The way forward is now to revisit the traditional evidence concerning the *axis mundi*, asking whether the sources actually do present the sky pillar in such restrictive terms as a solitary, cylindrical and motionless object.

Synopsis of Traditional Cosmologies

Using a comparative method, cross-culturally consistent information extracted from the global mythology of creation can be summarised in the following synopsis [72]. The relative chronology of events outlined here is the dominant pattern, but is not exclusive. The earliest remembered state is one of undifferentiated unity. This is followed by reports of the original condition of the Earth and of 'anomalous luminaries' in the sky. The *axis mundi* comes into existence and its remarkable properties are related. The column meets its demise along with a series of other catastrophes which end the 'age of myth'. The mythical history of the *axis mundi* can conveniently be divided into categories of formation, form, duration, location, number, movement and termination.

Undifferentiated Unity

The creation myths of most cultures open with a description of an inchoate, undifferentiated cosmos, characterised by darkness, cold, water instead of land, and a low-hanging 'sky' inseparably joined to the Earth.

Original Earth

The first discrete or organised form of matter to have appeared is often presented as a primeval 'root particle' in the shape of a blob or speck, a spiral or an enclosure. Common expressions of the 'speck' were a 'rock' or 'mound', a 'heart' and a 'seed', while the 'enclosure' was commonly represented as an 'egg', a 'gourd', a 'shell', a 'womb', an encompassing 'serpent' and a tight cavity within the originally close embrace of 'sky' and 'earth'. The speck is also situated inside the enclosure. Some sources identify a pair, a triplet or a small cluster of such particles. The speck is also portrayed as the original Earth or the 'navel' around which the Earth was to be formed, typically by means of radial expansion.

Anomalous Luminaries

On account of the luminosity of one or another such ‘particle’, a common expression is that of an original *sun*. Whereas some traditions attribute a dim light to this ‘nascent sun’, others aver that it was positioned uncomfortably close to the surface of the Earth, emitting excessive heat. Alternatively, a pair of concurrent luminaries – typically ‘two suns’ or ‘a sun and a moon’ – is envisioned. These are often stated to have created an ‘eternal day’ for an untold period of time, by either remaining stationary or traversing the sky in unbroken succession. They may be presented as undesirable due to their unbearable heat and brightness or the irregularity of their radiance and are often said to have vied among each other for dominance; in familiar applications of the motif, the moon had not yet been differentiated from the sun, but was as bright or brighter than it. Other features of these unsuccessful suns include their confinement to a bag, chest, box or comparable container, identical with the ‘enclosure’ mentioned above; their placement at a cosmic centre; and their diminutive size.

Axis Mundi: Formation

The columnar *axis mundi* was either regarded as primordial itself or as having evolved from a ‘primordial particle’. By its prodigious growth, it was held to have separated sky and earth, pushing up the former, if not also forcing down the latter or the underworld. This resulted in a triple-sheet cosmos of sky, earth and underworld or sky, atmosphere and earth arranged around the column. The separation of sky and earth provoked a sudden outburst of water, wind or light. The latter dispelled the original darkness to an extent.

Axis Mundi: Form

The sources present the column – once formed – under a breath-taking array of *different forms*, including a tree, a mountain, a pillar, a ladder, a giant being, a backbone or spine, a rope, a string of arrows, a river and a pathway. The equivalence of these motifs is well established as they all share the same set of functions and occupy the same structural slots in the spatial and the temporal fabric of the underlying template, while many individual cultures explicitly linked two or more such expressions to the same object (e.g., §§61–62, 193). Nevertheless, many of these forms seem mutually exclusive; it is practically impossible to conceive of a visual prototype that could have exhibited characteristics of all of these descriptors at once. If all of these labels were applied to a single generic phenomenon at one time or other, their remarkable morphological diversity suggests that the phenomenon manifested in a variety of forms, either as it evolved over time or in different locations. The descriptions can be viewed as metaphors, incorporating visual and functional aspects perceived in the underlying phenomenon.

