

Robert Temple

A New Science of Heaven

*How the science of plasma changes
our understanding of physical
and spiritual reality*



CORONET

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I must thank as always my wife Olivia for her continual and devoted involvement in this book, reading it, making suggestions, expressing doubts when necessary and giving encouragement when doubts would be misplaced. I have never written a book without her help, and never more so than with this one.

I wish to thank also my very dear friend of many years, Chandra Wickramasinghe, for his vision and encouragement in exploring this exciting area of science and for co-authoring the astrophysical paper reproduced in the Appendix.

I

The Discovery of the Clouds

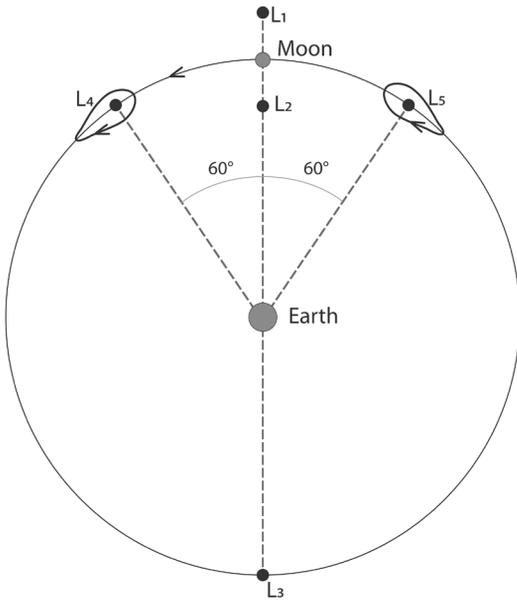


FIGURE 1. This diagram shows the locations of the 'Lagrange Points' known as L_4 and L_5 of the Earth–Moon system, indicating the positions of the two clouds. In this diagram, the Earth is at the centre, and the Moon is directly above it. Although distinct, bounded balls of plasma can form anywhere at modest scales (as for instance, and as we shortly see, the tiny balls of ball lightning on the Earth), for really big ones in space it is helpful for them to come to rest in spaces free of gravitational pulls, and when such a niche appears it is pretty certain that it will soon be filled by plasma which will form a ball as big as the niche allows. And that is why the L_4 and L_5 points are perfect homes for huge plasma clouds, for they are the only two points between the Earth and the Moon free of gravitational pull from either the Earth or the Moon. This image is not drawn to scale and the relative sizes of the bodies shown here bear no relation to their true sizes; this image is intended solely to show the geometrical spatial configuration. Seen at this scale, the Earth and the Moon would be extremely tiny or perhaps even too small to see, and as the main text explains, each of the Clouds is four and a half times the size of the Earth. (Image drawn for the author by Eric Wright)

3
A Brief History of Plasma Research

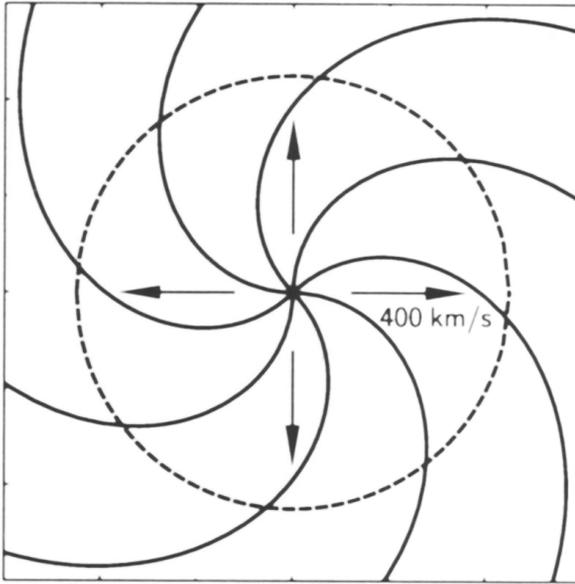


Figure 2. The central dark spot is the Sun. The dotted line is the orbit of the Earth, intentionally simplified here to look like a circle. The solar wind is not blasting straight at us, but is swirling in this way, with the swirls sweeping across us. This drawing is taken from Alexander Piel's excellent book *Plasma Physics* (2nd edition, Springer Verlag, Heidelberg, 2010). He does not give his source for it, and the speed has been indicated wrongly by the unknown artist, nor is the rotation taken into account for the speed indication. But the basic idea is clear, namely the Archimedean spiral form of the solar wind which fills our solar system.

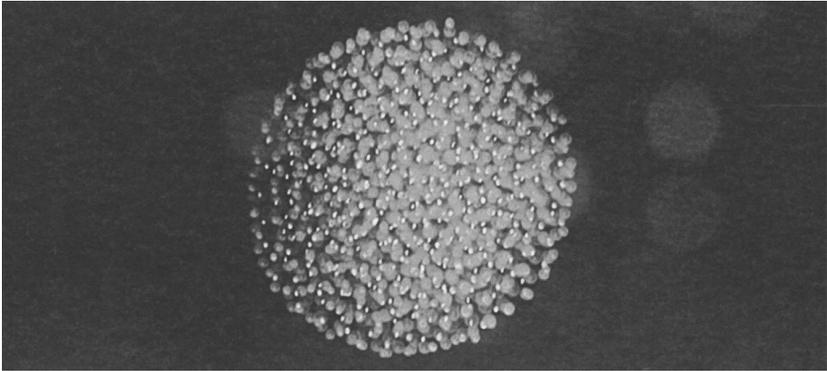


Figure 3. A Yukawa Ball, which consists of several hundred dust particles clustered together. The ball, which is a ‘strongly coupled’ (a term for describing elements of a system, such as particles, which have powerful interaction energies holding them together) dusty complex plasma structure, is approximately 7 mm across. The spherical cluster has a nested shell structure and is not just random inside. These balls are self-assembled. Such Yukawa Balls can form even at room temperature and do not need to have an exotic environment of very high or very low temperatures.

From Torben Ott, et al., ‘Molecular Dynamics Simulation of Strongly Correlated Dusty Plasmas’, 2010.⁸

5
Great Balls of Fire



Figure 4. A portion of Goepfert's photo taken in 1955 showing two of the three identical current paths of arc-mode current flashes travelling through the same lightning ball and occurring microseconds apart so that they all appeared on the same photograph side by side. This evidence substantiates the theory of ball lightning being charged dusty plasma crystals. If plotted in three dimensions, the current path would help us to reconstruct the invisible host crystalline structure. If the current paths had been randomly created, they could not have been the same like this. Just to be clear, this is a photo not of a lightning ball itself but of current flashes travelling through part of a lightning ball, showing only a portion of that ball, which is why the image itself does not look like a ball!



Figure 5. The Angel of the Lord speaks to Moses from the Burning Bush (top left corner). The snake may refer to the transformation of Moses' staff. This image is from an illustrated Latin Bible of 1567.

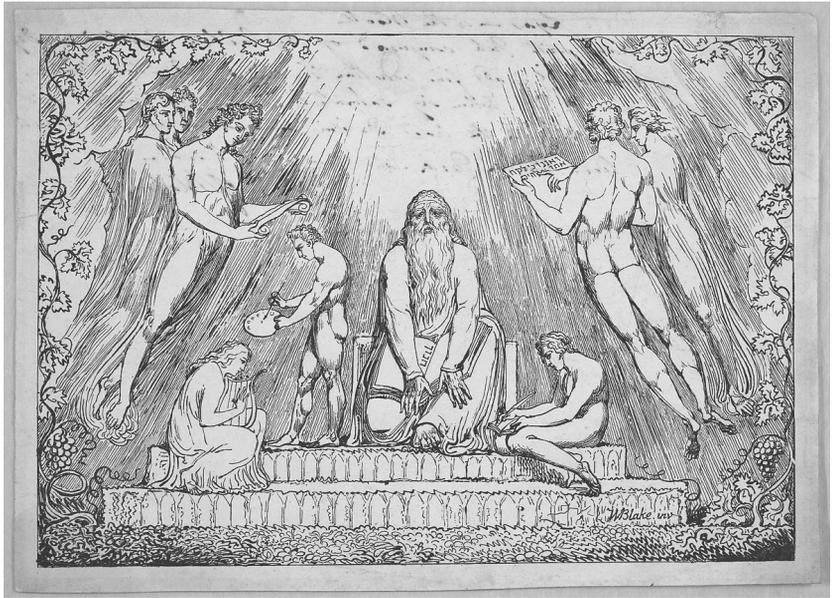
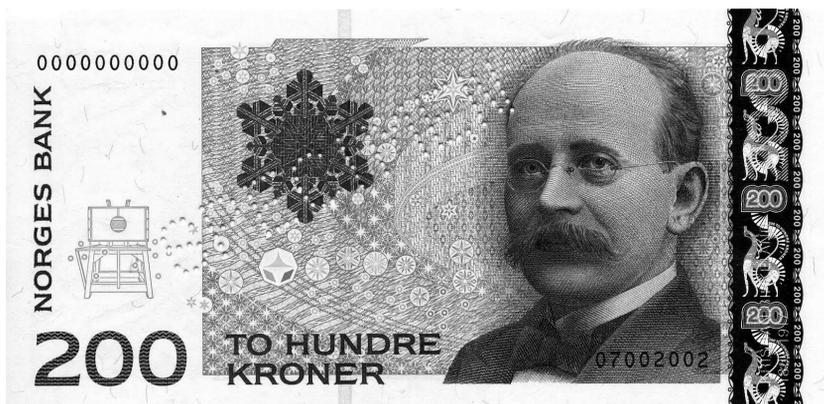


Figure 6. William Blake's 1807 lithograph of Enoch in Heaven.

Kristian Birkeland's Miraculous Discovery



Kristian Birkeland appeared until recently on the Norwegian 200 kroner banknote. Image reproduced with the kind permission of the Bank of Norway. Copyright by Norges Bank/ artist Sverre Morken. This banknote was legal tender in Norway between the years 1994 and 2018.

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12.

AURORA BOREALI,

QUAM GERMANI

Das Nord-Licht/

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A. c. 1716. d. 17. Martii

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PRÆSIDE

CHRISTOPHORO Sanghansen/

Mathematicum Prof. Extraord.

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CHRISTIANUS HENRICUS Gütther/ Reg. Boruff.

Phil. & S Theol. Stud.

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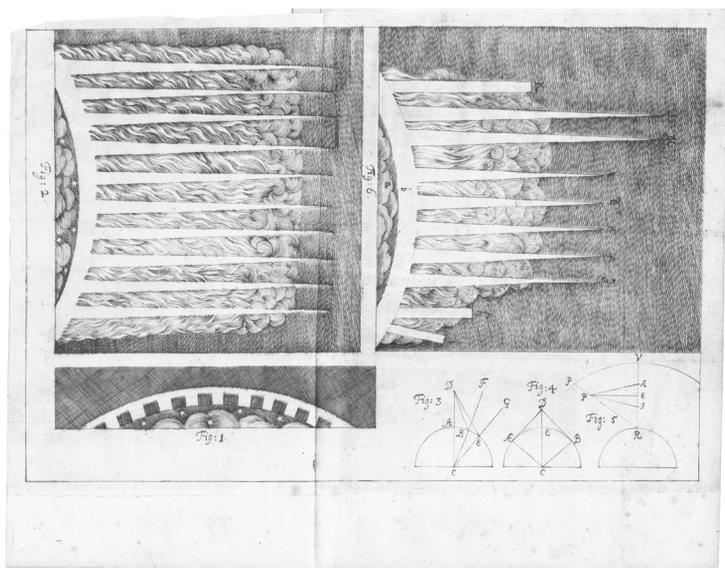
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ROYAL METEOROLOGICAL SOCIETY
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Kristian Birkeland's Miraculous Discovery



Figures 7 and 8. The title page and the fold-out engraving of the 1716 publication about the Aurora Borealis by Christoph Langhansen, from my imperfect copy of this rare work.

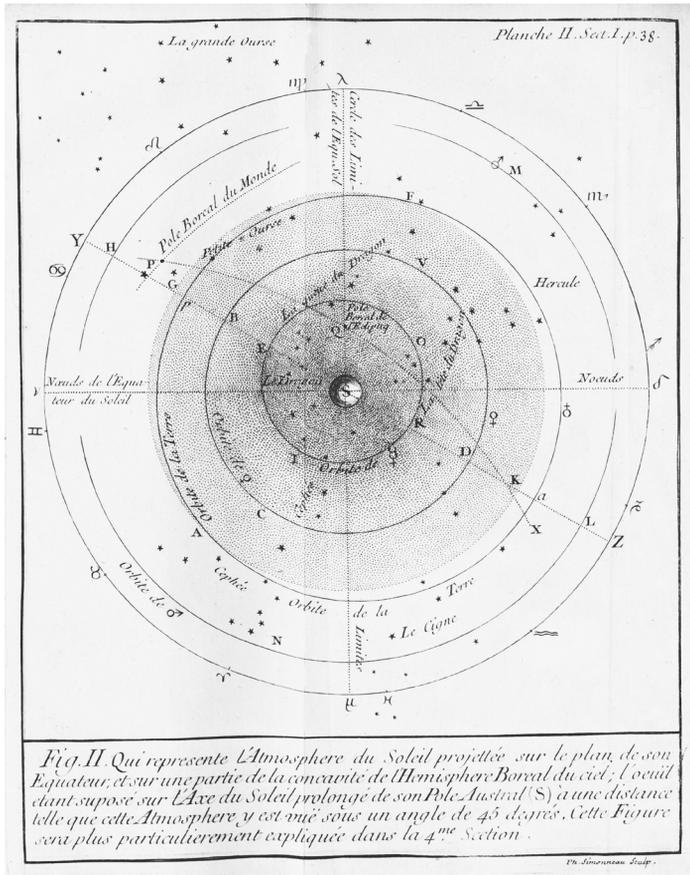


Figure 9. This engraving of 1733 shows the ‘Sun’s atmosphere’, as conceived of by de Mairan, extending from the Sun (shown in the centre and labelled with the capital letter S) to the orbit of the Earth (Orbite de la Terre). The solar atmosphere is represented in the drawing by the shaded portion, which is largely comprised within the orbit of the Earth. On p. 22 of his book, de Mairan describes the solar atmosphere as being ‘a spheroid which has been flattened at its edge into the form of a circular disc’. De Mairan’s concept of the solar atmosphere that reached the Earth partially arose from the researches by his Swiss contemporary Nicolas Fatio de Duillier (1664–1753, whom he calls simply ‘Fatio’) concerning the distance between the Earth and the Sun.

In his own caption de Mairan says: ‘This represents the atmosphere of the Sun. It is projected on a map of the Equator and on one section of the concavity of the Boreal hemisphere of the sky. The centre is superimposed upon the axis of the Sun projected onto the astral Pole at such a distance that this atmosphere is viewed at an angle of 45°.’ (From: Jean-Jacques d’Ortous de Mairan, *Traité Physique et Historique de l’Aurore Boréale (Physical and Historical Treatise Concerning the Aurora Borealis)*, Paris, 1733, the second folding plate following p. 32.)

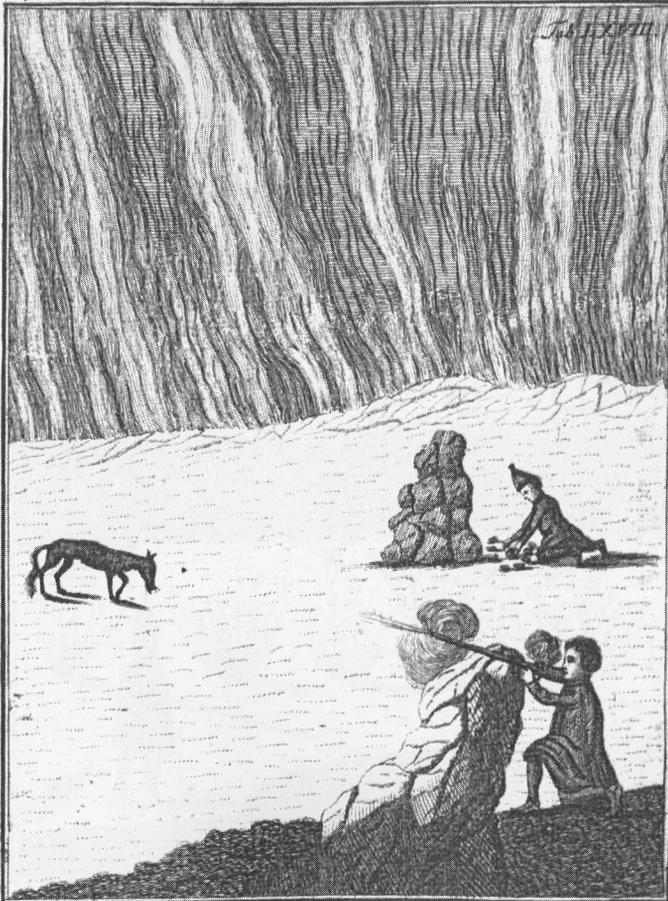


Figure 10. Knud Leem's drawing of 1767 showing the Lapps of Lapland hunting foxes on the ice at night, by the light of the Aurora Borealis.

Kristian Birkeland's Miraculous Discovery

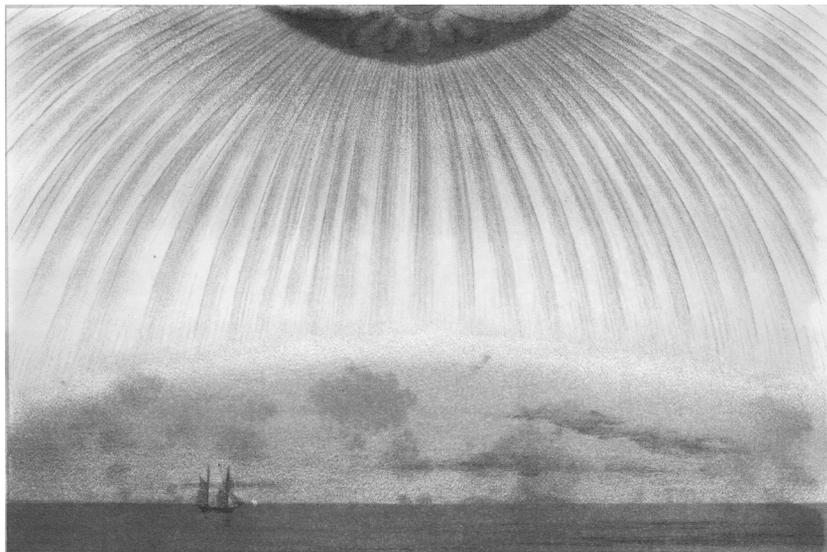


Figure 11. One of the many spectacular colour illustrations of the Aurora Borealis published by Lemström.

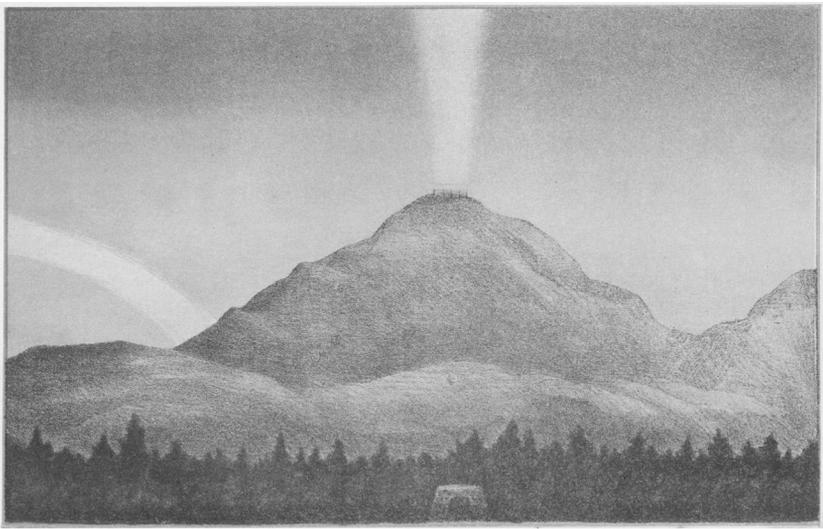
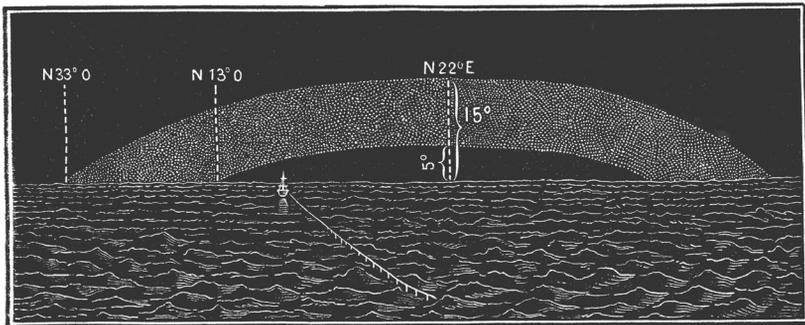


Figure 12. Tromholt's depiction of Lemström's experiment of 1882.



Arc large a éclat uniforme aperçu le 14 mars 1879 a $9^h 20^m$ du soir.

Figure 13. An illustration shown by Nordenskiöld in scientific form, with all the angular measurements precisely given and the *Vega* stuck in the ice.

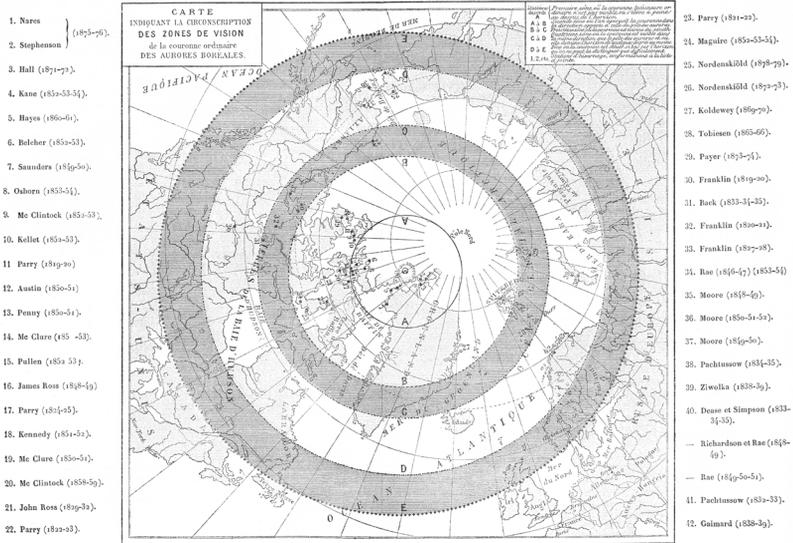


Figure 14. Nordenskiöld's plotting of the regions of the Earth where visibility of the Aurora Borealis had been reported. The North Pole is shown in the centre.

