

'ANGEL HAIR'

1. It is believed that this fibrous material resembling filaments, spider webs or candy-floss-like streamers is formed by reciprocal attraction between polarised dust particles. Sometimes the material is sticky. It can be carried large distances before being deposited and has been likened to long chaff and has even been named 'spacegrass'. It can leave a smoky or misty deposit. The thin filaments appear to be an electrostatic precipitation of atmospheric dust, which is unstable, and which eventually disintegrates and vanishes. On at least one occasion a UK witness has collected what was probably 'angel hair' in a jar, believing it to have come from a 'UFO' which "hovered at the bottom of his garden". The author of this report personally observed this material drifting in a light breeze in Norfolk on a hot but breezy summer's day in 1997.

METALLIC ARTEFACTS

2. Although no such artefacts have been found in the UKADR, it is claimed in Russia and Ukraine that items have been scientifically analysed. The results are not known. The Russians, like the USA, have never produced the artefacts which are claimed by some media reports to have been found. This seems to be quite extraordinary in view of the fact that it would be reasonable to expect that this might solve the extra-terrestrial hypothesis of 'UFO' origins once and for all. The Brazilian claim of 'extra-pure aluminium' artefacts was not sustainable after analysis.

SUMMARY

3. No proven tangible artefacts have been obtained by the public for display, or shown by governments to exist. The metallic materials analysed scientifically

have not been shown to be of unknown elements. **It is a fact that that some materials have entered the earth's atmosphere as a result of meteor activity and have survived to impact. Analysis has shown nothing to connect these with any type of flying vehicle or threat. MOD does not hold any such material**

WORKING PAPER NO. 23

LINKED VORTEX RINGS

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LINKED VORTEX RINGS

1. Quite apart from the possibility of water spouts, dust eddies, whirlwinds and similar atmospheric vortex phenomena, which can be reported as UAPs, there is the possibility of linked vortex rings, such as those filmed from the US spacecraft Challenger on its post-launch ascent. It is suggested that aerial formations of this kind may be related to the UK sightings of the type shown at Working Paper No. 11, Figures 2 to 7.

2. Experimental Vortices

Experimental work has been done¹ on linked vortex rings and this phenomenon has been modelled. Initially the vortex rings are formed separately. Under certain conditions, when collisions occur, linking is possible of distinctively separate rings. Some results shown at Figures 1(a) and (b). The appearance of linked vortices to an observer clearly depends:

- The viewing aspect.
- The relative position of the viewing light source.

3. If the ring assembly is rotating slowly then the component strands might be visible. The Challenger example cited shows the complex component strands (which, overall, could be described as being contained in a cylindrical volume) rotating (rolling) about its radius at an estimated rate of about 50-60 times a minute. However, if the structure was not rotating and viewed, for example, end-on, it would appear as either a solid ball, reflecting light according to the scattering of its component particles or as a dark spherical

silhouette if between the sun (or light source, such as light cloud background) and the observer.

4. **Challenger Spacecraft Video Recording** The few extant reports on this topic (which were fortuitously connected with the Challenger incident only because the Department had collected open-source material on this space-launch) are not connected with UAPs, since the unusual effects are studied purely from the interest of fluid physics. However, the brief footage taken by the Challenger crew seems to be very similar indeed to a number of UAP reports received by the Department. Some examples are at Figure 2. Unfortunately the imagery taken from the video does not do justice to the original, which can clearly be seen 'rolling', or 'tumbling', as described above.

5. No attempt has been made in this brief investigation to correlate the 'linked vortex' postulation with the conditions for their formation in the atmosphere or of a possible combination of this effect with an electrical/charged particle or EM field effect.

¹ "Linking of Vortex Rings" Aref and Zawadzki. Nature Vol. 354 Nov 1991.