The column is variously represented in forms suggesting a *horizontal* geometry, such as a river, bridge or pathway; a *vertical* one, such as a tree, mountain, pillar, ladder or dangling rope; or an *oblique* one, such as some of the preceding examples might be. These groups of traditions are not segregated over different geographic areas, but overlap widely and all appear to be attested wherever human beings have lived. Arctic peoples, such as the Finns, the Samoyed, the Yakut, the Tungus and the Inuit, were much preoccupied with the theme of a vertical cosmic axis. Adjusting the mythogeography to assumed ancestral homelands before 5000 BP, the verticality of the *axis mundi* is reliably attested from 60° N to 37° S, including at the equator [73]. The column was not invariably envisioned as a *straight* object, but was sometimes presented in *bent* form, even as an *arc*. Although it usually has one extremity in the sky above and one in the earth or underworld below, both extremities may come down to form the image of a curved bridge or two juxtaposed columns joined at the top. In some traditions, the curvature was related to the symbolism of the rainbow, the Milky Way, the ecliptic band or the zodiacal light, but this cannot be demonstrated for all. In other cases, the arc is combined with a vertical cylinder.

A range of other forms was associated with the column. *Filaments* resembling ribbons, strings, rays or feathers were suspended from a spoked ring or ‘wheel’ at the top of the column. The upper extremity of the column was associated with a resident deity or luminous entity and an enclosing dwelling or garden, which may be related to the stationary luminaries mentioned earlier. The lower extremity featured a contrasting deity or luminous entity; an object with a rounded shape, such as a seed, heart or head; or one with the shape of a cone or pyramid, such as a mound or mountain. The latter is interchangeable with the primordial particle of the Earth or its navel and may also represent the column as a whole. The base of the column was surrounded by a circular ‘ocean’ or ‘snake’, the latter known as the *ourobóros* or ‘tail-biter’, which matches the above-mentioned enclosure. Either the column or the entire cosmos was sometimes likened to an *hourglass*, typically with the upper half corresponding to the ‘sky’ and the lower half – which matches the cone – to the ‘earth’ or the ‘underworld’. *Vortical* properties are implicit in such forms as a celestial rope, cord, chain or cable, a spider’s thread, an umbilical cord, a vine, a snake, a strand of hair, and many more besides. A helix, both single and double, could either represent or envelop the column. *Bifurcation* or *trifurcation* of the top and less commonly also the bottom of the column are widely reported. And the column was frequently characterised as *hollow*, perforating a sky that was otherwise held to be solid. The column was vertically divided into a series of *segments or strata*, typically numbering 3 to 13, with a preference for 7 or 9. These sections were variously represented by superimposed ‘beads’, symmetrical pairs of ‘branches’ or ‘floors’. Often, each is distinguished by its own colour and corresponds to one of a

set of 'heavens' above the earth or 'earths' or 'underworlds' below the surface of the Earth. Viewed upwards from below, these layers appeared as *concentric circles* arranged radially around a cross-section of the column. The column was *luminous*, as bright as fire, lightning or the sun. It hosted radiant 'gems', 'suns' or 'stars' or what appeared to be sentient beings, some of which were linked to the vertical segments on a one-to-one basis, while many were passing through.

Axis Mundi: Duration

In its most distinctive forms, such as a sky-supporting tree or mountain, the column was an icon of stability and permanence, which seems to have existed for 'a very long time'. A smaller group of traditions seem to be concerned with a more ephemeral phenomenon which otherwise shares in many of the column's typical functions. These often involve a flexible device, such as a rope, spider's thread or strand of hair, along which mythical beings transport themselves through the layers of the cosmos. The lack of detail in many sources often does not permit a rigid distinction between long- or short-lived manifestations of the column.

Axis Mundi: Location

As stated earlier, traditions which locate the column at the rotational poles, both celestial and geographical, appear to be secondary and are limited to higher latitudes, where the celestial pole appears high enough above the horizon to surmount an impressive column. Yet the underlying theme that the column was situated at a vaguely defined *middle*, 'navel' or 'heart' of the world is universal and archaic. Traditions emphasising a central placement of the column compete with others that locate it at the boundary of the cosmos, such as the far east, west, north or south, or present it as encompassing the entire Earth, at least with its base or crown. None of these qualifications – central, peripheral or surrounding – precluded localisation, the common identification of the *axis mundi* or its seat with a feature of the local landscape such as a prominent peak, a hoary tree, a curious rock formation or a body of water. Such places are often indistinguishable from locations celebrated as the cosmic 'centre', 'navel' or 'heart'.