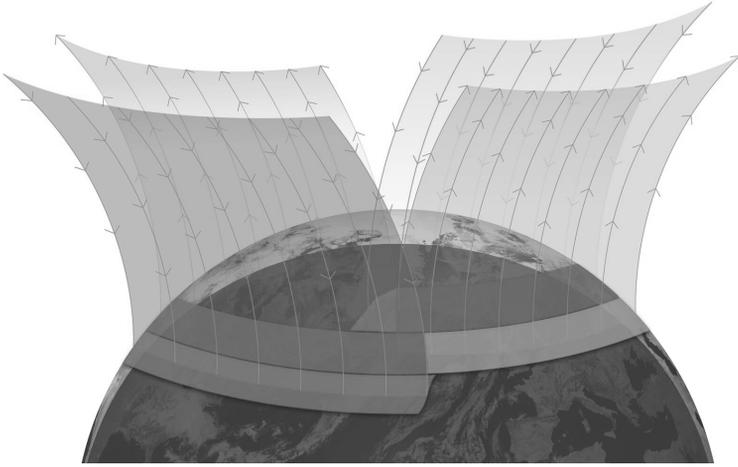
The Cosmic Web

Figure 15. Upward and downward current sheets of flat electric current extending between the Earth and space, discovered in 2017. The pale current sheets show the descent onto the planet of charged particles and the dark sheets show the upwards ascent of charged particles (as indicated by the small arrows). However, it has been well known for many decades that negative current pours into the pole in a stream. It is unclear why this is not also shown, nor is it clear why the current is rising from two opposite quarters of a ring current, how that is happening (what makes it rise?), and what charge these sheets have. (The same? Opposite?) Much more clarity is needed before we can simply accept this picture, which must only be part of a much larger process which is going on and which requires much more investigation. (Image courtesy of European Space Agency).

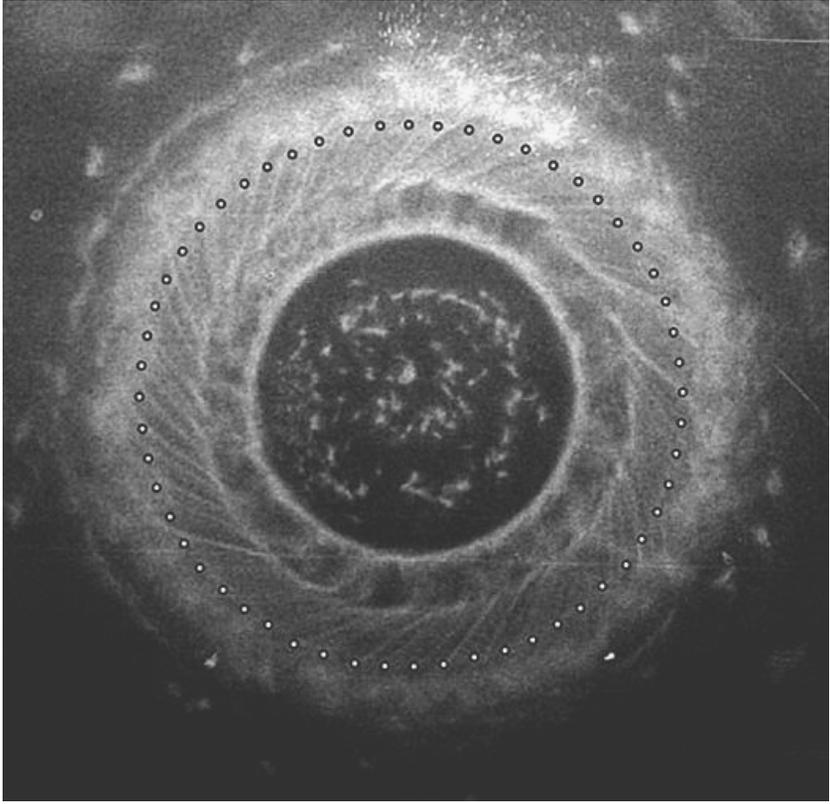


Figure 16. Cross-section of a dense plasma Birkeland Current captured on a photographic ‘witness’ plate in a plasma lab in 2007. The circle of dots is overlaid onto the image to indicate the 56 locations of the apparent spiral-shaped paths of matter. (Image supplied courtesy of Anthony Peratt, reproduced from Donald E. Scott’s seminal paper, ‘Birkeland Currents: A Force-Free Field-Aligned Model’, in *Progress in Physics*, Vol. 11, Issue 2, April 2015, pp. 167–179.) The spiralling currents counter-flow, in other words, one ring flows left and the next flows right, etc., and the whole thing is spiralling forward (towards you, looking at the page) at great speed in a cylindrical ‘skin’ known as a ‘double-layer sheath’.

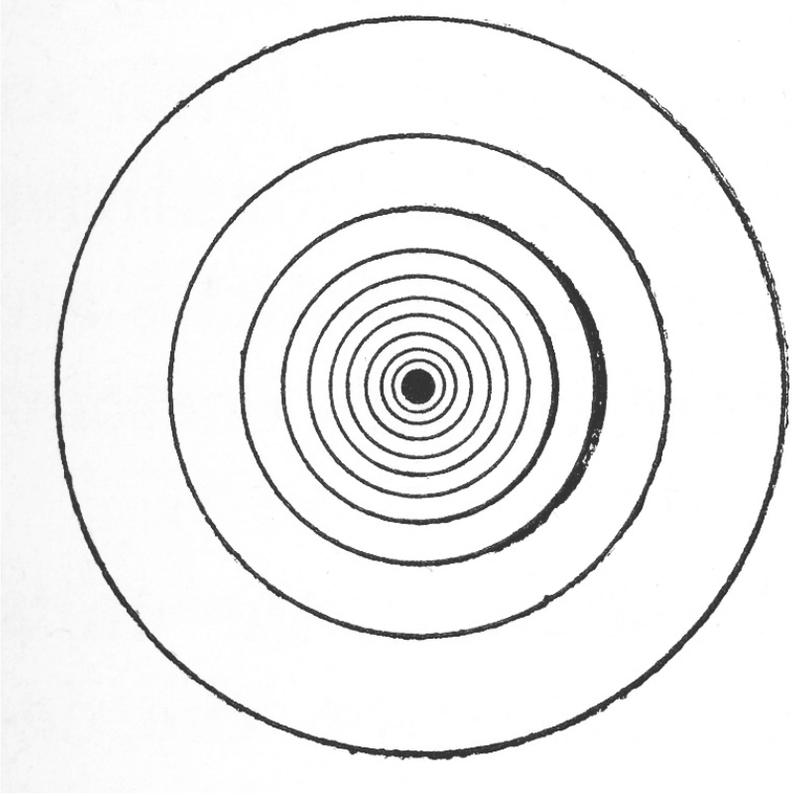


Figure 17. Willard Bennett's drawing. The fictitious 'lines of force' are drawn closer together the nearer they are to the wire (the black dot in the centre) to indicate increasing field strength. This is a section drawing, and the wire is coming straight at you in this picture.

The Cosmic Web

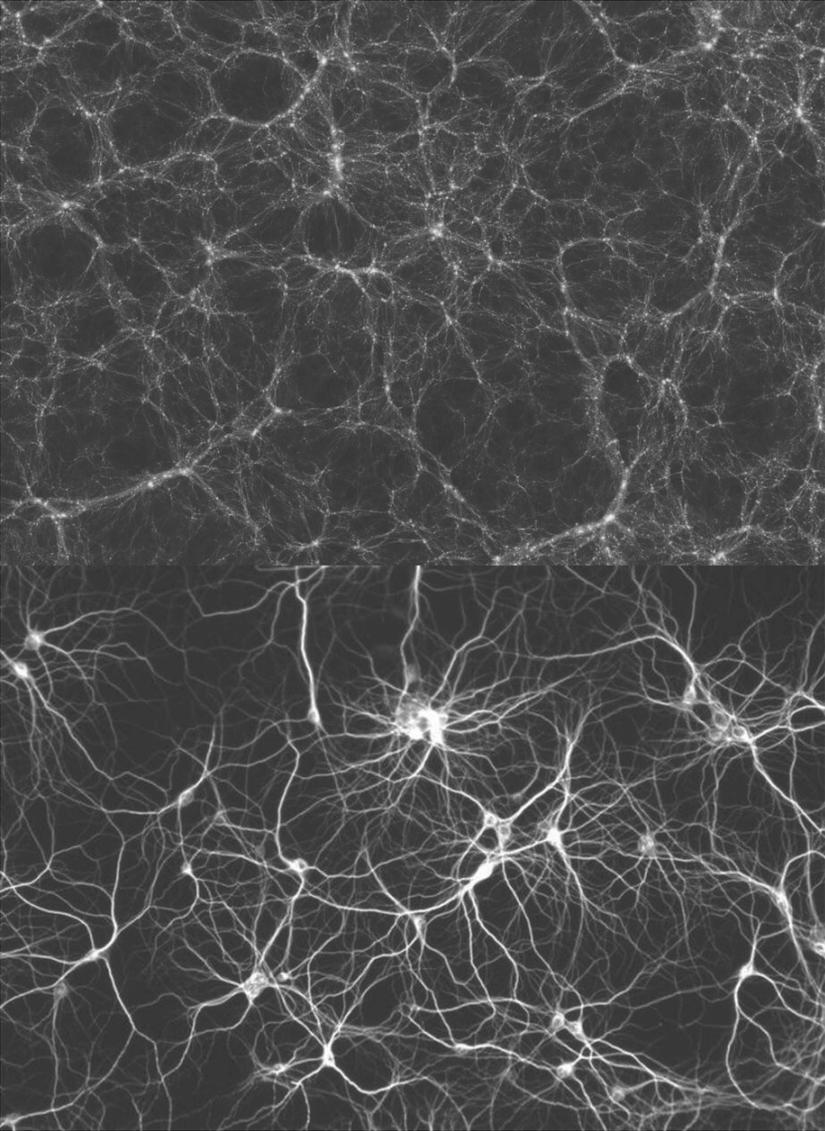


Figure 18. Filaments are fundamental to the Universe, and to all entities. They carry current. And they can carry information in the form of signals, they can transport energy, and so forth. In the Universe as a whole, they are everywhere. They constitute the major portion of the Universe's structure, which today is known as the Cosmic Web. Here we see two similar adjoining images. The top one shows the Cosmic Web of the Universe. The bottom one shows the neural network of the human brain. Both are constituted of masses of filaments separated by voids and joined at intersection points called nodes. The Cosmic Web is called that because of the web-like

nature of the filaments, which many believe to be filamentary channels for the conduction of energy and currents across astronomical distances. Some scientists call them Birkeland Currents (named after the Norwegian scientist Kristian Birkeland), which contain current-carrying double-helices spiralling forward and surrounded by protective sheaths. Such spiralling currents are sometimes conceived of as 'super-conducting', meaning that they can travel without resistance at speeds approaching the speed of light. The upper image was posted on www.researchgate.net by astronomer Professor Oliver Hahn of the Lagrange Laboratory, Côte d'Azur Observatory, Nice, France, on December, 2014, as Figure 1 on page 2 of his paper 'Collisionless Dynamics and the Cosmic Web', from the *Proceedings of the International Astronomical Union*. (His paper with the image is available for free public download. Hahn does not himself discuss super-conducting currents or use the term Birkeland Currents.) The bottom image is credited to Matt Lee and was posted by eLife Science Digests (www.elifesciences.org/digests/37935) in an article entitled 'Traffic Signals That Wire the Brain', November 19, 2018. As with the Universe and its Cosmic Web, the Brain Web of a human being displays filamentary networks separated by voids and joined at nodes. Is the Universe a giant brain? Is the human brain a mini-Universe? In any case, these phenomena are examples of 'fractality' (a term arising from the study of fractal geometry), which means similar patterns and structures occurring at different scales, from the microscopic to the cosmic. Such reoccurrences of shapes are often referred to as the 'self-similarity' of forms which remain the same across different scales. These concepts arise from the pioneering genius Benoit Mandelbrot (1924–2010), discoverer of fractals. I was so fortunate to meet this heroic scientist on one occasion and attend one of his lectures. There are many videos of him on YouTube, which I enthusiastically recommend to all who wish to have their brains constructively stretched.

IO
Invisible Earth

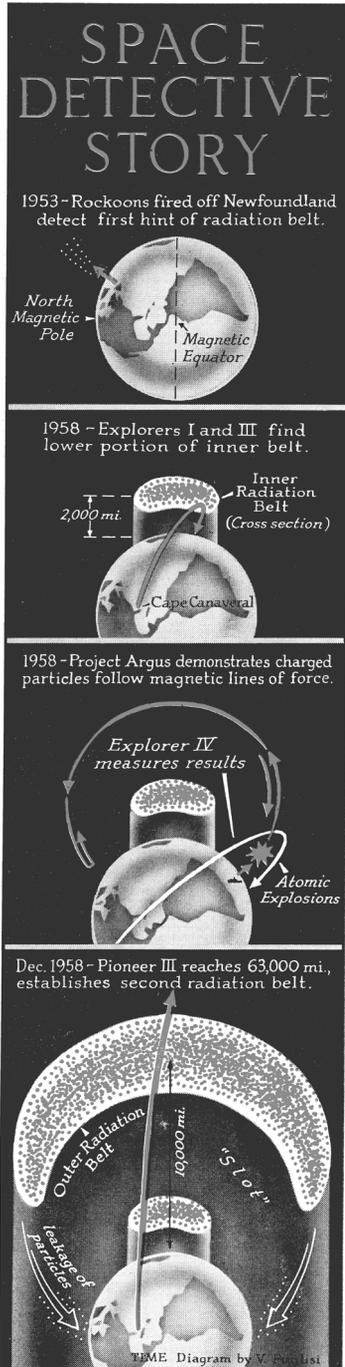


Figure 19. *Time* magazine's explanatory chart by V. Puglisi, of the discovery of the Van Allen Belts. The bottom picture shows how much bigger the Second ('Outer') Belt is than the First. A third higher Belt was discovered later. Note the shameless boasting about the 'Atomic Explosion' in the picture above the bottom one, complete with a helpful red explosion. How incredibly naïve, or should I say stupid, the military authorities were, and how idiotic the editors of *Time* must have been, to print this without any indication that they had turned their brains on and realized that maybe this was possibly not such a good idea.

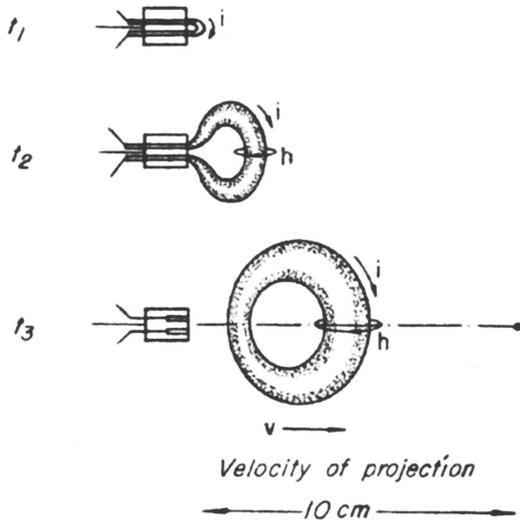


FIG. 2. Mechanism of projection of a plasmoid. No externally excited magnetic field is employed.

Figure 20. How to make an electric doughnut: the 'plasma gun' is at left, and from it emerges in three stages (shown as t_1 , t_2 , and t_3 , meaning 'time one, time two, and time three') a plasmoid in the shape of a doughnut, known in geometry as a torus. This is Bostick's own diagram from his famous 1956 paper, and depicts the first plasmoid ever created artificially in a laboratory.



Figure 21. Bostick's photo, taken as a two-microsecond 'snapshot', showing what happened when he fired two plasmoids at each other. To his astonishment, they combined to form a 'barred spiral' shape resembling the well-known barred-spiral galaxies in space. As he wrote: 'Occasionally two plasmoids crashing head on break into fragments, but even these fragments seem to behave as entities. In other words, we appear to be dealing with bodies which have strong powers of self-organization and preservation.'

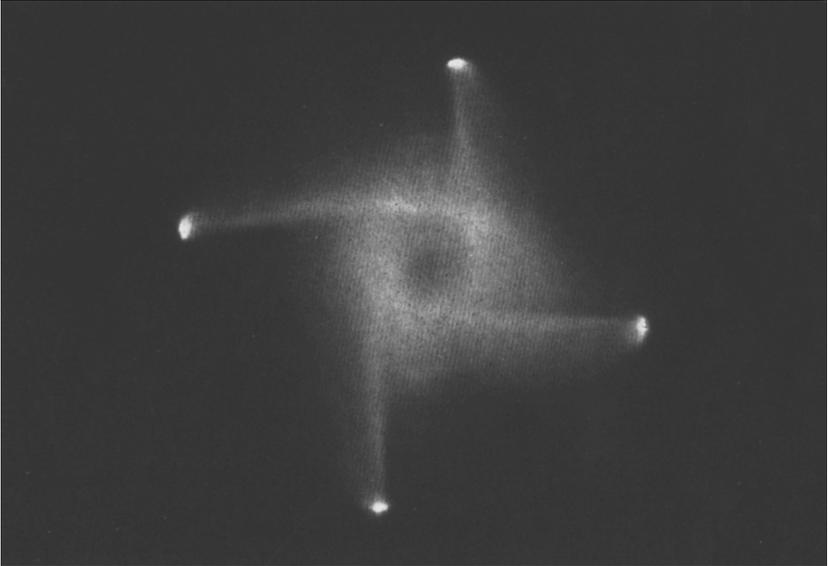


Figure 22. Bostick's time-exposure photo of what happened when he fired four plasmoids at each other, by aiming all of them at a common central point. He did this in a thin gas within a magnetic field, which is at right angles to this page. As soon as the plasmoids were fired, they ionized the gas so that electric current started flowing. The effect was this astonishing phenomenon, of a twisting and whirling ring with spiral arms.

As he says: 'The formation looks strikingly like a photograph of a spiral galaxy . . . We can look upon the combination of plasma and a magnetic field as a kind of self-shaping putty. Perhaps study of the forms assumed by this putty may help us understand configurations such as the stars and galaxies. It may also throw light, at the other end of the scale, on the construction of fundamental particles such as the electron, the proton, mesons and neutrinos. They, too, may be made of self-organizing putty: a putty composed of the electromagnetic field and its own gravitational forces, which, working together, create the bodies we know as particles.'

I2
Plasma Comes Alive

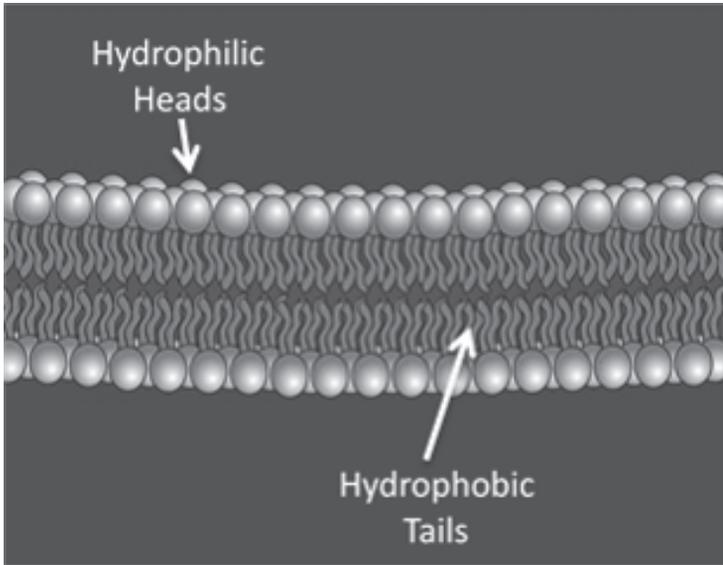


Figure 23. A typical double-layer cell membrane within a human body. Such membranes are analogous to the double layers that exist in plasma, and which surround the plasmoids and all the current-carrying filaments inside plasmas. Unless organic cells are protected by these walls called membranes, they cannot exist. The outward-facing parts of the membranes are hydrophilic, meaning ‘water-loving’ heads, and hence friendly to the watery environments of the cell and body. The inward-facing parts are hydrophobic, meaning ‘water-hating’ and they just hate being exposed to water. This excellent image comes from a course in Anatomy & Physiology, Bio 264, Cell Membranes section, at Brigham Young University, USA, and may be viewed at <https://content.byui.edu>. This is a simplified image of the basic structure of a cell membrane, although in reality there are often various ‘plug-ins’ sticking through and pathways for biocurrents such as flows of protons and ions across the membrane. In this book it has not been possible to take the space to discuss all those phenomena, for the discovery of which Peter Mitchell was the brilliant pioneer. (By showing how currents flowed through membranes, he totally changed the previous view of metabolism as being a static chemical process, known as ‘the Bag of Enzymes’ theory. He replaced that theory with the true description of what really happens, which is often called Vectorial Metabolism, meaning that metabolic processes are like vectors and have a direction in space, which is far from the random processes of chemicals sitting idly in a ‘bag of enzymes’ like loungers on adjoining deck chairs who might occasionally have a chat or a joke.)