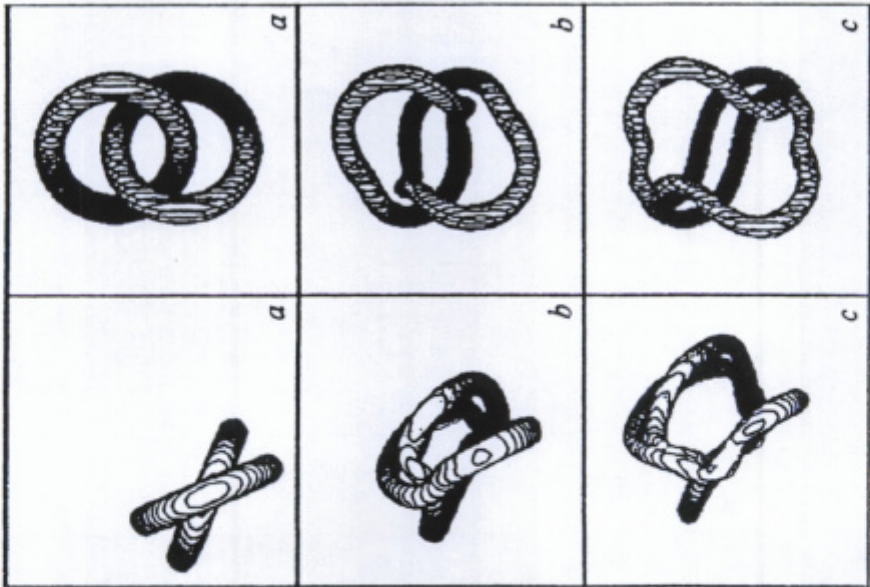
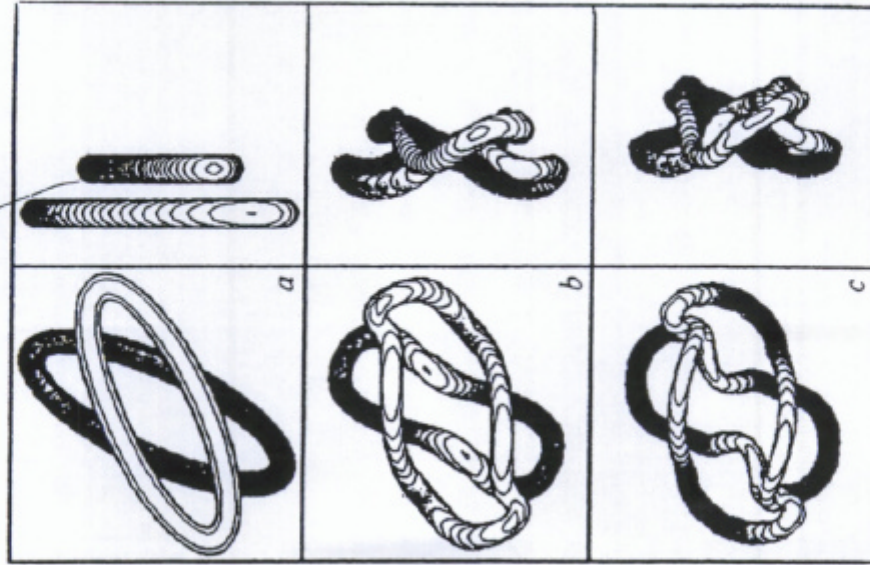