Axis Mundi: Number

Accounts of a single column appear to predominate, but alternate with traditions concerning a *double*, *triple* or *quadruple* column; numbers given less commonly are 7, 8 and 12. In some cases, the two or three columns are juxtaposed at a sacred place, such as the cosmic 'centre'; in others, they are distributed over opposite ends, such as the west and the east or the north and the south. A particularly well-developed theme is that of four pillars associated with the cardinal directions and mythologised as four trees or tree roots, mountains or buttresses, ropes, pathways, rivers, sky-bearing beings and so on. Typically, these are arranged around a central column, with which their upper parts may be joined. Their formation is often linked to an episode of cosmic upheaval, such as a universal flood or the 'elevation of the sky'. The themes of 2, 3 and 4 pillars have been recognised since the early 20th century, but researchers seeking a physical prototype for the mythology of the *axis mundi* nevertheless postulated only one original column. Talbott reduced the multiple columns to anatomical aspects of a single column, such as twin peaks [74], while Zysman invoked optical effects such as translucency and catoptric reduplication [75]. These approaches are likely correct in cases where the original wording or depiction of a tradition unequivocally concerns a single forked or translucent column or a grouping of adjacent columns associated with the mythological era of 'creation'. Nonetheless, other sources warrant no such conclusion and are best taken at face value, especially when multiple columns are explicitly located at opposite ends of the horizon. In the latter instance, care must be taken to distinguish references to the 'age of creation' from ones to the contemporary sky, which – as noted – might relate to extant phenomena such as the zodiacal light.

Axis Mundi: Movement

Of those sources that narrate the origin of the column, the majority state that it *sprang up* to the sky from the earth or underworld below, typically with a surprising celerity exceeding familiar rates of growth among plants and animals. Others have it *descend* from the sky in the opposite direction. Once formed, the column is not reported to have passed along the horizon or through the sky in the course of a day or other period of time, but is generally portrayed as a fixed entity. Some accounts impute a repetitive motion to segments of it, as in the rocking of the nascent Earth at its base prior to the fixative effect of the column, the comparison of the column to a spinning mill and the swaying of the upper part of the column that preceded the final collapse. Yet none portray the column itself as a mobile phenomenon, susceptible to the effects of the Earth's axial rotation. Some creation myths assert that the column, towards the end of the sequence, was *displaced*, *transplanted* or *levelled* and *restored* soon afterwards. These are portrayed as rare and often undesirable events, not as cyclical occurrences operating with clockwork regularity.

Axis Mundi: Termination

A popular theme is the final disconnection of the column, sometimes envisioned as its severance in mid-air or from its base. This was associated with an array of natural disasters and other radical changes in the environment: earthquakes; darkness; ravaging winds, fires and floods; the appearance of a monster, often a dragon, snake or bird; a cosmic inversion; the formation of mountains and valleys, islands, rivers and lakes on the surface of the earth, often through the actions of the monster; the near-extinction of the primordial race; the elimination of undesired 'suns', typically by

arrows or a snare; the dispersion of miscellaneous entities through space; the departure of mythical beings, typically into the sky; and collapse of the 'old sky'. Confusingly, while various traditions linked the separation of sky and earth with the emergence of the column, as noted, some related it to the column's demise; an unrestricted inflow of light, ushering in the day; and other events associated with the final chapters in the sequence of creation mythology. There may be no actual contradiction between these accounts if the 'lifting of the sky' is regarded as a protracted process, the final stage of which coincided with the disruption of the column.