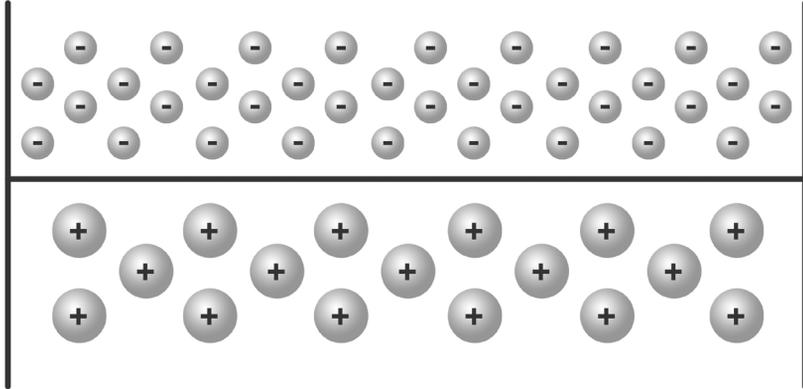


Figure 24. An electric double-layer. At the top of the diagram, the rows of small circles enclosing minus signs represent electrons, which are negatively charged. (The minus signs mean 'negative'.) At the bottom of the diagram, the rows of larger circles enclosing plus signs represent protons, which are positively charged. (The plus signs mean 'positive'.) Combined in this way in a double-layer, the electrons and the protons form a protective sheath which enables a blob of plasma to be protected from whatever is going on outside, and therefore to remain intact 'come Hell or high water'. Such a blob can cohere and retain its integrity no matter what surrounds it, blasts rays at it, or tries to destroy it, up to a limit which is usually very high indeed. Without protective sheaths, such plasmoids and other plasma blobs, filaments, and entities would be rapidly destroyed and could have only a momentary existence. It is clear that the same basic underlying principle is at work in the double-layers of organic cells and the double-layers of plasma blobs (or 'plasma cells' as we might well call them). In other words, the principle of the double-layer surrounding wall seems to be a universal structural element found in both organic and inorganic natural phenomena, as a means of enabling entities to maintain their identities within hostile or stressful environments. (Image drawn for the author by Eric Wright)

The Mysterious Case of the Dirty Gas

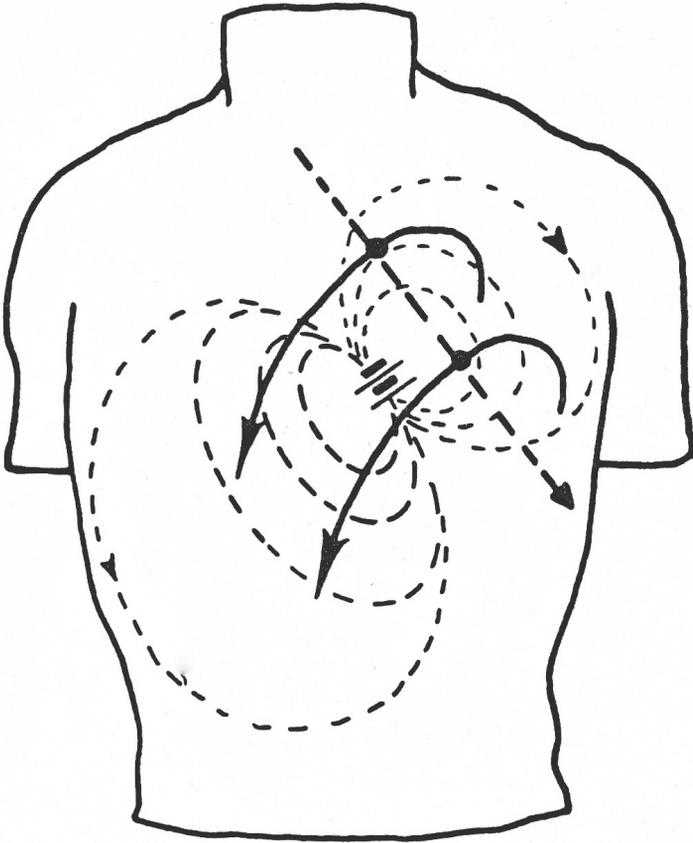


Figure 25. A diagram showing the electrical and magnetic activity of the human heart. The solid lines depict 'lines of force' with directional arrows, demonstrating that the heart's magnetic field travels from left to right across the human chest. The dotted lines show the electrical current produced. The artist has drawn a schematic small electric battery at the location of the heart to suggest the electromagnetic nature of the heart. From Gerhard M. Baule and Richard McFee, 1963 (see Footnote 4 to this chapter)).



Figure 26. The magnetic field around the human head. The magnetic field goes from the left hemisphere of the brain around the head and back in through the right hemisphere. The 'lines of force' have been drawn to depict this, with the arrows showing the direction of the field. From Gerhard M. Baule and Richard McFee, 1963 (see Footnote 4 to this chapter).

The Mysterious Case of the Dirty Gas

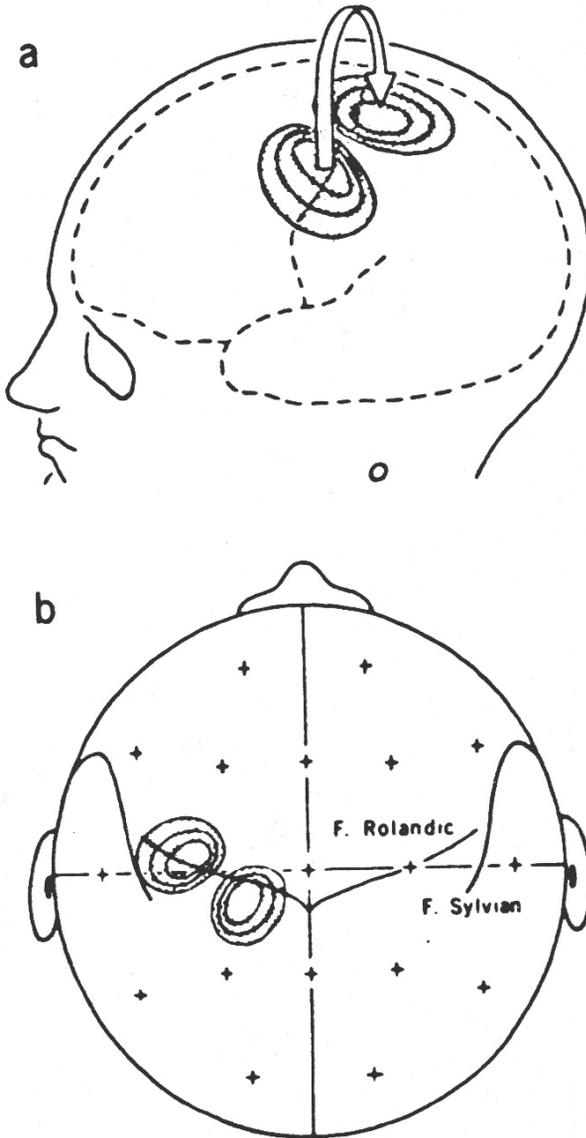


Figure 27. A separate magnetic field in the brain to that shown in Figure 26, and discovered subsequently. This field is sharply localized in a tiny region of the brain's left hemisphere – 'a': side view (with the arrow showing the field direction goes from left to right, as was the case with the field shown in Figure 26, and 'b': top view. This field is an 'evoked' field, created by shooting electric current into a person's finger! From Gerhard M. Baule and Richard McFee, 1963 (see Footnote 4 to this chapter).

14
Electric People

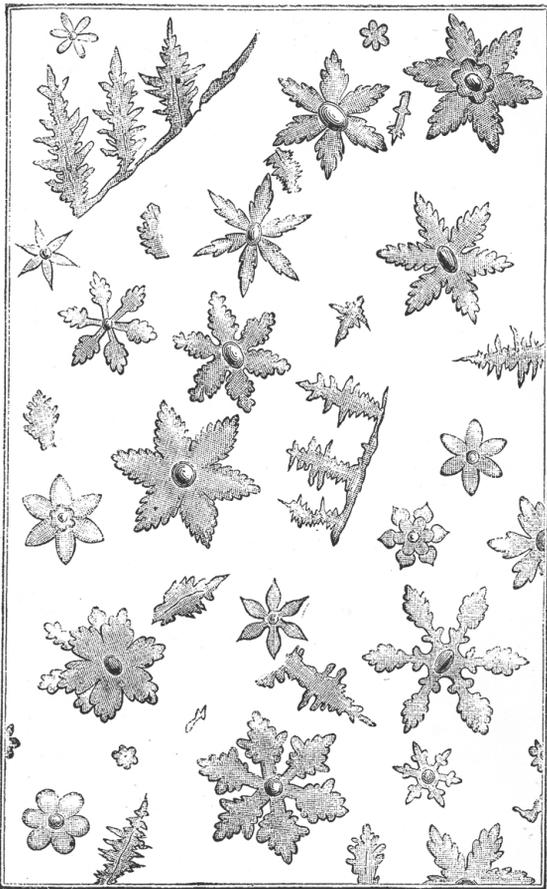


Figure 28, A nineteenth-century engraving of 'ice flowers' as seen through a microscope.

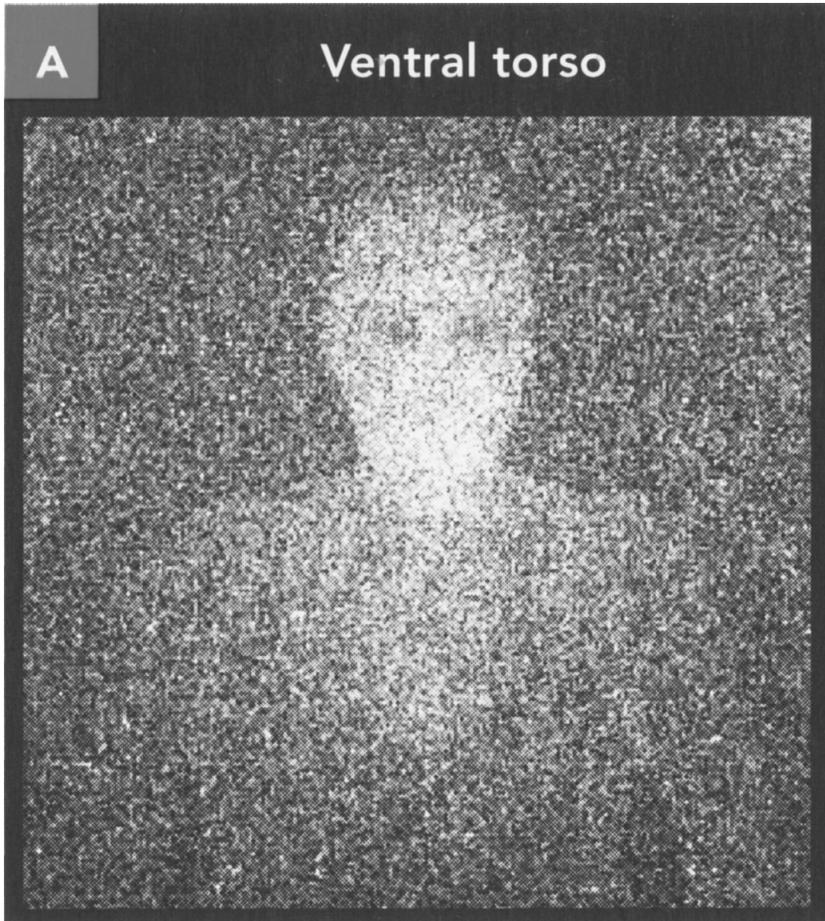


Figure 29. An image of the head and torso of a man sitting in total darkness, the only source of the light forming the image being the spontaneously emitted biophotons coming from his own body. For reasons that are not entirely understood, the eyeballs do not emit many photons, and so appear here as dark holes. Image courtesy of Professor Roeland van Wijk.

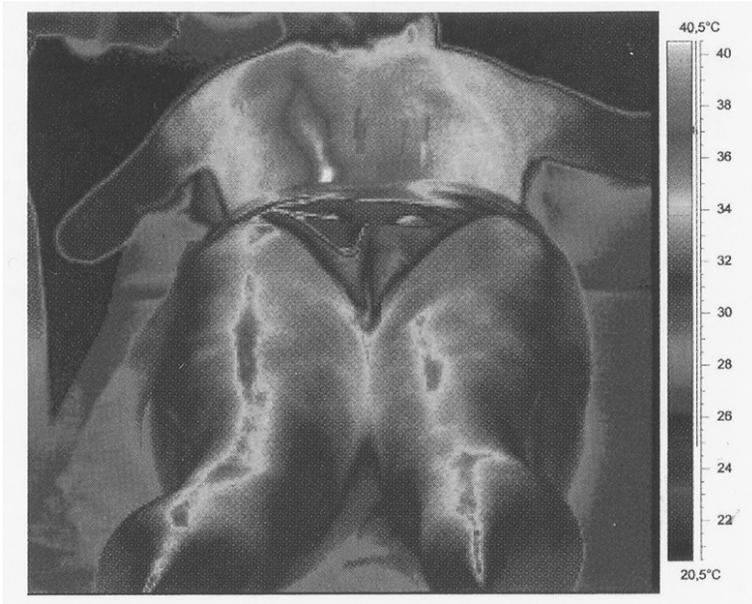


Figure 30. Biophotons being emitted along the meridians of the backs of the legs. Image courtesy of Professor Roeland van Wijk.

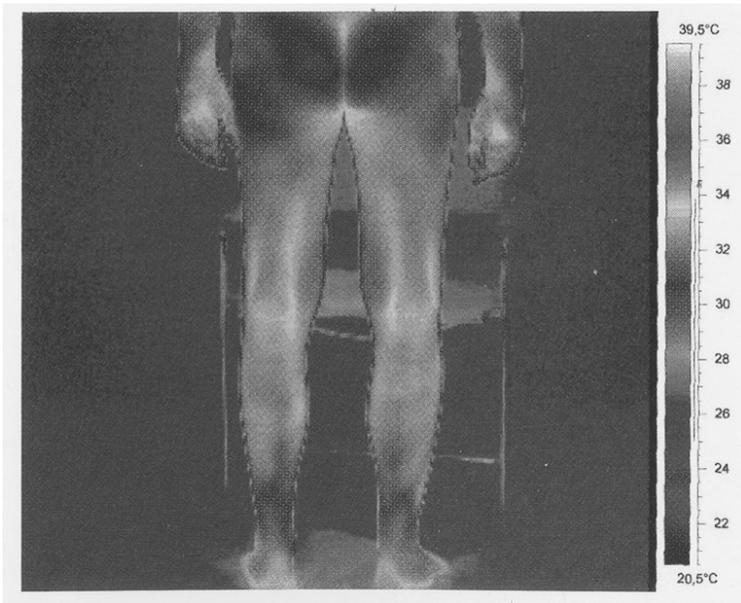


Figure 31. Biophotons along meridians of the legs seen in the standing position. Image courtesy of Professor Roeland van Wijk.

The 'Death Flash' and the 'Life Flash'

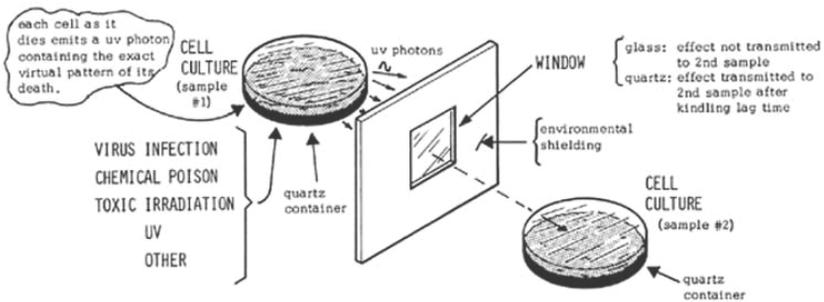


Figure 32. V.P. Kaznacheev's diagram of the process of 'death transmission' between cells, published in 1976 in English. The two dishes contain portions of the same cell culture placed in two separate quartz containers, and the experiment was done in darkness. As each cell in the cell culture at left dies, he says 'it emits an ultraviolet (UV) photon containing the exact virtual pattern of its death'. A shield with a window is set up between the two dishes of cell cultures. The UV rays pass through the window when it is made of quartz, but not when it is made of glass.

This was exactly what Alexander Gurwitsch had discovered about UV rays in the 1920s, which he called 'mitogenetic rays', and which are now called biophotons. Kaznacheev was thus partially replicating Gurwitsch's original experiment, which we saw earlier, concerning the ultraviolet signals passing between onion roots. These were similarly blocked by glass but permitted by quartz. What Kaznacheev discovered by his experiment was that if the cells in the dish on the left were killed by virus infection, chemical poison, toxic radiation, or some other means, death as if by the same means was paranormally transmitted to the cells in the right-hand dish, as long as the UV rays could pass through the window. He found out later that these death messages also can be transmitted in daylight but much more weakly.

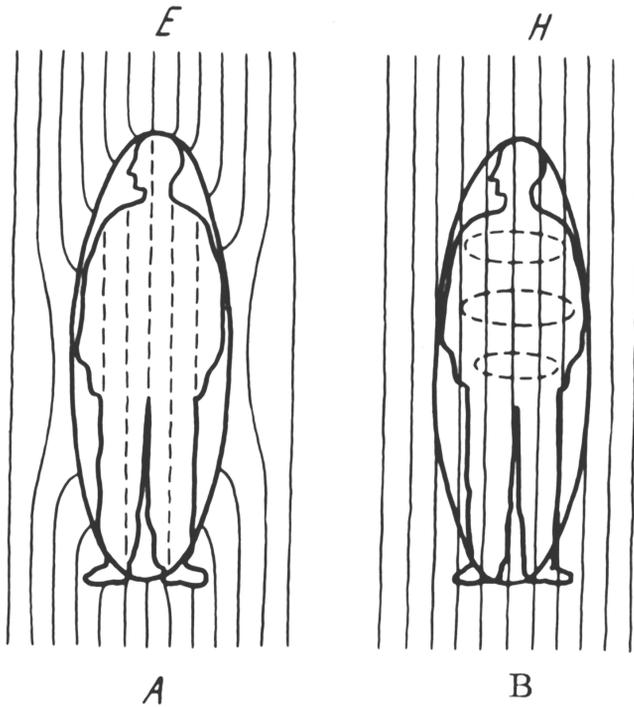


Figure 33. The standing human body is largely composed of electrically conductive water, and acts as an organic antenna, receiving waves and currents from outside and communicating them to the body's interior. It appears standing and therefore as an ellipse for the purposes of Presman's whole-body analyses and studies.

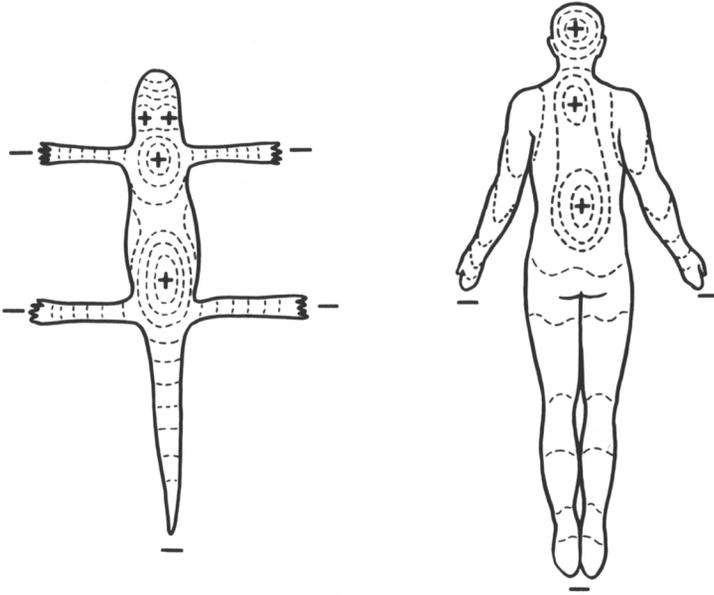


Figure 34. Presman's maps of the distribution of surface electric charge as it occurs on the body of a lizard and the body of a man. (From *Electromagnetic Fields and Life*, p. 237, fig. 93.) Key points for the man are the brain and the spinal cord.

Notes

Chapter 1: The Discovery of the Clouds

1. Kazimierz Kordylewski, *Acta Astronomica*, 11, 1961, page 165.
2. Judit Sliz-Balogh, András Barta, and Gábor Horváth, ‘Celestial Mechanics and Polarization Optics of the Kordylewski Dust Cloud in the Earth-Moon Lagrange Point L₅, Part I: Three-Dimensional Celestial Mechanical Modelling of Dust Cloud Formation’, subsequently followed by an Erratum and by a Part II: ‘On Imaging Polarimetric Observation for the Existence of Kordylewski Dust Cloud’. These were all in the *Monthly Notices of the Royal Astronomical Society*, 480, 2018, 5550; and 482, 2019, 762–70. In summarizing their observations, the conclusion of this astronomical team for Part II was: ‘. . . the only explanation remains the polarized scattering of sunlight on the particles collected around the L₅ point.’
3. Robert Temple and Chandra Wickramasinghe, ‘Kordylewski Dust Clouds: Could They Be Cosmic “Superbrains”?’, in *Advances in Astrophysics*, Vol. 4, No. 4, November 2019, pp. 129–32.

Chapter 2: Exploring the Nature of Plasma Clouds and Their Energy

1. Wang Zhehui, et al., ‘Physics of Dust in Magnetic Fusion Devices’, in Padma Kant Shukla, Lennart Stenflo, and Bengt Eliasson (eds.), *New Aspects of Plasma Physics*, Proceedings of the 2007 ICTP Summer College on Plasma Physics, World Scientific, Singapore, 2008, pp. 395–6.
2. Ions were recognized soon after we learned about the existence of atoms. In 1834 the British chemist Michael Faraday identified and

named this new subdivision of matter: things which were ‘almost atoms but not quite’. Because these tiny particles were detected travelling from one electrode to another in aqueous solutions, and because the act of going between things seemed to be their main characteristic at that time, Faraday looked for a Greek word to do with going or travelling. He chose the Greek verb *ienai* (a form of *eimi*), which means ‘to go, come to, go across, go (along a road)’, the neuter present participle of which was ion. And so he called them ‘ions’.

3. The definition of a qudit is a bit complicated. Such a unit is considered to be a ‘unit of quantum information by a superposition of d states, where d is an integer greater than 2.’ That explains what the ‘ d ’ in qudit stands for.
4. Osamu Ishihara, ‘Final Report on Study of Cryogenic Complex Plasma’ submitted on 27 October 2008 to the US Research Laboratory in Japan known as AOARD, declassified by the US Department of Defense and included in the publication entitled *Charged Colloidal Structures in Plasmas*, no date. In his experiment, Osamu first created the plasma in his lab and then injected the dust particles into it, hence his particular emphasis of the interaction of the two components.

Chapter 3: A Brief History of Plasma Research

1. In 1875, Crookes invented the vacuum tube, which came to be known as ‘Crookes tubes’. You might say that we owe the entire electronic age to him. The original radios and television sets were full of those odd vacuum tubes. (In Britain they were commonly called ‘valves’.) When one ‘blew’ it had to be replaced, like a light bulb, and if it were only in the radio, you would go to a radio parts shops and there would be shelves full of little thin cardboard boxes of different sizes. The man would rummage through his shelves and find the right one, take it down and hand it to you, saying: ‘Here you are, this is the one you want.’ Most people simply replaced the radio ones themselves. But it was more hazardous to open a television

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set, thanks to the dangers of possible electrocution, so the television repair men would come to replace the tubes in those, because they knew how to open TVs and handle the tubes safely. Even well into the 1970s, it was still possible to find valves (vacuum tubes) in small shops in most towns and buy them easily. In the 1990s, my wife Olivia and I wanted to keep an old radio set from the Second World War working and we succeeded in finding the right valve.