Retrospectively, the period preceding this catastrophic disruption and the present cosmic order, when people on the Earth freely communed with mythical beings, is commemorated as a 'golden age', a 'time of paradise', an 'age of creation' or an 'age of the gods'; anthropologists in the tradition of Eliade use the Latin term *illud tempus* ('that time') as a shorthand for it. A repetition of the entire cycle – including the original unorganised state, the golden age and the concluding cataclysms – is expected for the coming 'end time'.

Discussion

The picture that emerges from this overview differs radically from the naive concept of the *axis mundi* as promoted by Eliade, his precursors and his successors. Put succinctly, human traditions from every inhabited corner of the globe associated a turbulent epoch of 'creation', when the world was mostly shrouded in darkness, with one to five conspicuous columns that dominated the local sky before their eventual disruption. The columns generally appeared vertical and stationary to all witnesses, many observing their formation as well as their termination. These requirements are irreconcilable with the notion of a single column, be it fixed or mobile. By contrast, multiple columns observed by different people and visible changes in the appearance of each offer a satisfactory solution to the perplexing multitude of sometimes irreconcilable forms.

The columns were frequently thought to have formed from or at the location of a stationary and luminous speck, at a time when only darkness and water prevailed. Most observers appear to have perceived a single column shooting up from or coming down towards one of the cardinal points or what would seem to be the centre or zenith of the sky. When viewed from directly underneath, its base may have seemed to encompass the entire visible horizon. Depending on one's location on Earth, some witnesses discerned one to four additional columns either bunched together with the first or placed towards the far east, west, north or south at what appeared to be the boundary of the world. At the same time, such columns were frequently identified with specific features in the local landscape, perhaps partly as a result of perspective. Observations of perfectly straight columns prevailed, similar to rays or pillars, yet some detected varying degrees of curvature, including an occasional arc touching the ground at both ends. A vertical or steeply inclined profile characterised the forms viewed by most people, but a few reports suggest horizontal or gently sloping perspectives on manifestations that resembled a stream of water or a passageway of some sort. In some regions, a column was seen to be felled and restored at the same or another location; but common to all was the vision of the final dislodgement of the column or columns.

The familiar image of the *axis mundi* as promulgated in popular textbooks on mythology is exposed as a misleading and irresponsible simplification of the subtle complexity presented in the original sources, impeding any attempts to make sense of the phenomenon in physical terms. The often subliminal equation of the mythological sky columns with the Earth's rotational axis is exposed as a red herring. The analysis offered here, based on careful study of hundreds of primary sources drawn from around the globe, recommends itself in view of its seamless convergence with the conclusion drawn earlier from theoretical considerations of global visibility: any physical model to explain the human testimony regarding *axes mundi* requires a multiplicity of columns, arcs and patches existing more or less simultaneously and distributed quite unevenly over the surface of the Earth, some of which may have moved either at a rate imperceptible to the human eye or in occasional sudden leaps. The total number of columns, arcs and patches required to have existed above the earth in order to account most satisfactorily for the information supplied in traditional cosmologies cannot yet be determined. As many societies viewed only one column and all columns looked rather alike, it is understandable that the collective body of traditions about such sky pillars gives the impression of describing a single phenomenon – *e pluribus unum* ('one out of many'). These conditions must have lasted a few human generations at a minimum, but possibly many, giving rise to the notion of an entire mythical era.

In Part II of this article, the question of whether there is an appropriate physical model to explain the observations recorded in ancient sources will be addressed.

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Notes and References

1. M. A. van der Sluijs, *Traditional Cosmology*, All-Round Publications, London, 2011, vol. 1, pp. 18-20.
2. *Ibid.*, vols. 1-4. In the following text, the cross-cultural themes identified in this work are conveniently referred to in the form “§ ...”
3. W. F. Warren, *The True Key to Ancient Cosmology and Mythical Geography*, Ginn, Heath, & Co., Boston, 1882, pp. 12, 20-21.
4. e.g. for Atlas: Aristotle, *On the Movement of Animals*, 3 (699a); for Perseus: Hippolytus, *Refutation of All Heresies*, 4. 6. 4, tr. F. Legge, *Philosophumena or the Refutation of All Heresies*, Society for Promoting Christian Knowledge, London, 1921, vol. 1, p. 113; for Mount Meru: Lātadeva, *Sūrya Siddhānta* (c. 500 CE), 12. 34, 43, tr. E. Burgess, *Translation of the Sūrya-Siddhānta*, American Oriental Society, New Haven, 1860, p. 246, with 247 note; cf. M. A. van der Sluijs, *op. cit.* [1], vol. 1, p. 45.
5. e.g., pseudo-Aristotle, *On the Cosmos*, 2 (391b-392a); Geminus, *Elements of Astronomy*, 4. 1-2
6. M. A. van der Sluijs, *op. cit.* [1], vol. 1, pp. 47-55.
7. M. A. van der Sluijs, ‘The World Axis as an Atmospheric Phenomenon’, *Cosmos* 21(1), 2005, pp. 21-25; cf. *idem*, *op. cit.* [1], vol. 2, pp. 113-129.
8. M. A. van der Sluijs, *op. cit.* [1], vol. 2, p. 117; *idem*, *op. cit.* [7], p. 40 note 53.
9. M. A. van der Sluijs, *op. cit.* [7], pp. 26-27.
10. e. g., Manilius, *Astronomy*, 1. 279-293; Martianus Capella, *The Marriage of Philology and Mercury*, 8 (815-816); pseudo-Bede, *On the Constitution of the Heavenly and the Terrestrial World*, 1. 18-20 (881D).
11. W. F. Warren, *Paradise Found*, Houghton, Mifflin, New York, 1885³, in toto.
12. *Ibid.*, pp. 52, 61-62, 68.
13. B. G. Tilak, *The Arctic Home in the Vedas*, Tilak Bros., Poona, 1903, pp. 69-70.
14. H. Aoki, ‘Integer Quantum Hall Effect’, in P. Bhattacharya, R. Fornari & H. Kamimura (eds.), *Comprehensive Semiconductor Science and Technology*, Elsevier, Amsterdam, 2011, p. 188.
15. A. Piel, *Plasma Physics*, Springer, Heidelberg, 2010, pp. 323-324.
16. H. Aoki, *op. cit.* [14], p. 188.
17. F. Jueneman, ‘The First Law of Thermodynamics’, *Industrial Research* 16(2), February 1974, p. 18; *idem*, ‘A Three Ring Circus’, *Industrial Research*, 16(9), September 1974, p. 14; *idem*, ‘The Polar Column’, *Aeon* 1(4), 1988, pp. 40-41; *idem*, ‘The Hermes Connection’, *Aeon* 1(5), 1988, pp. 80, 92-93; pers. comm., 27- and 28-9-2013; L. E. Rose, ‘Variations on a Theme of Philolaos’, *Kronos* 5(1), 1979, p. 37; A. de Grazia & E. R. Milton, *Solaria Binaria*, Metron Publications, Princeton, NJ, 1984, pp. 51-82; R. [B.] Driscoll, ‘The Saturn Myth’, *Aeon* 1(4), 1988, p. 53; *idem*, ‘Magnetic Models of the Polar Configuration’, *Aeon* 4(2), 1995, p. 20; et caetera.
18. F. Jueneman, *op. cit.* [17 (2)], p. 14; R. [B.] Driscoll, *op. cit.* [17 (1)], p. 53; *idem*, *op. cit.* [17 (2)], p. 20; anonymous, ‘The Electric Saturnian System’, *Aeon* 6(1), 2001, p. 40; E. Cochrane, ‘Thundergods and Thunderbolts’, *Aeon* 6(1), 2001, p. 108.
19. W. Thornhill, *The Electric Universe*, self-published, 1997, p. 100.