2. Nikola Tesla, *My Inventions: The Autobiography of Nikola Tesla*, Cosimo Classics, New York, 2011, p. 80. The work was originally published in February–June and October 1919, in installments in a journal entitled the *Electrical Experimenter* (an American technical science monthly established in May 1913).
3. Irving Langmuir and Lewi Tonks, ‘Oscillations in Ionized Gases’ in *The Physical Review*, Second Series, Vol. 33, No. 2, February 1929, p. 196, footnote 5.
4. David Albertovich Frank-Kamenetsky (aka Kamenetskii), ‘Plasmic Phenomena in Semi-Conductors, and Biological Effects of Radio Waves’, in *Proceedings of the USSR Academy of Sciences [DAN, or Doklady Akademii Nauk SSSR]*, Vol. 136, No. 2, Moscow, 1961. (Presumably in Russian.) In 1963, he published a bold book insisting that plasma was the fourth state of matter (fourth after the gaseous, liquid, and solid states, which had been the traditional three states of matter until plasma was discovered). David Albertovich Frank-Kamenetsky (aka Kamenetskii), *Plasma – der Vierte Aggregatzustand*, Progress Verlag, Moscow, 1963.
5. Gary S. Selwyn, J. Singh, and R.S. Bennet, ‘In Situ Laser Diagnostic Studies of Plasma-Generated Particulate Contamination’, in *Journal of Vacuum Science and Technology*, A, 7, pp. 2758–65.
6. ‘Like complex fluids, complex plasmas belong to the group of so-called soft matter . . . Originally the name “complex plasma” was chosen in analogy to “complex fluids”; since complex plasmas can be regarded as the fourth state of soft matter, very much like ordinary plasmas can be regarded as the fourth state of ordinary matter . . . They are responsible for fundamental astrophysical

processes such as the formation of the solar systems and planets . . . In particular, the question about the structure of self-organized systems emerges as a key issue . . .’ Patrick Ludwig, Michael Bonitz, and Jürgen Meischner, ‘Complex Plasmas’, in Michael Bonitz, Norman Horing, and Patrick Ludwig (eds.), *Introduction to Complex Plasmas*, Springer Verlag, Heidelberg, 2010, pp. 6–8. In the quote under bullet 2010, soft matter was referred to, and that dusty complex plasmas were types of soft matter. So what is soft matter?

There is a useful book on just this subject by Masao Doi (*Soft Matter Physics*, Oxford University Press, 2013). His very first chapter is entitled ‘What is soft matter?’, in which he says:

Soft matter includes a large variety of materials, typically composed of polymers, colloids, liquid crystals, surfactants [such as detergents and emulsifiers], and other mesoscopic [intermediate-sized, in other words between nano scale and micrometre scale] constituents . . . Condensed states of matter are usually classified into two states, the crystalline state where the molecules are ordered, and the liquid state where the molecules are disordered. For certain materials, molecules form a semi-ordered state between crystal and liquid. Such materials are called liquid crystals . . . As we have seen, soft matter includes a large class of materials . . . What is common in the above materials is that they all consist of structural units that are much larger than atoms . . . soft matter consists of large molecules or assemblies of molecules which move collectively . . . the fundamental structural units of soft matter are very large.

7. News item: ‘Bacterial Mimic Spins and Swarms’ in *Nature*, Vol. 575, No. 7784, 28 November 2019, p. 568.
8. Torben Ott, Patrick Ludwig, Hanno Köhlert, and Michael Bonitz,

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- ‘Molecular Dynamics Simulation of Strongly Correlated Dusty Plasma’, in Michael Bonitz, Norman Horing, and Patrick Ludwig (eds.), *Introduction to Complex Plasmas*, Springer Verlag, Heidelberg, 2010, p. 232 (Figure 10.1).
9. Hamish Gordon, et al., ‘Causes and Importance of New Particle Formation in the Present-Day and Pre-Industrial Atmospheres’, in *Journal of Geophysical Research: Atmospheres*, 122 (16), 2017, pp. 8739–60.
 10. Robert Wagner, et al., ‘The Role of Ions in New Particle formation in the CLOUD Chamber’, in *Atmospheric Chemistry and Physics*, 17, 2017, pp. 15181–97.
 11. Dominik Stolzenburg, et al., ‘Rapid Growth of Organic Aerosol Nanoparticles over a Wide Tropospheric Temperature Range’, in *Proceedings of the National Academy of Sciences of the USA* (colloquially known as ‘PNAS’), Vol. 115, No. 37, 11 September 2018, pp. 9122–7. Winkler’s Appendix to this paper may be separately obtained by download from the PNAS website.
 12. Christina J. Williamson, et al., ‘A Large Source of Cloud Condensation Nuclei from New Particle Formation in the Tropics’, in *Nature*, Vol. 574, No. 7778, 17 October 2019, pp. 399–403.
 13. The ancient Greek mystics when discussing what mystical writers such as the Theosophists call ‘the subtle body’, in other words the soul, called it the *lepton ochēma* in the ancient book called *The Chaldaean Oracles*, the word *ochēma* meaning not ‘body’ but ‘vehicle’. This use of the word *lepton* gives it an extended meaning, which one could call ‘lighter than light’, since lightness has here been stretched to mean so light that it is barely material at all. (Or one might say it was their way of trying to give a name to what we call plasma, the existence of which they intuited but did not yet understand.) The name *baryon* was thus invented to describe the particles that were very different from electrons, such as protons and neutrons, and which are so much heavier than electrons, having so much more weight, or as one might more correctly say, rest mass. The proton, for instance, has 1836 times more rest mass than an

electron, is thus heavy, or as the Greeks would have said, *barys*, ‘weighty’. In 2016, I published a lengthy paper explaining why protons are exactly 1836 times heavier than electrons, which people interested in more detail on this subject can download from my www.researchgate.net entry, as my explanation was entirely new and had never been suggested before. There are very many types of baryons known now, but we cannot go into such a complicated discussion or give the lengthy lists of them here. The name baryon comes from the ancient Greek word *baros*, which means ‘weight’. Electrons are small, fast, and light, and they are in a different class of particles known as leptons, from the ancient Greek word *leptos*, which means ‘small’ and also ‘light, as in faint breezes and light wine’. Coincidentally, the Greeks also used lepton to describe the size of dust particles

14. T.D.C. Bevan, et al., ‘Momentum Creation by Vortices in Superfluid ^3He as a Model of Primordial Baryogenesis’, in *Nature*, Vol. 386, No. 6626, 17 April 1997, pp. 689–92.
15. Vadim Nikolaevich Tsytovich, Gregor Eugen Morfill, Vladimir E. (Yevgenyevich) Fortov, N.G. Gusein-Zade, Boris Aleksandrovich Klumov, and Sergey Vladimirovich Vladimirov, ‘From Plasma Crystals and Helical Structures towards Inorganic Living Matter’, in *New Journal of Physics*, Vol. 9, 2007, pp. 263ff. (11 pp.)
16. Sadruddin Bankadda, Vadim Nikolaevich Tsytovich, Sergey I. Popel, and Sergey Vladimirovich Vladimirov, ‘Self-Organization in Dusty Plasmas’, in Yoshiharu Nakamura, Toshiki Yokota, and Padma Kant Shukla (eds.), *Frontiers in Dusty Plasmas*, Proceedings of the Second International Conferences on the Physics of Dusty Plasmas 1999, Elsevier, Amsterdam, 200, pp. 123–34.
17. Vadim Nikolaevich Tsytovich, ‘Evolution of Voids in Dusty Plasmas’, in *Physica Scripta*, Vol. 2001, T89.
18. Vadim Nikolaevich Tsytovich and Gregor Eugen Morfill, ‘Non-linear Collective Phenomena in Dusty Plasmas’, in *Plasma Physics and Controlled Fusion*, Vol. 46, No. 128, B527.
19. Vadim Nikolaevich Tsytovich and Gregor Eugen Morfill, ‘Non-linear

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- Collective Phenomena in Dusty Plasmas', in *Plasma Physics and Controlled Fusion*, Vol. 46, No. 128, B527.
20. Sergey Vladimirovich Vladimirov, 'Dynamic and Static Structures in Dusty Plasmas', in *Plasma Physics and Controlled Fusion*, Vol. 49, No. 5A, S20.
21. Vadim Nikolaevich Tsytovich, Gregor Eugen Morfill, Vladimir E. [Yevgenyevich] Fortov, N. G. Husein-Zade, Boris Aleksandrovich Klumov, and Sergey Vladimirovich Vladimirov, 'From Plasma Crystals and Helical Structures towards Inorganic Living Matter', in *New Journal of Physics*, Vol. 9, 2007, pp. 263 ff.

Chapter 5: Great Balls of Fire

1. Mark Stenhoff, *Ball Lightning: An Unsolved Problem in Atmospheric Physics*, Kluwer Academic and Plenum Publishers, New York and Dordrecht, 1999.
2. C. [Cecil] Maxwell Cade and Delphine Davis, *The Taming of the Thunderbolts: The Science and Superstition of Ball Lightning*, Abelard-Schuman, London, 1969.
3. And because ball lightning has often been associated with poltergeist phenomena, and poltergeists have so often been associated with the strange emotional energies of teenage girls, it seems to me that it is not impossible that poltergeist-related ball lightning might be created by intensely neurotic teenage girls' own abnormal energy fields.
4. I have no view on the matter. Robots can certainly be organic. Clunky metallic robots are a childhood fantasy. It is possible that the proponents of 'transhumanism' know all of this very well. After all, I suspect that DARPA is well aware of what I am suggesting. And they probably assume that the clouds are hostile, if only because DARPA assumes everyone and everything is hostile. It is, after all, the job of the security agencies to be paranoid. And they certainly do not let us down in that. Plus, there's a lot of psychosis thrown in. When you get a paranoid psychopath, then you have the real thing, the perfect security agent.

5. Stanley Singer, *The Nature of Ball Lightning*, Plenum Press, New York and London, 1971 (reprinted 1972 and 1978); James Dale Barry, *Ball Lightning and Bead Lightning: Extreme Forms of Atmospheric Electricity*, Plenum Press, New York and London, 1980; Mark Stenhoff, *Ball Lightning: An Unsolved Problem in Atmospheric Physics*, Kluwer Academic/Plenum Publishers, New York, 1999.
6. Yoshi-Hiko Ohtsuki (ed.), *Science of Ball Lightning (Fire Ball)*, Proceedings of the First International Symposium on Ball Lightning (Fire Ball), 4–6 July 1988, World Scientific Publishing Company, Singapore, 1989. The paper by Singer and Barry is ‘Ball Lightning – the Continuing Challenge’, pp. 1–18.
7. Paul Sagan, *Ball Lightning: Paradox of Physics*, iUniverse, Inc., New York, Lincoln, Nebraska, and Shanghai, 2004. The book is copyright by Paul Snigier, and it appears that Paul Sagan is a nom de plume (the book is dedicated to Carl Sagan, which may be relevant to the choice of nom de plume); I have been unable to make an unambiguous identification of this author.
8. *Ibid.*, p. 284.
9. Abrahamson, John (ed. and contrib.), *Ball Lightning Theme Issue, Philosophical Transactions A of the Royal Society*, London, 2002. (Contains contributions by John Abrahamson, Alexander Vladimirovich Bychkov, Vladimir L. Bychkov, Celia I. Merzbacher, Stanley Singer, and D.J. Turner.
10. Some of their interesting scientific ideas about ball lightning will come into our discussion later in connection with the nature of complex plasmas. I shall not even attempt to summarize the contents of this fascinating book, as it would take too long, except to point out that it consists of contributions by six separate scientists of high repute, and should be studied carefully by anyone intending to study ball lightning.

The other source I should mention appeared piecemeal during 2015, and consists of a series of booklets in English translation by two Russian scientists of the Institute of Informatics Problems of the Russian Academy of Sciences in Moscow, named Vladimir

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Pavlovich Torchigin and Alexander Vladimirovich Torchigin. Vladimir Torchigin is the head of the Department of the Problems of Design of Information Computing Systems of High Parallelism at his Institute. Alexander Torchigin is the son of Vladimir Torchigin, as is a third Torchigin at the Academy, who has not written about ball lightning, Sergey Vladimirovich Torchigin. The English translations are grammatically imperfect in many places, and one must make allowance for that fact in reading the booklets.

In one of their booklets, the two Torchigin's point out that there have been more than 2000 papers and reports about ball lightning published, containing more than 200 theories of what ball lightning is, and then they say: 'But none of these theories seems to have gained general acceptance because they fail to explain all observed characteristics of the phenomenon.' They also mention that as little as 20 years ago some scientists still doubted the existence of ball lightning. However, they point out that as there are now more than 10,000 recorded accounts of ball lightning, there can be no doubt that it exists! (Vladimir Pavlovich Torchigin and Alexander Vladimirovich Torchigin, *Clue of Ball Lightning Puzzles: Ball Lightning Is the Light Rather than Matter*, no publisher named so privately published, 2015, pp. 5–6.)

The word 'the' in the title is an example of the imperfect grammar of the text. Errors with the use of definite articles are perhaps the single most common error made by non-native translators into English. The theories of Vladimir Torchigin are very interesting and novel. He believes that ball lightning is made out of trapped light rather than plasma. However, he says (and I have slightly improved his grammar): '. . . there is usually no plasma within Ball Light after its generation. There is certainly no plasma after Ball Light penetrates through windowpanes because plasma cannot penetrate through glass.' (Vladimir Pavlovich Torchigin, *Ball Lightning Physics: No Plasma and Electricity Are Required*, no publisher so privately published, 2015, p. 198.)

Torchigin is erroneous here, but may be forgiven for not knowing

about the most recent findings, which are known only to a small number of scientists at the moment. The latest discoveries about complex plasmas are so astounding that we now know that they can indeed penetrate not only glass but any form of solid dense matter. I wish to make the point that the Torchigins have done a good service by discussing confined and trapped light within the context of ball lightning. As we will see later, the creation of ‘a new kind of light’ and the ‘confinement of light’ have now both been accomplished in the laboratory, and ironically, the most exciting part of this work has taken place recently in Russia, though because it is known to such a small number of specialists, it is not yet known to the Torchigins.

We will see later when we come to the full explanation of complex plasmas, which is what I believe that we all are as living entities, that the instinct followed by the Torchigins in attempting to explain ball lightning as confined light without the presence of any plasma is useful and has important and indeed essential insights to offer, because ‘confined light’ is indeed part of the answers we are seeking, but within the contexts of highly complex plasmoids.

11. Pyotr Leonidovich Kapitsa, ‘O Priroda Sharovoi Mulnii’ (‘The Nature of Ball Lightning’, *sharovoi* being ‘ball’ and *mulnii* being ‘lightning’) in *Doklady Akademii Nauk S.S.S.R.* [*Proceedings of the USSR Academy of Science*], Vol. 101, No. 2, 1955, pp. 245–8. An English translation of this article was published in 1961, in: Donald J. Ritchie (ed.), *Ball Lightning: A Collection of Soviet Research in English Translation*, Consultants Bureau, New York, 1961, pp. 11–15.

12. He believes radiation that is reflected off the surface of the Earth causes interference patterns as a result of which ‘standing waves are set up, and at a distance equal to λ , the wavelength, multiplied by 0.25, 0.75, 1.25, 1.75, etc., there will be antinodes fixed in space at which the intensity of the electric field is doubled as compared with that of the incident wave. Because of the increased intensity in the neighbourhood of these surfaces, conditions will be suitable both

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for the formation of an initial [electric] discharge as well as for the further development and maintenance of the ionization in the cloud in which the ball lightning is formed.' (I should explain that the Greek letter *lambda* above is the standard symbol used in physics for 'wavelength'.)

13. Eugene Paul Wigner, *Symmetries and Reflections: Scientific Essays*, Indiana University Press, USA, 1967, pp. 82–90.
14. Harry Jones, *The Theory of Brillouin Zones and Electronic States in Crystals*, second revised edition, North-Holland/American Elsevier, Amsterdam, 1975.
15. D. Müller-Hillebrand, 'Ball Lightning', in Samuel C. Coroniti (ed.), *Problems of Atmospheric and Space Electricity: Proceedings of the Third International Conference on Atmospheric and Space Electricity*, 1963, Elsevier, Amsterdam, 1965, pp. 457–9; the photo is Figure 2 on p. 459.

Chapter 6: When Heaven Was Young

1. *Pistis Sophia*, edited by Carl Schmidt, translation and notes by Violet Macdermot, The Coptic Gnostic Library, Vol. IX, Brill, Leiden, 1978, pp. 184–7. (The textual reference is Book Two, Chapters 83 and 84.) There is an earlier translation of this work by G.R.S. Mead, which is also very good. The Brill volume is 806 pages, because the *Pistis Sophia* is immensely long.
2. This is related in *The Apocryphon of John*, for which see below, footnote 11.
3. In one translation known as the Darby Bible Translation, the bush is described as a thorn-bush. Commentators point out that the Hebrew word for the bush is *seneh*, which is the name of a thorny bush, a species of acacia, common in Sinai. But the original Hebrew language version is lost, and *seneh* is a translation into Hebrew from the Greek Septuagint where the Hebrew translator has used creative licence. (*Seneh* is thus a product of reverse-engineering by a Hebrew translator who has added it, thinking that he was thus being helpful to readers.) In the Septuagint, which is the oldest text

of Exodus in existence, the Greek word for the bush is *batos*. That means a bramble, in other words a wild raspberry or blackberry bush, not any other bush or plant such as buckthorn or acacia.

Theophrastus, the colleague and successor of Aristotle, was the founder of scientific botany, and the authoritative expert on Greek botanical terminology of the fourth century BC, taking precedence even over the herbalist Dioscorides, who lived AD 40–90 and was three centuries later. In his *Peri Phytōn Historias*, III, xviii, 4, Theophrastus explains that *batos* is a broad term for bramble-like plants.

He says: ‘Of the bramble (*batos*) again there are several kinds, showing very great variation; one is erect and tall, another runs along the ground and from the first bends downwards, and when it touches the earth, it roots again; this some call “the ground bramble”. The “dog’s bramble” (the wild rose that we today call the dog rose, thus continuing the ancient Greek name associated for unknown reasons with dogs) has a reddish fruit like that of the pomegranate, it is intermediate between a shrub and a tree; but the leaf is spinous.’ (Theophrastus, *Enquiry into Plants*, translated by Arthur F. Hort, Loeb Classical Library, Harvard University Press, Vol. I, 1916, pp. 270–1.)

Obviously the Burning Bush could not have been either the creeping bramble or the dog rose, and can only be the one that is ‘erect and tall’. As for the masculine noun *batos* meaning a blackberry bush, it is worth noting that the neuter noun *baton* specifically means ‘a blackberry’. The other word for a prickly shrub, often applied to buckthorn for instance, was *rhamnos*, and there was also the word *philukē*, which referred to an evergreen prickly shrub. It seems therefore that if the Septuagint had intended a prickly shrub other than the bramble, such as buckthorn, the word *rhamnos* would have been used instead of *batos*. And if acacia had been meant, its Greek name *akantha* would have been used. Hence the translation of *batos* as *seneh* was evidently incorrect.

It seems that in the earliest surviving text we are stuck with the

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unlikely and somewhat inglorious bramble, which sprawls at the sides of most English roads and hedges and from which country children pick berries to make jam in the autumn. Somehow, that is extraordinarily mundane for a divine epiphany. It is hardly surprising, therefore, that we are never told this by theologians, as the idea that Moses went up onto a mountain in order to converse with a burning blackberry bush is unimpressive.

4. It is necessary to say more about the mysterious 'Angel of the Lord', since this anomaly in both the Jewish and Christian religious traditions is usually ignored. Who and what was the 'Angel of the Lord'? This divine entity of the burning bush, who was not 'the Lord' but was someone or something else closely associated with 'the Lord', was known in very ancient Judaism (which testifies to the antiquity of the Moses account, I might add), but had been either forgotten or banished as heretical by the time of the sect of Judaism known as the Sadducees, who were the 'Temple Jews' of the Jerusalem Temple against whom Jesus struggled so energetically.

The Sadducees were a very vicious and murderous ruling theocratic sect. Biblical scholars have discovered that during the lifetime of Jesus, the Sadducees arrested and executed more than 6000 Jewish rabbis of the Pharisee sect, solely because they were rivals for control. The Sadducees were therefore a violent, bloodthirsty mafia using religion as their pretext for control over society. What the Sadducees did to the more mystical Jews such as the Gnostics was probably even worse than the massacres of the Pharisee rabbis, though the numbers of Gnostics within reach of Jerusalem was much smaller. Some of them, the Essenes, had fled to live in caves beside the Dead Sea, in order to avoid being murdered by the Sadducees.

The seizure and execution of Jesus was part of a wider and uniform purge by the Sadducees of all the Jewish rabbis or religious leaders who in any way challenged the Sadducees' monopoly of power. I could elaborate on this subject and explain the real significance of the 'overturning of the tables of the moneychangers in the Temple' by Jesus, but this is not the place to do so, interesting

as the subject is. North of Jerusalem lay the region of the Samaritans, who were a branch of the Jewish people who had escaped the control of the Jerusalem Temple mafia. They preserved some of the more ancient Jewish knowledge and traditions that the Sadducees had thrown overboard. Among these was the tradition and explanation of ‘the Angel of the Lord’.

The Dutch Biblical scholar Jarl Fossum was the first academic who explored in depth this fascinating information, which he articulated in his PhD thesis of 1981 (supervised by the famous Professor Gilles Quispel, one of the world’s leading Biblical scholars) and in the same year in an article in a scholarly anthology, Fossum, Jarl, ‘Samaritan Demiurgical Traditions and the Alleged Dove Cult of the Samaritans’, in Roelof van den Broek and Maarten Jozef Vermaseren (eds.), *Studies in Gnosticism and Hellenistic Religions Presented to Gilles Quispel on the Occasion of His 65th Birthday*, Brill, Leiden, 1981, pp. 143–60.

This was later followed by his book, *The Name of God and the Angel of the Lord: Samaritan and Jewish Concepts of Intermediation and the Origin of Gnosticism*, J.C.B. Mohr, Tübingen, 1985, which was based on his thesis. The ancient Jewish conception preserved by the Samaritans was that ‘the Angel of the Lord’ was the divine entity who actually created the bodies of men, while ‘the Lord’ infused spirits into those bodies. As Fossum puts it: ‘. . . the creation of the body of Adam from the earth is ascribed to the Angel of the Lord, while the infusion of the spirit into this corpus is a work assigned to God . . .’

The Samaritans claimed to know the actual name of the Angel of the Lord, which was Kebala, which means ‘the Secret’. They maintained that it was the Angel Kebala who really resided in the sanctuary of the Temple, not God himself (who remained in Heaven), and that Kebala was the mediator between God and humankind. Moreover, his glowing or burning nature is suggested by the Samaritans calling Kebala ‘the Glory who fills the Tabernacle’, and they say that he also manifested himself as Glory at the door

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of the Tent of Meeting in the passage of Exodus that commences at 21, 42 (ibid., pp. 143, 157–9). The Samaritans claimed that Kebala abided at Bethel, which means ‘House of God’, on top of Mount Gerizim.

I cannot go further into this interesting ancient variation of Judaism, which has been lost now for nearly 2000 years, but I wanted to offer this information to help explain the identity of ‘the Angel of the Lord’ for justly puzzled readers. A few years before Fossum’s important researches into the Samaritans, Alan F. Segal had partially addressed the problem in his fascinating book *Two Powers in Heaven*, in which he speaks of numerous early Jewish sects (when Judaism was not yet forcibly unified by a central theological authority at the central Jerusalem temple), who insisted that God had a divine deputy (a lesser god) who did all his work for him regarding the Earth and humans.

Probably the most frequently occurring name for this entity is Metatron. Segal also quotes numerous rabbinical sources regarding further details of the myth or legend of the ascent of Moses up the mountain. Some of these contain further plasmic details. For instance, there is a strong Jewish tradition that Moses was taken up from the mountain to heaven in a ‘cloud’, and a text known as the *Pesikta Rabbati* (20, 4), says:

‘Then a troop of angels of destruction, strong and mighty, who are set round about the throne of glory, met him. When Moses reached them, they sought to burn him with the breath of their mouths. What did the Holy One, blessed be He, do? He spread something of his own splendour about Moses . . . (this) prove(s), according to Rabbi Nahum, that the Almighty spread about Moses something of the splendour of the presence of God, which is His cloud.’

Alan F. Segal, *Two Powers in Heaven: Early Rabbinic Reports about Christianity and Gnosticism*, Brill, Leiden, 1977, p. 145.

One is tempted to wonder if the ancient Jews somehow realized that the Kordylewski Clouds existed, perhaps as a result of telepathic shamanic journeys. One could even construe these ancient Jewish ideas as suggesting that the Kordylewski Clouds are indeed Metatron. The subject of Metatron, who was traditionally the highest of the angels in both mystical Judaism and Islam, is especially intriguing considering that there was an ancient Jewish tradition that there were two Metatrons. One was called Prince of the Countenance and the other was called Yahoel. And one ancient text says that ‘the Ancient of Days’ mentioned in the Biblical Book of Daniel is really Metatron.

Metatron is also mentioned in the book 3 Enoch, and Enoch was said to be transformed into (or absorbed into) Metatron when he was raised in his ball of fire to the heavens. In that book, Metatron is also said to have seventy names, of which the first and chief was Yahoel (sometimes abbreviated as Yol). The Muslim name of Metatron is Mitatrush, which means ‘the angel of the veil’. In the mystical Jewish book *The Apocalypse of Abraham*, Yahoel is described as ‘the spiritual teacher of the Patriarch’ (Abraham), who taught Abraham the whole of the Torah.

The great scholar Gershom Scholem concludes that Metatron, whose original name was Yahoel, was ‘the highest of all created beings’. The name Yahoel was a ‘mystic name’ according to Scholem and thus had no etymological meaning. The suffix el is, I am told, an honorary termination for the name of any angel, and means ‘lord’, used in the polite sense only, not in the literal sense of ‘the Lord’. As for Yaho (the part of the name that precedes the honorific el), Scholem points out that it is an abbreviation of the name YHWH, i.e., Yahweh, whom we call in English Jehovah. But he stresses that the intention was not that Yahoel was meant to be Jehovah, but that his high status was meant to be signalled by the fact that his mystic name contained the name of the supreme God.

Scholem says that this explains the puzzling passage in the Book of Exodus (XXIII, 20 ff.): ‘Beware of him for my name is in him.’

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And in The Apocalypse of Abraham, Yahoel is quoted as saying to Abraham: ‘I am called Yahoel . . . a power in virtue of the ineffable name that is dwelling in me.’ And Jewish Gnostic literature makes explicit that Yahoel was not Yahweh, but was ‘the lesser Yaho’, (Gerschom Scholem, *Major Trends in Jewish Mysticism*, Schocken Publishing House, Jerusalem, 1941, pp. 66–9). That is essentially the same as saying that he was the Angel of the Lord, who as we know appeared as a glowing ball, so that we may assume that Yahoel was one, too.

This subject could be discussed at very great length indeed, to the great discomfort of ‘normative rabbinical Judaism’, as Gerschom Scholem (whom I was fortunate enough to know) called the dominant Judaism that exists in our contemporary world. The earliest name for God in Judaism appears to have been Elohim, and there is no escaping the embarrassing fact that that name is plural. In other words, there is little indication that the earliest Judaism was monotheistic, and ‘the Angel of the Lord’ was apparently left over from the earliest Judaism and only awkwardly accommodated in orthodoxy.

5. Another translation of these passages may be found in the book *1 Enoch: A New Translation*, by George W.E. Nickelsburg and James C. VanderKam, Fortress Press, Minneapolis, Minnesota, USA, 2004, pp. 34–6.
6. It was G.R.S. Mead who spotted and translated this fragment of a lost work by Damascius, which he found in the tenth-century Byzantine encyclopaedic lexicon named the *Suda*, which until contemporary times was mistakenly called ‘Suidas’. (Refs: p. 194 of Bekker’s edition of 1854, or I. 850 f. of Bernhardt’s edition of 1853.) See G.R.S. Mead, *The Subtle Body*, J.M. Watkins, London, 1919, p. 80 and note. The fragment comes from a lost work entitled *Life of Isidorus*. Isidorus was the husband of Hypatia and friend of Proclus and Marinus. What a pity that work is lost!

Mead’s translation of this passage by Damascius first appeared in the quarterly journal he edited named *The Quest*, Vol. I, No. 4,

July 1910, pp. 708–9, where he inserted some of the Greek words of the text as part of an extended discussion of the terminology used. To discuss the many points arising from all of this would unfortunately be out of place here.

7. Translation by G.R.S. Mead; see Mead, *op. cit.*, p. 88 and note. A more recent translation has also been published since Mead's time; see Philoponus, *On Aristotle's 'On the Soul'*, I, 1, 18. 27–33, translated by Philip J. van der Eijk, *Philoponus on Aristotle's 'On the Soul I.1–2'*, Cornell University Press, Ithaca, New York, USA, 2005, p. 34.

His translation reads: '. . . there is yet another body eternally attached to it [the pneumatic body], which is celestial and therefore eternal, which is called luminous or astral. For as the soul belongs to the cosmic entities, it must have a share assigned to it which it manages, being part of the cosmos; and if it is always in motion and always has to be active, it must have a body eternally attached to it which it will keep alive always; this is why they say the soul always has the luminous body, since this is eternal.' On pp. 123–4, van der Eijk's footnote 183 gives a lengthy historical survey of this concept of a 'radiant' or 'luminous' body, citing Plotinus, Porphyry, Iamblichus, Synesius, Hierocles, Proclus, and numerous modern scholars who have discussed the subject. We do not have space to survey this fascinating subject here.

8. *The Apocalypse of Adam* (the fifth and final tractate from Nag Hammadi Codex Five), edited and translated by George W. MacRae, in *The Coptic Gnostic Library: Nag Hammadi Codices V, 2–5 and V with Papyrus Berolinensis 8502, 1 and 4*, ed. by Douglas M. Parrott, Brill, Leiden, 1979, pp. 151–95. See also Charles W. Hedrick, *The Apocalypse of Adam: A Literary and Source Analysis*, Wipf & Stock Publishers, Eugene, Oregon, USA, 2005, for further background and analysis of this tractate.
9. *Marsanes* (from Nag Hammadi Codex 10), introduced, edited and translated by Birger A. Pearson, in *The Coptic Gnostic Library: Nag Hammadi Codices IX and X*, ed. by Birger A. Pearson, Brill, Leiden, 1981, pp. 229–347.

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10. *The Paraphrase of Shem* (Tractate One of Nag Hammadi Codex Seven), introduced and translated with commentary by Michel Roberge, Brill, Leiden, 2010.
11. *The Apocryphon of John* (from four sources: Nag Hammadi Codices II, 1; III, 1; and IV, 1, as well as Papyrus Berolinensis 8502, 2), edited and translated by Michael Waldstein and Frederik Wisse, Brill, Leiden, 1995. The Noah passage may be found preserved in three slightly varying versions on pp. 162–5, all three of which specifically mention the ‘luminous cloud’.
12. He also postulated the existence of something he called pneuma, which existed and intermingled with things here on earth and was, for instance, present in animal and human sperm. These ideas are expressed in Aristotle’s lengthy zoological works, which few people today ever read. I had to read them all thoroughly because I was asked to do a general review of them for *Nature* some years ago. (Robert Temple, ‘The Roots of Nature’, in *Nature*, Vol. 359, No. 6395, 8 October 1992, pp. 489–90.) This article may be downloaded from my researchgate.net entry. In it, I reconstructed the outline of his ‘lost’ zoological work, *Close Investigations of Things According to Kind* and I also surveyed all of the botanical works of Aristotle’s successor and friend, Theophrastus.

Before writing that article, I read closely every word in translation of Aristotle’s surviving zoological writings and Theophrastus’s botanical writings, all the footnotes, and checked lots of the original text with particular attention to the vocabulary, as I went along, which was an immense task, frankly, but well worth it. I do not believe that many classical scholars have ever done that. As for reading them all the way through in Greek, I have known a few scholars (such as Alan Gotthelf) who did that for the zoological works, but they did not extend their efforts to the botanical works as well.

Pneuma and aithēr were related, but aithēr was the pure form, which was restricted to the higher levels of reality, and pneuma was that lower and distinctly impure form that intermingled with and

helped to animate ordinary matter. Aristotle's concept of pneuma had a big influence on early Church Fathers and Christian theology, helping to inspire the Christian concept of the logos as the 'word of God' and Jesus as the aethēric being who became pneumatic to save us by bringing some of the aithēr down into corrupt matter to infuse it with light. These concepts inspired the Gospel of John in the Bible, and permeated even more thoroughly the ancient Gnostic texts. But these subjects are all another story that we cannot discuss further here.

13. Aristotle also stated that he believed there were exceptions to the parallel postulate in geometry, thus anticipating modern relativity theory. And he discovered the Eustachian tubes in the human ear approximately 1900 years before Bartolomeo Eustachi (1500–1574), to whom the discovery is normally attributed, and after whom they are named. For an account of this, see Robert Temple, 'Aristotle as Anatomist and Dissector: The Marvels of Nature', in *Helix: Amigen's Magazine of Biotechnology*, Vol. II, Issue 2, Bugamor International BV, Almere, Netherlands, 1993, pp. 49–55. The text is Aristotle, *Historia Animalium*, Book One, 502a17–502b27. This article may be downloaded from my Researchgate entry or from my personal website. But enough of Aristotle, that is, if one can have enough of Aristotle.
14. The Chinese texts for these passages, with translations and comments, may be found in Herbert A. Giles, 'The Remains of Lao Tzu', in *The China Review: or, Notes and Queries of the Far East*, China Mail, Hong Kong, Vol. XIV, issue for March and April, 1886, p. 244.
15. Olivia Temple and Robert Temple, *The Sphinx Mystery*, Inner Traditions, Rochester, Vermont, USA, 2009, p. 393.
16. John Coleman Darnell, *The Enigmatic Netherworld Books of the Solar-Osirian Unity*, Academic Press Fribourg, Switzerland, 2004, p. 365, footnote 389.

Chapter 7: Kristian Birkeland's Miraculous Discovery

1. Harald Falck-Ytter, *Aurora: The Northern Lights in Mythology, History and Science*, Bell Pond Books, Hudson, New York, USA, 1999, p. 49. This is the English translation of *Das Polarlicht*, Stuttgart, 1983.
2. Aristotle, *Meteōrologikōn* (*Meteorology*, but often referred to in Latin as the *Meteorologica*), Book One, Chapters 4 and 5, 341b1-342b24. See Aristotle, *Meteorologica*, trans. by H.D.P. Lee, Loeb Classical Library, Harvard University Press, 1952, pp. 28–39.
3. Falck-Ytter, op. cit., p. 45.
4. Aristotle, op. cit., Chapters 3 and 4, 340b25-7 and 341b1-24, pp. 19–23, 29–31 ('We maintain that the celestial region as far down as the moon is occupied by a body which is different from air and from fire . . . what we are accustomed to call fire, though it is not really fire . . . We must suppose therefore that the reason why clouds do not form in the upper region is that it contains not air only but rather a sort of fire . . . immediately beneath the circular celestial motion comes a warm and dry substance which we call fire. We must think of the substance we have just called fire as extending round the outside of the terrestrial sphere like a kind of inflammable material . . .')
5. Heraclitus, *Homeric Problems*, ed. and translated by Donald A. Russell and David Konstan, Brill, Leiden, 2005, Book 23, p. 45.
6. Plutarch, 'Life of Lysander', Chapter 12, in *Plutarch's Lives* (in four vols.), trans. by Aubrey Stewart and George Long, Bohn's Classical Library, George Bell & Sons, London, 1895, Vol. 2, pp. 294–5.
7. Lucius Annaeus Seneca, *Questiones Naturales* (*Natural Questions*), trans. as *Physical Science in the Time of Nero: Being a Translation of the Questiones Naturales of Seneca*, by John Clarke, with Notes by Sir Archibald Geikie, Macmillan and Co., London 1910, pp. 37–41; more recently, Seneca, *Naturales Questiones*, 2 vols., trans. by Thomas H. Corcoran, Loeb Classical Library, Harvard University Press, 1971–2, Vol. I, pp. 73–83.
8. Pliny, *Natural History*, Book Two, Chapter 26 or 27 depending on

the edition. In Bohn's Classical Library, trans. by John Bostock and H.T. Riley, Henry G. Bohn, London, 1855, Vol. 1, pp. 60–1, it is Chapter 27. In the Loeb Classical Library, trans. by H. Rackham, Harvard University Press, Vol. 1, p. 241, it is Chapter 26, which becomes 27 in the middle of a sentence. Puzzled by this, I checked the earliest translation done in Elizabethan times by Philemon Holland, of which I am fortunate to own copies of both the first edition of 1601 and the second edition, which appeared in 1635, and there it is Chapter 27, and the passage is found on p. 17.

Holland's translation reads: 'There appeareth in the Sky also a resemblance of blood, and (than which nothing is more dread and feared of men) a fiery impression, falling from out of heaven to earth, like as it hapned in the 3 yeare of the 107 Olympiad, at what time King Philip made all Greece to shake with fire and sword.' The Bohn's translation reads: 'There is a flame of a bloody appearance (and nothing is more dreaded by mortals) which falls down upon the earth, such as was seen in the third year of the 103rd Olympiad, when King Philip was disturbing Greece.' The Loeb translation says: 'There also occurs a yawning of the actual sky, called *chasma*, and also something that looks like blood, and a fire that falls from it to the earth – the most alarming possible cause of terror to mankind; as happened in the third year of the 107th Olympiad, when King Philip was throwing Greece into disturbance.'

9. Falck-Ytter, op. cit., pp. 54–5.
10. Jean-Jacques d'Ortous de Mairan, *Traité Physique et Historique de l'Aurore Boreale (Physical and Historical Treatise concerning the Aurora Borealis)*, Pierre Mortier, Amsterdam, 1735, 393 pp., with 17 folding plates. On the title page it is stated that the book is composed of a 'suite' of papers delivered to the Académie Royale des Sciences (in Paris) in 1731. I have an original copy of this book.
11. I have a copy also of this German edition, which appears in Wolf Balthazar Adolph von Steinwehr (1704–1771), translator and editor (with some commentary), Vol. 9 of *Der Königliche Academie der Wissenschaften in Paris Physiche Abhandlungen . . . welcher die*

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Jahre 1731, 1732, in sich hält, Breslau, 1753. (Please note that Wikipedia is incorrect in listing the year 1760 as publication date for this volume, though it may have been reprinted then perhaps.) The de Mairan material extends from p. 248 to p. 564. De Mairan is called von Mairan in this volume.

The Aurora Borealis in German is called *die Nordlichtern* (the Northern Lights). Only 9 of the 17 plates that appear in the 1735 French volume are found in this German edition. This series of volumes in German is essentially a translation of the Proceedings of the Royal Academy of Sciences in Paris. It should be noted that the 1731 publication by the Academy in Paris was used for the translation, and not the 1735 book, which may have been expanded and provided with additional illustrations. I have not compared the 1731 publications with the 1735 volume, so cannot state anything authoritatively about variations in the texts.

12. Knud Leem, *Beskrivelse over Finmarkens Lapper (An Account of the Lapps of Finmarken)*, Copenhagen, 1767. A reproduction of Leem's engraving was published by Lemström, Vol. 1, p. 238, and is reproduced from that on this book's website. For Lemström, see footnote 17 below.
13. Sir Humphry Davy, 'Of Electrical Attraction and Repulsion, and Their Relations to Chemical Changes', in *Elements of Chemical Philosophy*, London, 1812.
14. Baron Karl von Reichenbach, *Researches on Magnetism, Electricity, Heat, Light, Crystallization, and Chemical Attraction in Their Relation to the Vital Force*, translated and edited by William Gregory, Parts I and II, London, 1850, p. 5.
15. *Ibid.*, pp. 445–51.
16. Arthur-August De La Rive, 'Nouvelles Recherches sur les Aurores Boréales et Australes et Description d'un Appareil', *Extrait des Mémoires de la Société de Physique et d'Histoire Naturelle de Genève*, Vol. 16, 2nd Part, Geneva, 1862.
17. Karl Selim Lemström, 'On the Periodic Variations in Some Meteorological Phenomena, Their Connection with the Changes of

- the Solar Surface and Their Probable Influence on the Vegetation’, in *Finsk Tidkrift*, 1878. This article is in Swedish.
18. Sophus Tromholt, *Under the Rays of the Aurora Borealis in the Land of the Lapps and Kvaens*, edited by Carl Siewers, 2 vols., Houghton Mifflin, Cambridge, Massachusetts, USA, 1885. The section entitled ‘On the Aurora Borealis’ is found in Vol. 1, pp. 192–288, with numerous illustrations.
 19. Adam F.W. Paulsen, *Résumé des Travaux de l’Expédition Internationale Danoise Faits a Godthaab (Groënland Occidental) 1er Aout 1882–31 Aout 1883* [1 August 1882–31 August 1883], Danish Meteorological Institute, Copenhagen, 1884.
 20. Nils Adolf-Erik Nordenskiöld, ‘Sur les Aurores Boréales Observées Pendant l’Hivernage de la Véga au Détroit de Behring (1878–9)’, in *Annales de Chimie et de Physique (Annals of Chemistry and Physics)*, Sixth Series, Vol. 1, Paris, January 1884, pp. 5–72. His earlier publication in Swedish was ‘Om Norrskeneen under Vegas Öfvervintring vid Berings Sund (1878–9) af A.-E. Nordenskiöld’: extracted from *Vega-expeditionens Vetenskapliga Iakttagelser*, pp. 403–53 of Vol. 1, Stockholm, 1882. Nordenskiöld published a mammoth account of the Vega Expedition in 5 volumes, as well as a popular summary in 2 volumes, but these extracts related to the Aurora Borealis, as they appeared first in the original Swedish and then in the French translation.
 21. Kristian Birkeland, in *Archives des Sciences Physiques et Naturelles (Archives of the Physical and Natural Sciences)*, Geneva, June 1896 (in French). Perhaps Birkeland chose this journal because in its earlier incarnation it had published de la Rive’s account of the aurorae in 1862, thirty-four years before; see footnote 16 above.
 22. Kristian Birkeland, *Expédition Norvegienne 1899–1900 pour l’Étude des Aurores Boreales Resultats des Recherches Magnetiques* [*sic.* some acute accents omitted from title as printed], Jacob Dybwad, Christiania [now called Oslo], Norway, 1901. See p. 39, where in a footnote Birkeland refers to the article published by himself in the *Archives des Sciences Physiques et Naturelles* (see footnote 16 above).

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I have not found or consulted the original article and do not have its title and pagination.

23. Alv Egeland and William J. Burke, *Kristian Birkeland, The First Space Scientist*, Astrophysics and Space Science Library 325, Springer Verlag, 2005.
24. Lucy Jago, *The Northern Lights*, Penguin Books, London, 2001.
25. Kristian Birkeland, *The Norwegian Aurora Polaris Expedition 1902–1903*, 2 vols., Christiania [now Oslo], Vol. 1, 1908, and Vol. 2, 1913.
26. Alexander Piel, *Plasma Physics: An Introduction to Laboratory, Space, and Fusion Plasmas*, Springer Verlag, Heidelberg and Dordrecht, 2010, p. 7.
27. Kristian Birkeland, *Norwegian Aurora Polaris Expedition 1902–1903*, 2 vols., Christiania [now Oslo], Vol. 1 and Vol. 2, 1908, 1913.

Chapter 8: The Cosmic Web

1. I should point out that all power transmission lines on Earth are double, either in the form of a ‘two-wire line’ or a single wire inside a tube, which is known as a coaxial cable. (Transmission lines can of course be multiple, but they must at the very least be double.)
2. John P. Cullerne and Anton Machacek, *The Language of Physics: A Foundation for University Study*, Oxford University Press, 2008, p. 51.
3. This reminds me of the Berry Phase in physics, named after Michael Berry, a professor at Bristol University. He showed that if you mathematically transport a vector (the technical name for a line in a diagram showing the direction of a certain force, and which can actually be drawn with an arrow showing that direction) along the surface of a sphere from point A to point B, by the time it gets there it is not straight any more but is at a slight angle, because its path has curved due to moving along the spherical surface. (Berry’s student John Hannay demonstrated that this is true in classical physics as well as in quantum physics, and the angle is named after him as the Hannay Angle.) I mention this because if we consider the spiralling aspect of the electric field, introducing as it does a

curved path rather than a straight one, perhaps the introduction of that curvature causes the small deflected angle of the Hall Effect to appear, and the angle of the Hall Effect is therefore related to the Hannay Angle because of the curvature.