20. R. Ashton, ‘The Bedrock of Myth’, unpublished, 1987, at <http://www.saturnian.org/bedrock.htm>; M. Zysman, ‘Saturn Myth’, *Kataklysmos*, privately circulated, 1987, pp. 9-13; *idem*, ‘Let there Be Lights’, in M. Zysman & C. Whelton (eds.), *Catastrophism 2000*, Heretic Press, Toronto, 1990, pp. 141-198. Compare Ch. Raspil, ‘Snapshots of the Gods?’, *C&C Review* 1998: 2, pp. 20-27; *idem*, ‘Archetypes Showing the Presence of Anomalous Electromagnetic Activity’, *C&C Review* 2000: 1, pp. 53-59; and in anonymous, ‘Brains Trust’, *C&C Review* 2000: 1, p. 120; T. van Rhee, ‘Proposed Variations on the Saturnian Configuration’, *Aeon* 6(1), 2001, pp. 23-24.
21. R. H. Eather, *Majestic Lights*, American Geophysical Union, Washington, DC, 1980, p. 34.
22. Compare M. A. van der Sluijs, *op. cit.* [7].
23. S. Tromholt, *Under the Rays of the Aurora Borealis*, tr. C. Siewers, Sampson Low, Marston, Searle, and Rivington, London, 1885, vol. 1, p. 217.
24. T. Iijima & T. A. Potemra, ‘Field-Aligned Currents in the Dayside Cusp Observed by Triad’, *Journal of Geophysical Research*, 81(34), 1976, p. 5977 Fig. 6; T. A. Potemra, ‘Birkeland Currents in the Earth’s Magnetosphere’, in C.-G. Fälthammar, G. Arrhenius, B. R. De et al. (eds.), *Plasma and the Universe*, Kluwer Academic Publishers, Dordrecht, 1988, p. 167.
25. T. A. Potemra, *op. cit.* [24], p. 157.
26. *Ibid.*, p. 167.
27. H. Alfvén, *Cosmical Electrodynamics*, Clarendon Press, Oxford, 1950, p. 206; cf. H. F. Webster & Th. J. Hallinan, ‘Instabilities in Charge Sheets and Current Sheets and their Possible Occurrence in the Aurora’, *Radio Science*, 8(5), 1973, p. 475; A. L. Peratt & C. M. Snell, ‘Microwave Generation from Filamentation and Vortex Formation within Magnetically Confined Electron Beams’, *Physical Review Letters* 54(11), 1985, p. 1167; R. Buneman, R. J. Barker, A. L. Peratt et al., ‘A Tribute to Oscar Buneman – Pioneer of Plasma Simulation’, *IEEE Transactions on Plasma Science* 22(1), 1994, p. 23; A. L. Peratt, J. McGovern, A. H. Qöyawayma et al., ‘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), 2007, p. 802.
28. H. F. Webster, ‘Breakup of Hollow Electron Beams’, *Journal of Applied Physics* 26(11), 1955, p. 1386; cf. C. C. Cutler, ‘Instability in Hollow and Strip Electron Beams’, *Journal of Applied Physics* 27(9), 1956, p. 1028; A. L. Peratt, *Physics of the Plasma Universe*, Springer, New York, 2015², pp. 341-342.
29. Th. J. Hallinan & T. N. Davis, ‘Small-Scale Auroral Arc Distortions’, *Planetary and Space Science* 18, 1970, pp. 1735, 1740-1741, distinguishing between “curls” and “folds”, p. 1737.
30. “Large radius beams ... propagating through plasma are susceptible to a filamentation instability ... The filamentation instability most readily occurs for large currents.” A. L. Peratt, *op. cit.* [28], p. 78.
31. H. F. Webster & Th. J. Hallinan, *op. cit.* [27]; Th. J. Hallinan & T. N. Davis, *op. cit.* [29]
32. R. Buneman, *op. cit.* [27], p. 23.
33. A. L. Peratt, *op. cit.* [28], p. 27.
34. W. H. Bostick, ‘What Laboratory-Produced Plasma Structures Can Contribute to the Understanding of Cosmic Structures both Large and Small’, *IEEE Transactions on Plasma Science* 14(6), 1986, pp. 703, 708. Relativistic electrons are those which move at a speed almost identical to the speed of light.