4. Anthony L. Peratt, *Physics of the Plasma Universe*, 2nd edition, 2015, p. 373.

Chapter 9: The Cold Sun

1. Lang, Kenneth R., *The Cambridge Encyclopaedia of the Sun*, Cambridge University Press, 2001, p. 111.
2. Arthur J. Hundhausen, 'Plasma Flow from the Sun', in Oran R. White (ed.), *The Solar Output and Its Variation*, Colorado Associated University Press, Boulder, Colorado, USA, 1977, pp. 36–9.

Chapter 10: Invisible Earth

1. Thomas Gold, *The Deep Hot Biosphere*, Copernicus, Springer Verlag, New York, 1999. He did not remain connected with plasma research, however, as he had other interests such as cosmology and, towards the end of his life, deep carbon stores beneath the surface of the Earth. Tommy was also a founder, with Fred Hoyle and Hermann Bondi, of the steady state theory of the Universe, which neither he nor Fred (whom I also knew well) ever abandoned, though of course they held to it in a modified form to take account of the many objections made against it by cosmologists determined to believe in what Fred had derisively named 'the Big Bang', a name that has stuck and unfortunately is still taken seriously, along with the ridiculous theory to which it is attached.

In 2017, I published a paper proposing an alternative explanation of what is known as 'the cosmic microwave background radiation temperature', the primary basis for the Big Bang Theory. Robert Temple, 'A New Explanation for the Cosmic Microwave Background Radiation Temperature', in *Journal of Cosmology*, Vol. 26, No. 11, 2017, pp. 14790–803.

Chapter 11: Radiant Matter, Plasma and Plasmoids

1. Winston Harper Bostick, 'Experimental Study of Ionized Matter Projected across a Magnetic Field', *Physical Review*, Vol. 104, No. 2, 15 October 1956, pp. 292–9, plus seven pages of captioned plates.
2. Robert Temple, 'Is Particle Mass a Function of Degrees of Freedom?', in *Journal of Cosmology*, Vol. 26, No. 3, January 2016, pp. 13995–14090; see p. 66 of the paper.
3. E.G. Harris, R.B. Theus, and Winston Harper Bostick, 'Experimental Investigations of the Motion of Plasma Projected from a Button Source across Magnetic Field', *Physical Review*, Vol. 105, No. 1, 1 January 1957, pp. 46–50.
4. Winston Harper Bostick and Lyman Spitzer, *Plasma Physics: Selected Reprints*, American Association of Physics Teachers, 1963.
5. Winston Harper Bostick, 'Plasmoids', in *Scientific American*, Vol. 197, No. 4, October 1957, pp. 87–94.
6. Winston Harper Bostick, 'Experimental Study of Plasmoids', in Bo Lehnert (ed.), *Electromagnetic Phenomena in Cosmical Physics*, Proceedings of the International Astronomical Union Symposium No. 6, held in Stockholm, August 1956, Cambridge University Press, 1958, pp. 86–98 (includes one and a half pages of discussion at the end, including further elucidations by Bostick).

Chapter 12: Plasma Comes Alive

1. Kaushik Roy and Prasanta Chatterjee, *Nonlinear Structures in Dusty Plasma*, Lambert Academic Publishing, Saarbrücken, Germany, 2012, p. 2.
2. I have discussed the Kelvin Scale at some length in my scientific paper of 2017 about the cosmic background radiation: Robert Temple, 'A New Explanation for the Cosmic Microwave Background Radiation Temperature', in *Journal of Cosmology*, Vol. 26, No. 11, 2017, pp. 14790–803.
3. Mazuo Minami, Chikara Kojima, Takeo Ohira, and Osamu Ishihara, 'Microwave Measurement of Decaying Plasma in Liquid

Helium’, Appendix One to Osamu Ishihara, ‘Final Report on Study of Cryogenic Plasma in Superfluid Liquid Helium’, submitted to AOARD 23 August 2005, declassified by the US Department of Defense. The Appendix was released for publication in *Transactions on Plasma Science of the IEEE*, August 2005 (8 pp.)

4. Ibid., p. 4.
5. Norman R. Bergrun, *Ringmakers of Saturn*, Pentland Press, Edinburgh, 1986. The late Norman Bergrun was a scientist who had an entirely different explanation for the ‘spokes’. In 1986, he published his book *Ringmakers of Saturn*, which suggested that not only the spokes of Ring B but the whole of Ring A of Saturn were being artificially created by mysterious cylindrical craft of extraterrestrial origin, possibly manned by intelligent robots. Both in his book and in many later talks, some of which can readily be found on the internet, Bergrun has shown photographs of strange cylinders of enormous size orbiting Saturn, which are spewing out what he calls ‘streamers’. He claims that these are plasma streamers, although he does not appear to have any idea as to why this is being done.

His idea of strange cylindrical craft emitting streamers of plasma arose from a chance personal observation that he made of such a craft in the atmosphere off the coast of California in September 1971, which was also viewed by his wife from a separate location. By triangulating their observations, he and his wife were able to place the ‘UFO’ at a distance of sixty miles off the coast of Monterey Bay. Bergrun calls these craft ‘EMVs’, for electromagnetic vehicles. Although this all sounds very fanciful, I was told in 2015 by a friend who knows top scientists and officials at DARPA, the Defence Advanced Research Projects Agency of the US Government (by far the most advanced ‘weird science’ organization or agency in America, which developed stealth aircraft, among other things), that the DARPA people not only know of but accept and worry about the intrusive cylindrical craft, which they accept are ‘not of this Earth’.

They may come from ‘another world’ ‘another dimension’, ‘the future’, or whatever you like, but they do not come from any human

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civilization of the present day. Some of the cylindrical craft can be of such enormous size that no contemporary civilization on Earth would be capable of constructing anything so huge, even if it were sitting on the ground. It is apparently known and accepted by the scientists at DARPA that these craft have intimate connections with a highly advanced plasma science that is far beyond our present understanding or capacities. Apparently they also believe that they are not manned by living beings, but by hyper-intelligent robots that come from ‘somewhere else’, but no one knows where.

No living entities could accomplish these feats, as the gigantic tasks involved could only be undertaken by robots over extremely long periods of time, far exceeding any conceivable human or other organic lifespans. Just in case anybody thinks that constructing spaceships by robots is far-fetched, I can point out that we humans are already doing it. The London *Sunday Times* published on 15 August 2021 (page 9 in the ‘Money’ section) an article entitled ‘Backing the spaceships being built by robots’, which reported that the American company Relativity Space is building ‘its “Stargate” factory (which) will build rockets through 3D printing’ and assemble by robots the more than 100,000 parts that must go into each spaceship.

I mention all of this about Bergrun’s ideas in passing without personal comment, because it is not the subject of this book. However, it appears that the urgent impetus behind much of the advanced plasma research going on at the moment comes from DARPA, who are desperate to try to understand the intruders. (Another reason is that stealth aircraft can be much improved if Bose-Einstein condensate technology can be mastered for the exterior skins of the planes. That relies upon extraordinary discoveries which have been made since 2010. Although this relates to our subject, it has been necessary to remove my account of it from the book for reasons of space. The technology is named after Satyendra Nath Bose (an Indian) and Albert Einstein. Information about its basic principles can be found on the web.)

6. Douglas C.B. Whittet, *Dust in the Galactic Environment*, Institute of Physics Publishing, Bristol, Philadelphia and New York, 1992, pp. 1–2.
7. Vadim Nikolaevich Tsytovich, Gregor Eugen Morfill, Vladimir E. [Yevgenyevich] Fortov, N.G. Husein-Zade, Boris Aleksandrovich Klumov, and Sergey Vladimirovich Vladimirov, ‘From Plasma Crystals and Helical Structures towards Inorganic Living Matter’, in *New Journal of Physics*, Vol. 9, 2007, pp. 263 ff.
8. Dietmar Block and André Melzer, ‘Imaging Diagnosis in Dusty Plasmas’, in Michael Bonitz, Norman Horing, and Patrick Ludwig (eds.), *Introduction to Complex Plasmas*, Springer, Berlin, 2010, p. 136.
9. Fred Hoyle, *The Black Cloud*, Heinemann, London, 1957. This novel concerns a large black cloud in outer space, which possesses a high degree of intelligence. This science fiction novel caused a considerable sensation with the public when it was published, and established Fred Hoyle as one of the world’s major science fiction authors. Such was the popular clamour for more such intelligent science fiction from Hoyle that he was approached by the BBC and, with the BBC producer John Elliot, wrote a famous TV drama series called *A for Andromeda*, broadcast in 1961, which was followed by *The Andromeda Breakthrough* in 1962. These caught the popular imagination, and people still talk about them all these many decades later. *A for Andromeda* was made into a feature film in 2006. *The Black Cloud* has never been filmed.

Chapter 13: The Mysterious Case of the Dirty Gas

1. The first one I saw (unsigned) was in the London *Daily Telegraph*, 23 September 2015, and was entitled ‘Why We Are All Under a Cloud (of Germs, That Is)’. On the same day, the BBC News website carried an article by James Gallagher, the BBC’s Health Editor, entitled ‘Everyone Has a “Microbial Cloud”’. Gallagher speculated: ‘So should we all take extra showers?’ But a British bacteriologist whom he consulted told him ‘It wouldn’t help.’ Adam Altricher, a

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researcher working with Meadow, told him on the phone: ‘We need to understand that we’re not sterile and this is something completely natural and healthy.’

2. James Meadow, Adam E. Altrichter, Ashley C. Bateman, Jason Stenson, G.Z. Brown, Jessica L. Green, and Brendan J.M. Bohannon, ‘Humans Differ in Their Personal Microbial Cloud’, *PeerJ*, 22 September 2015, at <https://doi.org> (the International DOI Federation, or IDF).
3. Gregor Morfill, Yuri Baturin, and Vladimir Fortov, *Plasma Research at the Limit: From the International Space Station to Applications on Earth*, Imperial College Press, London, London, 2013, pp. 231–2.
4. G.M. Baule and R. McFee, ‘Detection of the Magnetic Field of the Heart’, in *American Heart Journal*, Vol. 66, 1963, pp. 95–6. This was followed two years later by their paper ‘Theory of Magnetic Detection of the Heart’s Electrical Activity’, in the *Journal of Applied Physics*, Vol. 36, 1965, pp. 2066–73.
5. David B. Geselowitz, ‘On the Magnetic Field Generated Outside an Inhomogenous Volume Conductor by Internal Current Sources’ in *Transactions of the IEEE Magazine*, MAG-6, 1970, pp. 346–7.
6. David B. Geselowitz, ‘Model Studies of Electric and Magnetic Fields of the Heart’, in *Journal of the Franklin Institute*, Vol. 296, No. 6, December 1973, pp. 379–91. He then went on to become a world expert on this subject.
7. Freeman Widener Cope, ‘Activation Energies of Acceleration and Hypoxia Stress’, Report No. 5 for the Bureau of Medicine and Surgery, Naval Air Development Center, Aerospace Medical Research Department, 2 July 1970, declassified sometime subsequent to 1979.
8. W. Edward Mann, *Orgone, Reich & Eros: Wilhelm Reich’s Theory of Life Energy*, Simon and Schuster, New York, 1973, pp. 38–9.
9. David Talbot, *The Devil’s Chessboard: Allen Dulles, the CIA, and the Rise of America’s Secret Government*, Harper Collins,

London, 2015, p. 56. So eager was Dulles to reach an accommodation with the Nazis before the Second World War ended that he initiated his own secret peace plan entitled Operation Sunrise, falsely claiming that he was a personal representative and close friend of President Roosevelt. In pursuit of his plan, he secretly negotiated a peace deal, entirely without authority, with SS General Karl Wolff, who had previously been Himmler's Chief of Staff (Himmler was so fond of Wolff that he called him 'Wolffie').

Wolffie was also popular with Hitler, was the principal liaison between Hitler and Himmler, and was always welcome at Hitler's dinner parties. The Nazi High Command used to cite Wolffie as 'the ideal Aryan'. As an old man, Wolffie recalled: 'Hitler wanted to have me nearby, because he knew that he could rely on me completely. He had known me for a long time, and rather well.' Despite being directly ordered by President Roosevelt not to negotiate with Wolffie, Dulles continued his own private American foreign policy by plotting a deal with Wolffie. Wolffie was in fact negotiating a potential deal on behalf of his boss Himmler. The plan of Dulles failed, but then, as they were such chums, Dulles went on to save Wolffie's life. The sleazy details of this treasonous tale have been discovered by Talbot. See Chapter 4, 'Sunrise', commencing on p. 74.

10. Adam Lebor, *Tower of Basel: The Shadowy History of the Secret Bank That Runs the World*, Public Affairs, New York, 2013, passim. (See the Index for Allen Dulles, his equally pro-Nazi brother John Foster Dulles, and McKittrick.)
11. Talbot, op. cit., pp. 17, 617.
12. Wilhelm Reich, *The Mass Psychology of Fascism* (translation from the manuscript of the third enlarged edition of *Die Massenpsychologie des Fascismus*), Orgone Institute Press, Inc., New York, New York, 1946, p. 31. (The first edition of this book in German was published in 1933, the second edition in 1934. The third enlarged edition existed in German only in manuscript, and fortunately it was translated by Reich and published in English

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- before the FBI could burn it! Presumably, however, the original German manuscript of the third edition, never published in German, was destroyed or seized by the FBI, which must have delighted America's imported Nazis.)
13. I once asked a man the first name of one of his former colleagues with whom he had jointly written a now declassified article. That is because for my bibliographies I don't like using first initials, but always like to know the first names of scientists. He denied ever knowing him, despite the fact that I have a copy of an article describing their joint work together. That shows you the fear scientists have, which is so great that they dare not admit that they have even met the people with whom they worked for years.
 14. Freeman Widener Cope, 'Man in a Gas of Tachyon Magneto-electric Dipoles – A New Hypothesis', Parts 1, 2, 3, and 4, appearing sequentially in *Physiological Chemistry & Physics*, Vols. 10 and 11 for 1978 and 1979. Part 1 is Vol. 10, 1978, pp. 535–40; Part 2 is Vol. 10, 1978, pp. 541–5; Part 3 is Vol. 10, 1978, pp. 547–55; Part 4 is Vol. 11, 1979, pp. 87–91. Cope's fifth article was separate and entitled 'Delocalized Clouds (Wavefunctions) of Polymerized Tachyon Magnetolectric Monopoles', in the same journal, Vol. 11, 1979, pp. 175–9. It does not appear that he published anything further on the subject, and he died young in 1983. In the notes I shall refer to Cope, Parts 1 to 5. This quotation is from Part 1, p. 535.
 15. Baron (*Freiherr*) Karl von Reichenbach, *Researches on Magnetism, Electricity, Heat, Light, Crystallization, and Chemical Attraction in Their Relations to The Vital Force*, Parts I and II (including the second edition of the First Part, corrected and improved), edited and translated with a preface, notes, and appendix by William Gregory, Taylor, Walton and Maberly, London, 1850.
 16. Another strange cosmic force of 'vital magnetism' was proposed in 1871 by the supernatural novelist Edward Bulwer-Lytton, in his novel *The Coming Race*, though Cope does not mention this. Bulwer-Lytton appears to have taken his idea of vril from Reichenbach's odic force. Strangely enough, some of the occult Nazis seriously

believed in the actual existence of vril, despite its having appeared in an admitted work of fiction. They apparently believed that Bulwer-Lytton knew of its true existence and revealed it in intentionally disguised form by proposing it within the context of a novel.

17. Cope, Part 3, op. cit., p. 547.
18. Paul Dirac, 'Quantized Singularities in the Electromagnetic Field' in: *Proceedings of the Royal Society of London, Series A*, Vol. CXXXIII, London, October 1931, pp. 60–72. On page 71 of this paper, Dirac says: 'The object of this paper is to show that quantum mechanics does not really preclude the existence of isolated magnetic poles. On the contrary, the present formalism of quantum mechanics, when developed naturally without the imposition of arbitrary restrictions, leads inevitably to wave equations whose only physical interpretation is the motion of an electron in the field of a single [magnetic] pole.'
19. Dirac expanded and refined these ideas seventeen years later in 1948: Paul Dirac, 'The Theory of Magnetic Poles' in: *The Physical Review*, Second Series, Vol. 74, No. 7, 1 October 1948, pp. 817–30. In this paper, Dirac more emphatically than ever suggested that magnetic monopoles must exist. In the various discussions of magnetic monopoles that I have encountered, Dirac's paper of 1931 tends to be cited, but I do not recall anyone citing his follow-up paper of 1948, which expands the theory considerably. (Perhaps Lochak mentioned it, although I do not recall that.)

In the 1948 paper, of which I have an original copy, Dirac says: 'In 1931 I gave a primitive theory which described the action of a pole in the field of a charged particle whose motion is given, or the motion of a charged particle in the field of a pole whose motion is given. The present paper sets up a general theory of charged particles and poles in interaction through the medium of the electromagnetic field. The idea which makes this generalization possible consists in supposing each pole to be at the end of an unobservable string, which is the line along which the electromagnetic potentials

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are singular, and introducing dynamic coordinates and momenta to describe the motion of the strings. The whole theory then comes out by the application of standard methods . . . The theory developed in the present paper is essentially symmetrical between electric charges and magnetic poles.’

This brilliant paper by Dirac seems largely to have escaped notice by his fellow physicists. Dirac’s idea of a ‘string’ is also very suggestive. My own instinct is not to think of the string as being straight, but on the contrary that it must exist either in helical form or in toroidal form (i.e., existing on one or other of the two circularities of a toroidal surface, unless linking the two). In fact, to say that a particle is a ‘string’ is effectively to say that it is a filament. And filaments like to spiral helically. And because they also like to spiral as double-helices, this might apply to those paired electrons known as ‘Cooper Pairs’, which are discussed later. These matters require deeper consideration than an aside in a footnote, however.

20. Georges Lochak, Harald Stumpf, and Peter W. Hawkes, *Advances in Imaging and Electron Physics: The Leptonic Magnetic Monopole: Theory and Experiments*, Elsevier, Amsterdam, 2015.
21. Ritika Dusat, Franziska K.K. Kirschner, Jesse C. Hoke, et al., ‘Magnetic Monopole Noise’, in *Nature*, Vol. 571, No. 7764, 11 July 2019, pp. 234–9.
22. Ibid.
23. Ibid., p. 553.
24. Herbert Charles Corben, *Classical and Quantum Theories of Spinning Particles*, Holden-Day, San Francisco, 1968.
25. Herbert Charles Corben, ‘Electromagnetic and Hadronic Properties of Tachyons’, in Hugo E. Hernández-Figueroa, Michel Zamboni-Rached, and Erasmo Recami (eds.), *Localized Waves*, Wiley-Interscience, John Wiley & Sons, Hoboken, New Jersey, 2008, pp. 31–41.
26. Cope, Part 3, op. cit., p. 553.
27. Cope, Part 5, op. cit.
28. Dominic J. Clarke, Heather M. Whitney, Gregory P. Sutton,

and Daniel Robert, 'Detection and Learning of Floral Electric Fields by Bumblebees', in *Science*, Vol. 340, Issue 6128, 5 April 2013, pp. 66–9. And also: Gregory P. Sutton, Dominic J. Clarke, Erica L. Morley, and Daniel Robert, 'Mechanosensory Hairs in Bumblebees (*Bombus terrestris*) Detect Weak Electric Fields', in *Proceedings of the National Academy of Sciences*, Early Edition, 2016, 9 pages. Press reports on the latter appeared on 31 May 2016 in the *London Daily Telegraph*, p. 10, the *London Daily Mail*, p. 3., and the *London Times*, p. 21.

Chapter 14: Electric People

1. Robert Temple, 'David Bohm', *The New Scientist Interview*, *New Scientist*, 11 November 1982, pp. 361–5.
2. Richard P. Feynman, *The Character of Physical Law*, M.I.T. Press, Cambridge, Massachusetts, 1965. (This book is the transcription of a series of lectures given by Feynman at Cornell University, which were recorded by the BBC.) I do not have a page number for this quote, as I found it given by Chris Philippidis, Christopher Dewdney, and Basil J. Hiley, in their paper 'Quantum Interference and the Quantum Potential', in *Il Nuovo Cimento*, Vol. 52 B, N. 1, 11 July 1979, p. 15, where in their footnote they omit the page number for Feynman.
3. Richard Feynman, *QED: The Strange Theory of Light and Matter*, Penguin Books, London, 1985, pp. 150–2.
4. Ilya Prigogine, *Is Future Given?*, World Scientific Press, Singapore, 2003, pp. 66–75.
5. Albert Szent-Györgyi, *Electronic Biology and Cancer: A New Theory of Cancer*, Marcel Dekker, Inc., New York and Basel, 1976, pp. 18–19.
6. Albert Szent-Györgyi, *Bioenergetics*, Academic Press, New York, 1957, *passim*: The energy of the photon absorbed by the protein has to travel first through the protein molecule . . . (and) is emitted as fluorescent light . . . Molecules send us messages through photons . . . The biological energy unit . . . (has a) wavelength

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(which) corresponds to the near infrared. It is thus this spectral region which will have the greatest direct interest for the biologists . . . Electronic excitations give us valuable information about properties and reactions of molecules . . . One of the main functions of protoplasmic structures may be to generate in water those specific structures which make forms of electronic excitations and energy transmissions possible which would be improbable outside these structures. The solid matter and the water of the cell form together that unique system which has the queer property of being alive.

7. Albert Szent-Györgyi, *Bioelectronics: A Study in Cellular Regulations, Defense, and Cancer*, Academic Press, New York, 1968, p. vii.
8. *Ibid.*, p. 21.
9. Albert Szent-Györgyi, *The Living State: With Observations on Cancer*, Academic Press, New York, 1972.
10. Andrew Marino, *Going Somewhere: Truth About a Life in Science*, Cassandra Publishing, Belcher, Louisiana, USA, 2010, pp. 337–9, and see also pp. 341–2.
11. Percy W. Bridgman, *The Physics of High Pressure*, G. Bell and Sons, London, 1949, pp. 190, 208–9.
12. C. Lobban, J.L. Finney, and Werner F. Kuhs, ‘The Structure of a New Phase of Ice’, *Nature*, Vol. 391, 15 January 1998, pp. 268–70.
13. *Bioenergetics*, op. cit., pp. 34–9.
14. Freeman W. Cope, ‘Evidence from Activation Energies for Superconductive Tunneling in Biological Systems at Physiological Temperatures’, in *Physiological Chemistry & Physics*, 3, 1971, p. 403.
15. William A. Little, ‘Possibility of Synthesizing an Organic Superconductor’, in *Physical Review*, Vol. 1234, No. 6A, 14 June 1964, pp. A1416–24.
16. János Ladik and Géza Biczó, ‘A Note on F.W. Cope’s Paper “Evidence from Activation Energies for Superconductive Tunneling in Biological Systems at Physiological Temperatures”’, in *Physiological Chemistry & Physics*, 4, 1972, pp. 495–6.

17. Freeman W. Cope, 'Biological Sensitivity to Weak Magnetic Fields Due to Biological Superconductive Josephson Junctions', in *Physiological Chemistry & Physics*, 5, 1973, pp. 173–6.
18. J.P. Marton, 'Conjectures on Superconductivity and Cancer', in *Physiological Chemistry & Physics*, 5, 1973, pp. 259–70.
19. Solomon Goldfein, 'Some Evidence for High-Temperature Superconduction in Cholates', in *Physiological Chemistry & Physics*, 6, 1974, pp. 261–9.
20. K. Antonowicz, 'Possible Superconductivity at Room Temperature', in *Nature*, Vol. 247, No. 14, 8 February 1974, pp. 358–60.
21. Freeman W. Cope, 'Superconductive Josephson Junctions – A Possible Mechanism for Detection of Weak Magnetic Fields and of Microwaves by Living Organisms' (abstract only printed) in Tom S. Tenforde (ed.), *Magnetic Field Effect on Biological Systems* (Proceedings of the Biomagnetic Effects Workshop, 1978) Plenum Press, New York, 1979, p. 87.
22. Emilio Del Giudice, Silvia Doglia, Marziale Milani, Cyril W. Smith, and Giuseppe Vitiello, 'Magnetic Flux Quantization and Josephson Behaviour in Living Systems', in *Physica Scripta*, Vol. 40, 1989, pp. 786–91.
23. Vladimir Z. Kresin and William A. Little (eds.), *Organic Superconductivity*, Plenum Press, New York, 1990.
24. *Ibid.*, p. 18, in a paper by A.M. Hermann, H. Duan, W. Kiehl and D. Weeks entitled 'Thallium-Based Copper Oxide Superconductors'.

Chapter 15: How Our Bodies Emit Light

1. Roeland van Wijk, *Light in Shaping Life: Biophotons in Biology and Medicine*, Meluna, Geldermalsen, The Netherlands, 2014, p. 355.
2. It is for this reason that I have registered a website to preserve as much as possible of the scientific papers in all languages on the subject, and thousands of pages have already been scanned and turned into pdfs for download. All the publications in German and

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Russian, as well as the working notebooks, of Alexandr Gurvich (discoverer of biophotons) will be available for public download, because they are out of copyright. However, most of the material will only be accessible to a closed registered group because of copyright complications involving journals and publishers. But at least the archives will be preserved for posterity in this way. The most helpful person in making material available has been my friend Marco Bischof, whose enthusiasm is exceeded only by his profound knowledge.

3. Van Wijk, *op. cit.*
4. Vladimir Leonidevich Voiekov and Lev Vladimirovich Belousov, 'From Mitogenetic Rays to Biophotons', in Lev Vladimirovich Belousov, Vladimir L. Voiekov, and Victor Semenovich Martynyuk (eds.), *Biophotonics and Coherent Systems in Biology*, Springer Verlag, New York, 2007, pp. 1–16.
5. Strange and somewhat embarrassing support came from one of Himmler's S.S. researchers, Otto Rahn (1904–1939). Anyone interested in the bizarre career of Rahn can read about it on Wikipedia, but Wikipedia does not mention the important book by Rahn relating to biophotons, *Invisible Radiations of Organisms* (Berlin, 1936, reprinted 1944), which suggested that aging was due to the slowing and cessation of the emission of ultra-violet radiation within the body, a dubious idea. Rahn also pointed out, however, that the healing of wounds took place because of UV (ultra-violet) emissions, and that irregularities of these emissions were implicated in cancer (which we now know to be true). Rahn tried to leave the employ of Himmler, and was apparently murdered in consequence. Many of his publications were cranky, and it is thus ironical that no attention has been called to the one that was actually useful.
6. Joseph Needham, *Chemical Embryology*, Cambridge University Press, 1950.
7. Changlin Zhang, Fritz-Albert Popp, and Marco Bischof (eds.), *Current Development of Biophysics – The Stage from an Ugly Duckling to a Beautiful Swan*, Hangzhou University Press, China,

no date, but 1996. (The poetic nature of the title was thought of by Zhang Changlin, who is that rare thing, a dreamy and poetic person who is also a scientist. He was based at that time in the College of Life Sciences of Hangzhou University, but today lives in the West.)

8. Kilmister, Clive W., *Disequilibrium and Self-Organisation*, D. Reidel, Kluwer, Dordrecht, 1986; Popp, Fritz-Albert, Warnke, Ulrich, König, Herbert L., and Peschka, Walter (eds.), *Electromagnetic Bio-Information*, Urban & Schwarzenberg, Munich, 2nd edition, 1989;

Jeżowska-Trzebiatowska, Bogusława, Kochel, Bonawentura, Sławiński, Janusz, and Stręk, Wiesław (eds.), *Photon Emission from Biological Systems, Proceedings of the First International Symposium, Wrocław, Poland, January 24–26, 1986*, World Scientific, Singapore, 1987;

Popp, Fritz-Albert, Li, Ke-hsueh [‘K.H.’], and Gu, Qiao (eds.), *Recent Advances in Biophoton Research and Its Applications*, World Scientific, Singapore, 1992;

Belousov, Lev Vladimirovich, and Popp, Fritz-Albert (eds.), *Biophotonics: Non-equilibrium and Coherent Systems in Biology, Biophysics and Biotechnology*, Proceedings of International Conference Dedicated to the 120th Birthday of Alexander Gavrilovich Gurwitsch (1874–1954), 28 September– 2 October 1994, Moscow, Bioinform Services Co., Russia, 1995;

Zhang, Popp, and Bischof (eds.): see preceding footnote; Chang, Jiin-Ju, Joachim Fisch, and Fritz-Albert Popp (eds.), *Biophotons*, Kluwer Academic Publishers, Dordrecht, 1998; Fritz-Albert Popp, and Lev Vladimirovich Belousov (eds.), *Integrative Biophysics: Biophotonics*, Kluwer Academic Publishers, 2003; Shen, Xun, and Roeland van Wijk (eds.), *Biophotonics: Optical Science and Engineering for the 21st Century*, Springer Science and Business Media Inc., New York, 2005;

Francesco Musumeci, Larissa S. Brizhik, and Ho, Mae-Wan (eds.), *Energy and Information Transfer in Biological Systems: How*

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- Physics Could Enrich Biological Understanding*, Proceedings of the International Workshop, Acireale, Catania, Italy, 18–22 September 2002, World Scientific, New Jersey, Singapore, and London, 2003; Lev Vladimirovich Belousov, Vladimir Leonidovich Voeikov, and Viktor Semenovich Martynyuk (eds.), *Biophotonics and Coherent Systems in Biology*, Springer Verlag, New York, 2007.
9. Marco Bischof, *Biophotonen: Das Licht in Unseren Zellen (Biophotons: The Light in Our Cells)*, Zeitausendeins, Frankfurt am Main, 1995. Michael König, *Photonen-Diagnose: Vitalität ist Messbar – Wie Lebendig Sind Sie Wirklichlich?*, Scorpio, Munich, 2014. Fritz-Albert Popp, *Biophotonen – Neue Horizonte in der Medizin: Von den Grandlagen zur Ziophotonik*, Karl F. Haug Verlag, Stuttgart, third revised and updated edition, 2006 (originally published 1983).
 10. Roeland van Wijk, Yu Yan, and Edouard Pieter van Wijk, *Biophoton Technology in Energy and Vitality Diagnostics: A Multi-Disciplinary Systems Biology and Biotechnology Approach*, Medusa Research, Qi Nanophotonics, Netherlands, 2017.
 11. Viktor Mikhailovich Inyushin, ‘Bioplasma: The Fifth State of Matter?’, in John White and Stanley Krippner (eds.), *Future Science: Life Energies and the Physics of Paranormal Phenomena*, Anchor Books, Doubleday, Garden City, New York, 1977, pp. 115–20.
 12. See for instance: Karl H. Pribram, *The Form Within*, Prospecta Press, Westport, Connecticut, USA, 2013.
 13. Karl H. Pribram, *Languages of the Brain: Experimental Paradoxes and Principles in Neurophysiology*, Prentice-Hall Inc., 1971; reprinted Brooks/Cole, Monterey, California, 1977, pp. 150–9.
 14. Adam Gregorz Adamski, ‘Bioplasma Concept of Consciousness’, in *NeuroQuantology*, Vol. 9, Issue 4, December 2011, pp. 681–91.

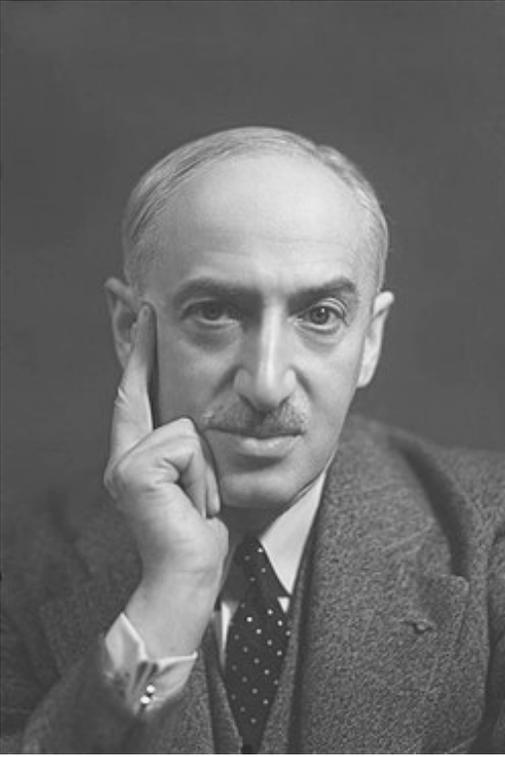
Chapter 16: The 'Death Flash' and the 'Life Flash'

1. Janusz Slawinski, 'Electromagnetic Radiation and the Afterlife', in *Journal of Near-Death Studies*, Vol. 6, Part 2, winter 1987, pp. 79-94.
2. Because I am interested in French literature (and indeed my wife Olivia and I have sponsored numerous translations of modern French literary classics into English), I have read widely in twentieth-century French fiction. One of the most congenial authors to me is the passionate French Anglophile, André Maurois. By chance, browsing in a bookshop some years ago, I came across a little book by him containing a novella bearing the strange title *The Weigher of Souls*, which is a direct translation of its original French title *Le Peseur d'Ames*. I now possess a first edition of this novella signed by Maurois, whose signature by the way is practically microscopic, so that you almost need a magnifying glass to read it. (He must have been a very modest person!)

The book was published originally in 1931 in Paris in several simultaneous editions on different kinds of paper, and later in the same year in a version atmospherically illustrated by Francis Picabia. (I have been fortunate to acquire Maurois's own personal copy with his bookplate of this special edition. André Maurois, *Le Peseur d'Ames*, with frontispiece and eight illustrations by Francis Picabia, Antoine Roche, Paris, 1931, unnumbered author's own *exemplaire sur japon impérial*; the bookplate says 'Ex Libris Simone Andre Maurois'. Simone de Caillevet was the second wife of Maurois and died in 1968, a year after he did. It seems that they shared their bookplate.)

Also in the same year, the English translation appeared in America in the popular highbrow magazine *Scribner's*, for March 1931. That issue announces prominently on the cover: 'André Maurois's New Novel "The Weigher of Souls" Complete in this Issue.' I also have its first edition in English as a book, published in the same year by D. Appleton & Company in association with Scribner's, in both London and New York. Despite the prominence

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André Maurois (1885–1967), the author of *The Weigher of Souls*.

with which this title was thus originally launched, it seems to have attracted only limited attention, which I also find curious. The French were always somewhat uncomfortable about Maurois, because he liked the English too much, and also because he was a Jew (Maurois was his pen name, and his real surname was Herzog).

Today, if you ask someone in France about Maurois, the person will either look blank or pretend to look blank. After all, grumbling about the barbaric nature of les ros bifs ('the roast beefs') who live across the English Channel is one of the favourite hobbies of the French, and one that they do not wish to see compromised by too much Anglophilia. Hence, it has been convenient largely to 'forget about' both Maurois and his contemporary French Anglophile,

the novelist Valéry Larbaud, who translated James Joyce's *Ulysses* into French.

Maurois met with tremendous literary success in Britain with his series of Colonel Bramble novels, light-hearted and comic accounts of the British soldiers during the First World War, written in a tone of great affection. Maurois had been a French military liaison officer with a British regiment just behind the Front for most of the war. He was thus unusual in that he was a French officer who spent the war in the company of British officers rather than French ones.

3. Wilfried-René Chettéoui (note that Wilfried is misspelled Wifried in this source), 'The Process of Birth and Reincarnation Theory', in the Proceedings and Abstracts of the 6th International Conference on Psychotronic Research held at Zagreb, Yugoslavia, 13–16 November 1986, published by the Society for Natural Sciences at Zagreb in 1987 (though no publication date is given), the volume apparently being edited by Zdenek Rejdák, p. 314. (The main title of this book is in Czech, with the English title beneath.)
4. Duncan MacDougall, 'Hypothesis concerning Soul Substance together with Experimental Evidence of the Existence of Such a Substance', in *Journal of the American Society for Psychical Research*, 1 (1), 1907, p. 237; also 'The Soul: Hypothesis concerning Soul Substance together with Experimental Evidence of the Existence of Such Substance', in *American Medicine*, 2, April 1907, pp. 240–3. A popular report of this appeared in *The New York Times*, entitled 'Soul Has Weight, Physician Thinks', 11 March 1907; this appeared before MacDougall's own articles had even been published later that year. See the Wikipedia entry '21 Grams Experiment'. Apparently, MacDougall's experiments of 1907 have never been repeated.
5. This account is to be found on the website:
www.thebiggeststudy.blogspot.com/2012/12/the-mist-at-death.html.
6. Sheila Ostrander and Lynn Schroeder, *Psychic Discoveries behind the Iron Curtain*, Prentice-Hall Inc., Englewood Cliffs, New Jersey, USA, 1970, p. 205.

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7. Konstantin Korotkov, *Aura and Consciousness: A New Stage of Scientific Understanding*, translated from the Russian by Roger Taylor, State Editing & Publishing Unit 'Kultura', St Petersburg Division of the Russian Ministry of Culture, St Petersburg, 1998; 2nd edition, 1999.
8. Janusz Slawinski, 'Photon Emission from Perturbed and Dying Organisms – The Concept of Photon Cycling in Biological Systems', in Fritz-Albert Popp and Lev Belousov (eds.), *Integrative Biophysics: Biophotonics*, Kluwer Academic Publishers, Dordrecht, Netherlands, 2003.
9. This story about Franz Werfel is not generally known. It was told to me by my dear friend Professor Adolph Klarmann, the editor of Werfel's collected works (in German), a close friend of Werfel and the guardian and confidante of Werfel's widow, Alma Maria Gropius Mahler Werfel, whom he looked after in New York in her last years. I intend to publish more about this in a separate publication.
10. Jelena Vuckovic, Dirk Englund, David Fattal, Edo Waks, and Yoshihisa Yamamoto, 'Generation and Manipulation of Nonclassical Light Using Photonic Crystals', in *Physica E: Low-dimensional Systems and Nanostructures*, 32 (1–2), July 2005. DOI: 10.16/i.physe.2005.12.135. (See arXiv website.) This paper was subsequently replaced with a revised version. Although this paper is not available on Researchgate, one can request a full text from the authors via www.researchgate.net, though it means scrolling down an immensely long chronological list of publications by Vuckovic, who seems to have been more prolific with words than either Tolstoy or Proust. (Englund has meanwhile moved to MIT, Fattal is still at Stanford, and Edo Waks and Yamamoto are not on Researchgate.net.)
11. Barbara W. Chwirot, 'Do We Always Need to Know Molecular Origin of Light Emitted by Living Systems?', in Chang Jiin-Ju, Joachim Fisch, and Fritz-Albert Popp (eds.), *Biophotons*, Kluwer Academic Publishers, Dordrecht, 1998, pp. 229–37.
12. Raymond Moody, *Glimpses of Eternity*, Guideposts, New York, 2010, pp. 101–4.

13. Ibid., p. 24.
14. Ibid., pp. 101–2.
15. Ibid., p. 103.
16. Bernard J.F. Laubscher, *Beyond Life's Curtain*, C.W. Daniel Co./ Spearman, 1975.
17. Peter and Elizabeth Fenwick, *The Art of Dying*, Bloomsbury Continuum, London, 2008, pp. 160–3.
18. Ibid., p. 167.
19. Reported by Dr. Robert Crookall in his book *Out of the Body Experiences*, Citadel Press, 1970.
20. Report by Ed Bodin for the magazine *Psychic Observer*, 25 January 1945. I have taken this information from a blog on the internet posted in 2010 by Michael Tymn, author of the book *The Afterlife Revealed: What Happens After We Die*, 2011.
21. Michael Otmar Hengartner, 'Out-of-Body Experiences: Cell-Free Death', in *Bioessays*, 17 (6), June 1995, pp. 549–52.
22. Xianrui Cheng and James E. Ferrell Junior, 'Apoptosis Propagates through the Cytoplasm as Trigger Waves', in *Science*, 361 (6402), 10 August 2018, pp. 607–12. Please note that although the official listing at the head of the article suggests that the paper is only five pages long, it is in fact 14 pages long in the downloadable Public Access author manuscript dated 29 November 2018, so that the reference is therefore misleading.
23. R.J.P. Williams, 'Purpose of Proton Pathways', in *Nature*, Vol. 376, No. 6542, 24 August 1995, p. 643.
24. Vlail Petrovich Kaznacheev (aka Kaznachejev), et al., 'Distant Intercellular Interactions in a System of Two Tissue Cultures', in *Psychoenergetic Systems*, Vol. 1, No. 3, March 1976, pp. 141–2.
25. See for instance: <https://www.sciencealert.com/scientists-just-captured-the-actual-flash-of-light-that-sparks-when-sperm-meets-egg> (which is dated 27 April 2016).

Chapter 17: Our Plasma Selves

1. Aleksandr Samuilovich Presman, *Electromagnetic Fields and Life*, translated by F.L. Sinclair and edited by Frank A. Brown, Plenum Press, New York and London, 1970. The original Russian edition, *Elektromagnitnye Polya I Zhivaya Priroda*, was published by Nauka ['Science'] Press of Moscow in 1968.
2. *Ibid.*, pp. 5–6.
3. Robert Temple, *The Genius of China: 3000 Years of Science Discovery & Invention*, with Foreword by Joseph Needham, Andre Deutsch, London, 2007.
4. Paul Alfred Weiss, *Principles of Development: A Text in Experimental Embryology*, Henry Holt and Company, New York, 1939. Paul Alfred Weiss should not be confused with Paul Weiss the philosopher. Later publications by Weiss, not cited by Presman, include *Dynamics of Development: Experiments and Inferences*, Academic Press, New York and London, 1968, and *The Science of Life: The Living System – A System for Living*, Futura Publishing Company, Mount Kisco, New York, 1973.
5. Presman, *op. cit.*, p. 249.
6. Robert Temple, 'David Bohm', in *New Scientist*, London, 11 November 1982, pp. 361–6. A whole line of type was left out, and other errors appeared in the published article. I urge people interested in David Bohm to download for free a pdf of this article with my hand corrections, including the missing line of type. It may be obtained from my entry on www.researchgate.net. Just type in my name, click on my publications, and scroll down the chronological list until you get to 1982, and there it is.
7. David Bohm, *Quantum Theory*, Prentice-Hall Inc., New York, 1951. David signed my copy of the original edition.
8. Here is a scan of a postcard that Saral sent to us, to show the nature of the friendship, sent from America on their trip there in the spring of 1985. It reads: 'Dear Olivia & Robert, Thanks for sending on the material on Oppenheimer. All goes well including Dave's talk to U.N. Lots of interest in Dave's scientific work every-

where – more about that on our return. Hope all's well with you.
Love Saral & Dave.'



9. Paavo Pylkkänen, *Mind, Matter and Active Information: The Relevance of David Bohm's Interpretation of Quantum Theory to Cognitive Science*, Reports from the Department of Philosophy, No. 2, University of Helsinki, Finland, 1992, p. 66.
10. David Bohm, 'A Suggested Interpretation of the Quantum Theory in Terms of "Hidden Variables" Part I (14 pages), 15 January, pp. 166–79, and Part II (14 pages), 15 January, pp. 180–93, in *Physical Review*, American Physical Society, Vol. 85, Second Series, 1 January–15 March 1952. At the time of writing he was still based at the Palmer Physical Laboratory at Princeton, and his papers are marked received on 5 July 1951, but a note says: 'Now at Universidade de Sao Paulo, Faculdade de Filosofia, Ciencias e Letras, Sao Paulo,

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- Brazil. (I have an original bound volume containing these papers.) So between the time of submission and publication, Bohm had had to flee the country and seek refuge in the philosophy department of a university in Brazil, where he did not even have a science position.
11. I need to explain to the reader that the aspect of David Bohm's thinking that we are dealing with here is a later outgrowth of his main ideas. I have discussed the theories of Louis de Broglie and David's impact on them at some length here: Robert Temple, 'Is Particle Mass a Function of Degrees of Freedom?', in *Journal of Cosmology*, Vol. 26, No. 3, 2017, pp. 13995–14090. Downloadable as a pdf from my entry on www.researchgate.net, under the date 2017.
12. This point relates to one of my own major points made in my lengthy 2017 paper (just mentioned), regarding the crucial importance of amplification in every aspect of science, and where I said for instance: 'Amplification in electronics turns a weak signal into a strong signal, and it does not necessarily require an amplifier, such as we in our macroscopic world employ, because it apparently occurs spontaneously at the ultra-weak level in Nature in electron streams under the influence of magnetism.' See page 20 and *passim* in my paper.
13. David Bohm and F. David Peat, *Science, Order, and Creativity*, Bantam Books, New York, 1987, p. 93.
14. David Bohm, 'A New Theory of the relationship of Mind and Matter', in *Philosophical Psychology*, Vol. 3, No. 2, 1990, pp. 271–86.
15. Pyllkänen, *op. cit.*
16. Paavo T.I. Pyllkänen, *Mind, Matter and the Implicate Order*, Springer Verlag, Berlin and Heidelberg, 2006.
17. Pyllkänen, 1992, *op. cit.*, p. 91.
18. As is usual with Wikipedia, Rupert's entry on it is riddled with vitriol and insults against him, Wikipedia being apparently partial to the most intensely partisan and extreme attacks on people whose names are on whatever black list it is that they consult. When people like Rupert attack the stupidities and idiocies of Establishment ideas,

the Establishment strikes back. Most of the famous scientists mentioned in this book were savagely attacked during their lifetimes because they thought for themselves.