35. A. L. Peratt, J. Green & D. Nielsen, 'Evolution of Colliding Plasmas', *Physical Review Letters* 44(26), 1980, p. 1769; cf. A. L. Peratt *et al.*, *op. cit.* [27], p. 798; A. L. Peratt & C. M. Snell, *op. cit.* [27], p. 1167; A. L. Peratt, *op. cit.* [28], pp. 27-29, 86-88, 341.
36. A. L. Peratt, 'Characteristics for the Occurrence of a High-Current, Z-pinch Aurora as Recorded in Antiquity', *IEEE Transactions on Plasma Science* 31(6), 2003, p. 1193.
37. G. L. Siscoe, 'Polar Cap Size and Potential', *Geophysical Research Letters* 9(6), 1982, 672-675.
38. A. L. Peratt, *op. cit.* [28], pp. 59-60, cf. 72-73.
39. A. L. Peratt, *op. cit.* [36], p. 1193; cf. A. L. Peratt *et al.*, *op. cit.* [27], pp. 779, 797-798; A. L. Peratt & W. F. Yao, 'Evidence for an Intense Solar Outburst in Prehistory', *Physica Scripta* 131, 2008, p. 2; A. L. Peratt, *op. cit.* [28], p. 12.
40. A. Brekke & A. Egeland, *The Northern Light*, Springer-Verlag, Berlin, 1983, p. 87 Table 7. 1 note a.
41. A. L. Peratt, *op. cit.* [28], p. 354, cf. A. L. Peratt *et al.*, *op. cit.* [27], pp. 799, 801; A. L. Peratt & W. F. Yao, *op. cit.* [39], p. 10, referring to the 1992 edition of A. L. Peratt, *op. cit.* [28], pp. 62-63 (= 60-61) for the figures for the contemporary aurora. M. A. Schield, J. W. Freeman & A. J. Dessler ('A Source for Field-Aligned Currents at Auroral Latitudes', *Journal of Geophysical Research, Space Physics* 74(1), 1969, p. 253) estimated a total Birkeland current strength of 2 MA for a normal situation. "REB" connotes 'relativistic electron beam'.
42. C. G. Fälthammar, 'Electrodynamics of Cosmical Plasmas', *IEEE Transactions on Plasma Science* 18(1), 1990, p. 15.
43. A. L. Peratt, *op. cit.* [36], p. 1193. Compare M. Zysman, *op. cit.* [20 (2)], pp. 146-147, 159, 178-179, 187, 190; *idem*, *op. cit.* [20 (1)], pp. 11-12.
44. H. Alfvén, *Cosmic Plasma*, D. Reidel, Dordrecht, 1981, p. 22.
45. A. L. Peratt & W. F. Yao, *op. cit.* [39], p. 1.
46. A. L. Peratt, *op. cit.* [36], p. 1193.
47. A. L. Peratt, *op. cit.* [28], p. 354; cf. A. L. Peratt *et al.*, *op. cit.* [27], pp. 800-801 = A. L. Peratt & W. F. Yao, *op. cit.* [39], pp. 2, 4. As discussed below, Gold's article, which was actually published in 1963, was not concerned with aurorae, but with geomagnetic crisis.
48. A. L. Peratt, *op. cit.* [36], pp. 1197, 1212.
49. M. A. van der Sluijs & A. L. Peratt, 'Astronomical Petroglyphs', *Expedition* 52(2), 2010, pp. 40 figure, 42.
50. For the stratigraphy of auroral colours, see, e. g., S. Silverman, 'Early Auroral Observations', *Journal of Atmospheric and Solar-Terrestrial Physics* 60, 1998, p. 1001; G. Paschmann, S. Haaland & R. Treumann, *Auroral Plasma Physics*, Kluwer Academic Publishers, Dordrecht, 2003, p. 34.
51. The following discussion benefits from communication with Robert J. Johnson.
52. A. L. Peratt *et al.*, *op. cit.* [27], p. 799.
53. M. A. van der Sluijs & R. J. Johnson, 'Geometry of an Intense Auroral Column as Recorded in Rock Art', *Journal of Scientific Exploration* 27(2), 2013, pp. 229, 231-232.