Rupert told me that when he was a student at Cambridge, he was told in lectures that there was a man named Peter Mitchell who was crazy and none of the students should pay any attention to his ideas if they should ever come across them. That is the same Peter Mitchell, my good friend whom I have mentioned before, who won the Nobel Prize after a lifetime of being called crazy and libelled even in lectures given to students at Cambridge such as Rupert. Cambridge is also the place from which Sir Fred Hoyle was driven by relentless and vicious personal attacks led by a cabal of snobbish enemies who, among other things, did not like Fred's Yorkshire accent and his lowly origins. The world of learning can be more poisonous even than the world of politics.

19. Joseph Glanvill, *Scepsis Scientifica: or, Confest Ignorance, the Way to Science*, London, 1665, p. 17.
20. For decades I have said to friends that the reason why I can walk into a library of three million books on open shelves (such as the one at my university when I was in my teens), go down an apparently random aisle, reach up to an apparently random shelf, and without looking at it pick the book I need and open it to the page I require is that I am able 'to see directly into Information Space'. Since I have been doing this all my life, when I speak of Information Space and 'the Universe as Information', my natural scepticism dissolves into something approaching certainty. In other words, even though I do not believe in belief, this I not only believe but know.
21. Nikola Tesla, op. cit., pp. 9–14.
22. Benjamin Schumacher and Michael Westmoreland, *Quantum Processes, Systems, and Information*, Cambridge University Press, 2010, p. 1.
23. Wojciech Hubert Zurek (ed.), *Complexity, Entropy, and the Physics of Information: The Proceedings of the Workshop on*

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Complexity, Entropy and the Physics of Information Held May-June, 1989, in Santa Fe, New Mexico, Vol. VIII, Santa Fe Institute Studies in the Science of Complexity, Westview Press, 1990; reprint by CRC Press, Baton Rouge, Florida, 2019.

24. Werner G. Teich and Günter Mahler, 'Information Processing at the Molecular Level: Possible Realizations and Physical Constraints', in *Ibid.*, pp. 289–99.
25. Seth Lloyd, 'Valuable Information', in *Ibid.*, pp. 193–7.
26. Robert Temple, *Netherworld*, Century, London, 2002. The relevant section of this book is the final chapter, entitled 'Higher-Order Events'; this chapter has been extracted from the book and may be downloaded from my www.researchgate.net entry under the date of 2002 (as the entries on the website are chronological).
27. *Ibid.*, p. 354 (UK edition). I might add for those interested in the prehistories of ideas that the main ancient proponent of voids occurring in matter was the philosopher Strato of Lampsacus (335 BC–269 BC). He was the second successor of Aristotle as the Head of the Lyceum, though he could not have known him because he was only a boy when Aristotle died. His works are lost except for fragments and testimonia, which have been gathered and translated in the volume: Marie-Laurence Desclos and William W. Fortenbaugh, *Strato of Lampsacus: Text, Translation, and Discussion*, Vol. XVI of the series Rutgers University Studies in Classical Humanities, Transaction Publishers, New Brunswick, New Jersey, USA, 2011. The fragments relating to void (*kenon* in Greek) are found on pages 70–83.

Most were preserved by Simplicius, who disagreed with him, in his Commentary on Aristotle's *Physics*. On page 79 we find Simplicius saying this: 'Strato of Lampsacus tries to show that void divides the whole of body, so that it is not continuous . . .' And on the same page and following we find Hero in his *Pneumatica* saying that there are voids in matter. And he adds: 'It is also clear . . . that there are voids in water . . . there are many other demonstrations of the nature of the void . . . every body is composed of small

bodily particles, between which there are scattered voids which are smaller than the particles . . .’

Part of Hero’s extended discussion is directly drawn from Strato. This volume concerning Strato is part of an extended series of collections of the fragments and testimonia of the Peripatetic philosophers. I am very fortunate to have enjoyed the jolly company and warm friendship of Bill Fortenbaugh, who has been a genuine culture hero and shining light in the world of classical studies in our time.

28. Vadim Nikolaevich Tsytovich (aka Cytovič), Sergey Vladimirovich Vladimirov, and Gregor Eugen Morfill, ‘Size of Dust Voids as a Function of the Power Input in Dusty Plasmas’, in *Journal of Experimental and Theoretical Physics*, Vol. 102, 2006, pp. 334–41. (The attentive reader will notice that Tsytovich is the man who has been quoted by me as suggesting that complex dusty plasmas can become life forms.)
29. Osamu Ishihara and Noriyoshi Sato, ‘Attractive Force on Like Charges in a Complex Plasma’, in *Physics of Plasmas*, Vol. 12, 070705 (2005). There is a drawing of a plasma void as Figure 2 in that paper. This work was done for the United States Air Force Research Agency.
30. Osamu Ishihara, ‘Report on Study of Cryogenic Complex Plasma’, report date 5 November 2008, submitted to the funding agency, the Asian Office of Aerospace Research and Development (AOARD), an extension in Asia of the US Air Force Research Agency, reporting to the Air Force Research Laboratory at Kirtland Air Force Base near Albuquerque, New Mexico. This Report appears in a collection of material entitled ‘Charged Colloidal Structures in Plasmas’, declassified and released by the US Department of Defense, no date.
31. Xiao-Qiong Wang, et al., ‘Evidence of an Atomic Chiral Superfluid with Topological Excitations’, in *Nature*, Vol. 596, No. 7871, 12 August 2021, pp. 227–31.

Chapter 18: Wrapping Up the Universe

1. Robert Temple, *Open to Suggestion*, The Aquarian Press, Wellingborough, Northamptonshire, England, 1989. The relevant discussion constitutes the final chapter in the book pp. 361–458. The ideas which I propounded in that chapter were praised by Professor Ernest R. ('Jack') Hilgard, Former President of the American Psychological Association, and also by Professor John Taylor, who told me that he had adopted many of my concepts and suggestions for his neural network team at Kings College London, and that I had therefore contributed towards an advance in neural network science, for which he thanked me.

The book's publication in the USA was blocked by the CIA, as I was informed by no less than eight American publishers who had been personally visited and warned not to publish the book. This had the indirect result of giving the UK an advantage in neural network science, since no one in America was able to obtain the book (no international Amazon sales existed then).

2. This paper, entitled 'Early Einstein Completed', was published in June 2019 and may be downloaded from my www.researchgate.net entry, by looking for that date, as the entries are chronological.
3. David Bohm and Basil J. Hiley, *The Undivided Universe: An Ontological Interpretation of Quantum Theory*, Routledge, London, 1993, p. 140.

Appendix One

KORDYLEWSKI DUST CLOUDS: COULD THEY BE COSMIC “SUPERBRAINS”?

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Abstract

Recent astronomical observations combined with dynamical simulations have led to a possible confirmation of the existence of the much disputed stable dust clouds (Kordylewski Dust Clouds) at the Lagrange libration points of the Earth-Moon system. The new data leads to an estimate of the size of the cloud at L5 as well as of the average radii of the scattering/polarizing dust particles in the cloud’s interior. The diameter of the cloud is somewhat less than 3 times the Earth’s diameter, and the average grain radius is estimated at $\sim 3 \times 10^{-5}$ cm, consistent with bacterial-type cells, with a mean separation of less than 1 cm. Such grains, most likely elongated on the average (rod-like bacteria), and photoelectrically charged to a few eV, would acquire a spin through collisions with gas atoms and thus could act as emitters and absorbers of longwave electromagnetic radiation. We speculate that the entire Kordylewski Dust Cloud comprised of such particles has the potential to acquire electromagnetic connectivity with an information storage/processing capacity akin to a form of intelligence.

1. Introduction

The existence of large stable dust clouds at the Lagrange libration points L4 and L5 of the Earth-Moon system appears to have been finally confirmed by a combination of numerical dynamical simulations and polarimetric studies (Sliz-Balogh et al, 2018, 2019). An initial tentative observation of such clouds was reported in 1961 by the Polish astronomer Kazimierz Kordylewski following which they came to be known as Kordylewski Dust Clouds (KDC) (Kordylewski, 1961). The existence of these clouds has, however, been questioned for over 3 decades mainly because of the difficulty of interpreting minute enhancements of night sky brightness in relation to other possible causes. There were also early attempts to detect centimetre to metre-sized bolides in the putative KD clouds using RADAR with negative results and these have been widely considered as disproof of their existence (Roosen and Wolff, 1969; see also, Hou et al, 2015). It is clearly desirable to repeat the earlier RADAR observations and also possibly deploy LiDAR (*Light Detection And Ranging*) measurements to look for returns from smaller particles to establish their presence.

In two recent publications Sliz-Balogh et al (2018, 2019) focussed their attention on the particular dust cloud (KDC) at the L5 point of the Earth-Moon system using sensitive polarimetric techniques. They found clear evidence that a cloud of submicron dust does indeed exist there through examination of polarized scattered light that varied with time (Sliz-Balogh et al, 2019). The cloud appeared to be “dynamic” and contained within it smaller dust clouds, perhaps displaying a cellular-like structure. Although evidence was cited to support the presence ferric and silicate particles we cannot rule out, on the basis of available evidence, the presence of a dominant contribution of carbonaceous or organic grains, as indeed is known to be predominantly present in the interplanetary zodiacal cloud, in cometary dust, as well as the interstellar medium (Hoyle and Wickramasinghe, 2000; Steele et al, 2018).

Further definitive confirmation of the existence of KDC’s is clearly desirable and we hope this will be done. It will also be important to unravel the fine structure within clouds, including their internal dynamic properties, but these cannot easily be studied from Earth. Such studies will require investigation by dedicated satellite and astronomical studies at some future date.

In this article we explore some interesting features of these dust clouds particularly if they are comprised of particles that include a significant biological component.

2. Inferred Properties of the L5 KDC

The stability and existence of a KDC at the L5 point has been modelled using 3-D by dynamical simulations, and its actual existence confirmed by means of polarimetric observations of scattered light (Sliz-Balogh et al, 2018,2019). The inferred angular extent of the scattering dust cloud at L5 has been estimated at between $\theta=6$ and 7 degrees. At the known distance of L5, $r = 3.84 \times 10^9$ cm, this angular extent transfers to an average cloud diameter D given by

$$D \approx \frac{\theta}{360} 2\pi r \cong 4.35 \times 10^8 \text{ cm} \quad (1)$$

This is to be compared with the Earth’s diameter of $\sim 1.27 \times 10^8$ cm.

For a spherical particle of radius a (silicate grain or an organic grain typified for example by a bacterium) the cross-section for scattering of sunlight is

$$C_{sca} \cong Q_{sca} \pi a^2 \quad (2)$$

with Q_{sca} having a value close to 1 at optical wavelengths (eg. Wickramasinghe, 1973). For an assembly of such grains in the cloud the average mass scattering coefficient is thus

$$\kappa_{sca} \cong \frac{\pi a^2 Q_{sca}}{\frac{4}{3} \pi a^3 s} \approx \frac{3}{4as} \text{ cm}^2 \text{g}^{-1} \approx 2.5 \times 10^4 \text{ cm}^2 \text{g}^{-1} \quad (3)$$

assuming $a \sim 3 \times 10^{-5}$ cm, $s \sim 1 \text{ g cm}^{-3}$.

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For significant polarization effects to be observable (Sliz-Balogh et al, 2019) the scattering optical depth through the 4.35×10^8 cm path-length of the cloud (equation (1)) must be of order unity, say for instance, $\tau_{sca} \approx 0.3$. This converts to a mass density of bacterial dust ρ in the cloud given by the equation

$$0.3 \cong \kappa_{sca} D \rho \cong 1.09 \times 10^{13} \rho \quad (4)$$

with the diameter of the cloud given by (1), thus yielding a mass density

$$\rho \approx 2.75 \times 10^{-14} \text{ g cm}^{-3} \quad (5)$$

The Kordykowski dust cloud at L5 on this basis has a density which is at least 10^9 higher than the density of the ambient interplanetary dust (Allen, 1963). Losses due to the effects of solar radiation, as well as the solar wind effects and small gravitational perturbations which occur mostly in the outermost regions of the KDC will, over long timescales, be made good by the acquisition of new dusty material from comets and the interplanetary medium. The total mass of the cloud observed by virtue of (1) and (5) is thus $\sim 1.17 \times 10^{12}$ g.

Assuming that a typical dust particle in the cloud has the size characteristics of a bacterial spore with a particle radius $a \sim 3 \times 10^{-5}$ cm and mass density $\sim 1 \text{ g cm}^{-3}$, we therefore have an average *number* density of dust particles in the cloud of

$$n \approx 2.43 \text{ cm}^{-3}. \quad (6)$$

The mean distance between neighbouring particles is then

$$\sim n^{-1/3} \sim 0.74 \text{ cm!} \quad (7)$$

very short indeed, and yielding the possibility of inter-particle “communication” if electromagnetic signals can be exchanged. This could be made possible because the bacterial dust would be charged to a potential of a few volts due to the photoelectric effect caused by absorption of solar ultraviolet photons; and collisions with ambient gas would lead to rotation (spinning) at radio frequencies as had been discussed many years ago by Hoyle and Wickramasinghe (1970).

3. Emergent properties of KDC's

Spinning charged grains, particularly those in the form of elongated needles typified by bacilli, would be efficient absorbers and emitters of electromagnetic radiation. Most interestingly the total number N of such charged dust particles in a KDC (distance of < 1 cm apart) would be truly vast

$$N \approx \frac{\frac{4}{3}\pi R^3}{n} \cong 2 \times 10^{26} \quad (8)$$

With electromagnetic-wave emission/absorption across cloud dimensions as well as electrical connections (charge/current exchanges) between adjacent charged particles just centimetres apart, a KDC, might well be able to function as a gigantic

computer/brain capable of storing and processing digital information. We are reminded in the present context of the well-attested cooperative behaviour of bacteria in a wide range of terrestrial settings (Asfahl and Schuster, 2017; Mitchell and Kogure, 2006).

A human brain has only some 10^{11} brain cells, and about 10^{15} synapses. A KDC (from (8)) may well have a total number of binary connections

$$\sim {}^n C_2 \approx 10^{52}$$

between its constituent oscillators, so defining a super-astronomical sum total for its potential computing power. This estimate exceeds the computing power available in all human brains and indeed all other intelligent life on Earth as well by very many orders of magnitude.

Finally, we refer to a few of the remarkable features that are known to characterise dusty complex plasmas and which could also play a role in the present context (eg. Bouchoule, A., 1999; Mikikian *et al.*, 2018). The nucleation and growth of mainly siliceous dust within such plasmas have been documented in several laboratory studies. In our case, however, the dust nucleation process will be side-stepped and condensation within KDC's is likely to occur upon pre-existing interplanetary dust particles which we already argued will probably have a biological component. Thus, we could envisage a population of bacterial particles coated with semi-conducting siliceous mantles that may well have the effect of enhancing inter-particle electronic connectivity. Such speculations may sound far-fetched but they lie within a broad framework of possible outcomes based on known behaviour of complex dusty plasmas.

We might thus be tempted to view the Lagrange Dust Balls as highly structured "intelligent" systems capable of storing and processing "information". that they may have more surprising and unexpected features. Indeed, such huge stable entities which have presumably endured for astronomical timescales and have steadily grown in complexity over billions of year may display spontaneously evolved phenomena which might resemble those of the most highly complex living entities. This situation is not dissimilar to the brain-like like complexity of the "cosmic web" discussed by Ginsburg *et al.* (2019), although it is potentially even more impressive in its computational potential.

It is often said anecdotally that the human brain contains more neurons than there are observable stars in the night sky. But the human brain only fits inside a small skull. A stable dusty complex plasma ball of immense size which has possibly endured for aeons and experienced continual growth and expansion over countless millennia is in principle capable of developing something resembling a much more complex nervous system than a human brain with its average lifetime of $\sim 10^2$ years. A complex dust cloud (KDC) which has existed for many millions of years might even have become self-aware.... with all that this implies. It is conceivable that Fred Hoyle's fictional Black Cloud has a reality in the context of KDC's - which of course he could not have recognised in 1957 (Fred Hoyle, 1953).

Appendix One

Acknowledgement

We are grateful to Professor Michael Smith for comments that helped improve an earlier version of this paper.

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Appendix Two

CORRECTION: The conversation reported in the second paragraph of yesterday's obituary of Peter Mitchell took place in 1980, not 1950 as printed.

PETER MITCHELL was one of the most brilliant and original of Britain's men of science, though he was little known outside his field until he received the Nobel Prize for Chemistry in 1978.

Mitchell was modest, perhaps excessively so, and reclusive. He told me in 1950: "I suppose that in a few years' time nobody will even remember me." And he believed that. He hated publicity of any kind and said: "I'm really worried by having attention drawn to me as a person." Two scientists who wrote the first popular article about him in 1975 in *New Scientist* remarked: "To say more about Mitchell the man would evoke a good natured retort on the telephone asking if we intended this article to be his obituary."

Mitchell had a magically warm and conspiratorial smile; indeed, he once signed a paper to me "To a co-conspirator". The conspiracy was simple: to try at all times to defeat humourlessness and intolerance, arrogance and closed thinking. And that was what his smile said to his co-conspirators; to others of whom he was not sure, his smile said: "Are you what I hope you are?" For he never believed himself superior to a single living person and he told me: "It worries me to think of people I don't know being unhappy. What I really care about is the people who are going to be alive after I'm dead." But he also had one of the most subtle and sophisticated senses of humour I have ever encountered and liked to laugh with, rather than at, the human condition, and at no individual but him-

self. He was the basis for the main character in Michael Mulkey's book *Pandora's Box* which dealt with the relationship of scientists' personalities to their work.

Mitchell entirely revolutionised the science of bioenergetics by effectively standing its theory on its head. For a time he worked at Cambridge and Edinburgh universities (where he was Reader), but most of his work was done in a private laboratory, the Glynn Research Institute, an eighteenth-century mansion in Cornwall which he restored with his own hands from a ruin. He pretended out of modesty that his institute was funded by foundation grants, but in fact he and his brother Christopher used the wealth they inherited from their family's construction firm, Wimpey, to fund the crucial work that led to the Nobel Prize.

If Peter Mitchell had had to be subject to peer review and to apply for grants he would have had little time left for his work and would not have received any grants anyway, thus getting nowhere. The sums of money he spent on research were vast, but he could not bear anybody to know about it. At all times he wished to be the Invisible Man. He could probably not have succeeded without the enduring love of his second wife, Helen French, whose passionate devotion both to Peter the man and to his work gave him the emotional support he needed, providing the protection of his privacy and the spectacular hospitality to guests, as they were needed. Helen's French provincial cooking

Pete

OBITUARIES

er Mitchell



and Peter's connoisseurship of fine wines meant that meals at Glynn were always of Michelin-star quality.

Also crucial to Mitchell's career was Dr Jennifer Moyle, his research associate from 1948 until her retirement a few years ago, who, in 35 years, "only really ever had one quarrel with Peter". For 20 years Mitchell was ridiculed, and Jennifer Moyle was his only professional supporter. So vicious was the scientific opposition to him that students were routinely lectured at some universities about how intellectually crazy he was. He was kept out of the Royal Society for many years by jealous scientific colleagues whose own theories were threatened by his work. But in 1981 the Royal Society awarded him their highest honour, the Copley Medal, by which time he had been a fellow for seven years.

Mitchell's work is hideously

complex. But, simply, it used to be thought that cell walls were like partitions on a factory floor, and that the energy absorbed by animals and humans from food, and by plants from sunlight, was somehow turned into the energy necessary to run the body by purely chemical means — the so-called "bag of enzymes" theory, which postulated random and directionless processes. But Mitchell ignored mass ridicule to prove his hunch that in fact that "there was a direction to the flame of life", as one admirer later put it. He demonstrated that currents of protons passed through cell walls, which far from being idle partitions were actually riddled with directional pathways, and that this sensible and directed form of energy transport was at the basis of all life of bodily cells.

This discovery also showed for the first time a reverse form of electricity (which he named "proticity"), which he successfully demonstrated could run an engine and which may some day become a major factor in energy processes. The discoveries were a conceptual breakthrough as fundamental in cell biology as relativity theory was in physics. Scientists are still struggling to realise all the implications, and medical results will probably eventually follow.

The last 10 years of Mitchell's life were spent largely trying to raise funding for his institute after his own money dried up. His philosophical ideas, which he wanted to pursue and elaborate, were sacrificed to this desperate fundraising task. He had as much

to offer in the areas of his other interests as he had in pure science, but one lifetime is too short for such a man, and his philosophical promise tended to be known only to a few friends such as Sir Karl Popper, whom he revered. Mitchell has been called "the Socrates of Glynn Valley"; the historical Socrates restored old buildings and worked in stone as Mitchell did, and they both devoted themselves to philosophical questioning at a deeply profound level of conversation.

Peter rose far above the level of "the great man" (which, hating all pomposity he could never have been) to be in the quiet of his Cornwall retreat what I can only call a great and old soul. His nature was so kind, so gentle, so tolerant and sympathetic; he survived so cheerfully the decades of abuse from jealous and petty colleagues without rancour in his heart or blame towards anyone. However outstanding his achievements in science, his human qualities were of a higher order still.

Robert Temple

Peter Dennis Mitchell, biochemist, born Mitcham Surrey 29 September 1920, Founder and Director of Research Glynn Research Laboratories 1964-86, FRS 1974, Nobel Prize for Chemistry 1978, Chairman and Honorary Director Glynn Research Institute 1987-92, Visiting Professor King's College London 1987-89, married Eileen Rollo (one son, one daughter; marriage dissolved), 1958 Helen French (two sons), died Glynn Cornwall 10 April 1992.

Appendix Three

A James Van Allen Bibliography

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