54. The same observation applies to the argument in D. E. Scott, 'Birkeland Currents', *Progress in Physics* 11(2), 2015, 167-179, that the auroral rings above each pole form a cross-section of a single, giant 'Birkeland current'; cf. Robert J. Johnson, pers. comm., 4-, 22- and 23-7-2013, 9-9-2013 and 14-11-2013.
55. A. L. Peratt, *op. cit.* [36], p. 1193 Fig. 4.
56. A. L. Peratt, *op. cit.* [28], p. 363. Note the odd expression "geophysical south".
57. A. L. Peratt *et al.*, *op. cit.* [27], p. 802.
58. e. g., W. H. Bostick, 'The Pinch Effect Revisited', *International Journal of Fusion Energy* 1(1), 1977, pp. 10, 16-17, 36, 47; *idem*, *op. cit.* [34], pp. 703-706; Peratt, *op. cit.* [28], pp. 78-79.
59. M. G. Haines, 'A Review of the Dense Z-Pinch', *Plasma Physics and Controlled Fusion* 53(9), 2011, p. 71 Fig. 42.
60. A. L. Peratt, *op. cit.* [28], pp. 355-357; A. L. Peratt & W. F. Yao, *op. cit.* [39], pp. 2-4.
61. A. L. Peratt & W. F. Yao, *op. cit.* [39], p. 3; A. L. Peratt *et al.*, *op. cit.* [27], pp. 800-801.
62. However, M. Zysman (*op. cit.* [20 (2)], p. 179) did reflect on the effects of "an alteration in the electro-magnetic field strength" of the earth on the intense-auroral column.
63. See M. A. van der Sluijs & R. J. Johnson, *op. cit.* [53], p. 229.
64. I. N. Vail, *The Heavens and Earth of Prehistoric Man*, Annular World Company, Pasadena, CA, 1913, p. 21, but see pp. 57-58, 82.
65. M. Zysman, *op. cit.* [20 (1)], pp. 11-12. The figure of 65,000 km represents the average height of the magnetopause on the sun-facing side.
66. I. N. Vail, *The Deluge and its Cause*, Suggestion Publishing Company, Chicago, 1905, p. 56.
67. D. L. Cyr (ed.), *Waters above the Firmament*, Isaac N. Vail, Stonehenge Viewpoint, Santa Barbara, CA, 1988, p. 5.
68. R. Ashton, *op. cit.* [20].
69. M. A. van der Sluijs & R. J. Johnson, *op. cit.* [53].
70. A. L. Peratt *et al.*, *op. cit.* [27], p. 802 Fig. 67.
71. "... one might expect plasma columns under very intense geomagnetic-storm conditions to occur near both magnetic poles just as contemporary aurora [sic] occur at both poles for comparatively modest storm conditions." A. L. Peratt *et al.*, *op. cit.* [27], p. 805.
72. M. A. van der Sluijs, *op. cit.* [1], vols. 1-4.
73. For examples from the Central Alaskan Yup'ik (c. 64° N), see E. W. Nelson, 'The Eskimo about Bering Strait', *Annual Report of the Bureau of American Ethnology* 18(1), 1899, pp. 452, 482, and from the Wotjobaluk (central-western Victoria, Australia) (c. 37° S), see A. W. Howitt, *The Native Tribes of South-East Australia*, MacMillan and Co., London, 1904, p. 433.
74. D. N. Talbott, *The Saturn Myth*, Doubleday, Garden City, NY, 1980, pp. 138-139, 144, 265, 269, 282-308, 330.
75. M. Zysman, *op. cit.* [20 (1)], pp. 4, 8, 12; *idem*, *op. cit.* [20 (2)], pp. 161, 165, 178, 195.

Figures: sources

Figure 1. Provenance unknown. http://www.cyberhymnal.org/bio/w/a/t/warren_wf.htm

Figure 2. A. L. Peratt, [28], p. 7 Fig. 1. 5. © Anthony Lee Peratt.

Figure 3. T. Iijima & T. A. Potemra, [24], p. 5977 Fig. 6.

Figure 4. A. L. Peratt *et al.*, [27], p. 802 Fig. 66. © Anthony Lee Peratt.