FIGURE 1(a): LINKED VORTEX RINGS

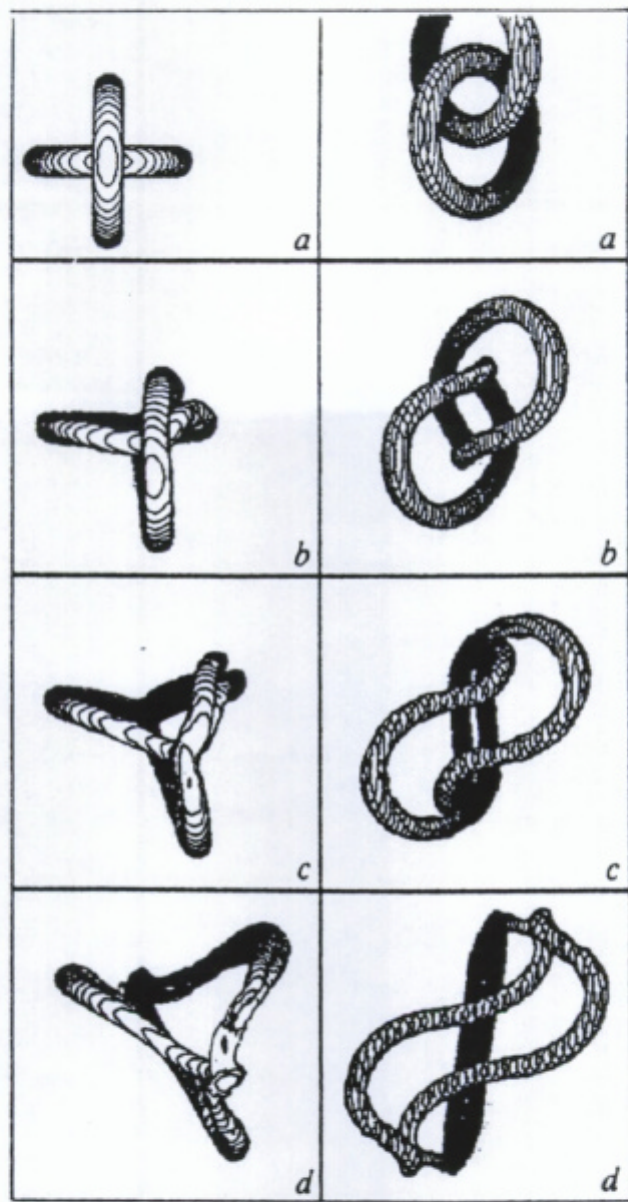


FIGURE 1(b): LINKED VORTEX RINGS

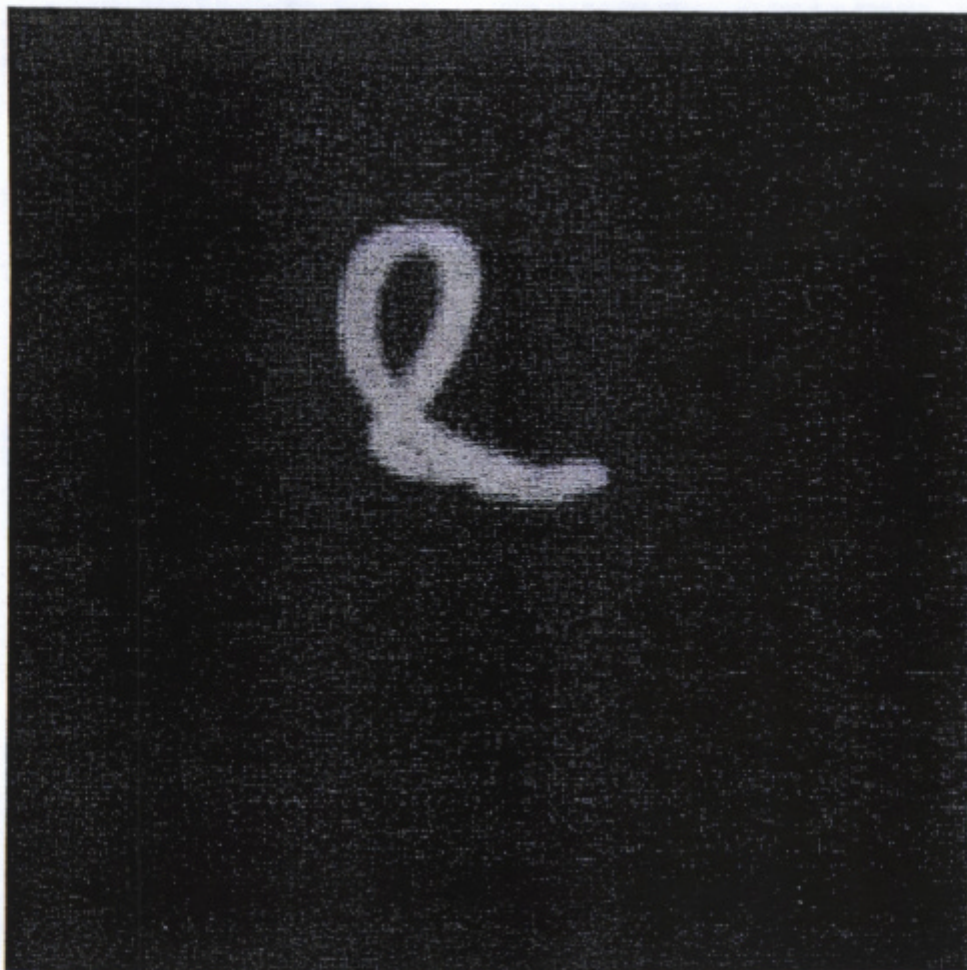


FIGURE 2: ROTATING/TUMBLING OBJECT (CHALLENGER SPACECRAFT)

WORKING PAPER NO. 24

'SPRITES', 'ELVES' AND 'BLUE JETS'

(ATMOSPHERIC AND IONOSPHERIC PHENOMENA)

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SPRITES, ELVES AND BLUE JETS

INTRODUCTION

1. Three types of transient optical luminous vertically-orientated phenomena have been observed at high altitudes above thunderstorms: 'Elves' at roughly 90km, which is an enhanced airglow, 'Sprites', a reddish glow from 50-90km and an upward-moving bluish beam emission from cloud tops, known as 'Jets', below 40km. Large area multi-cell thunderstorms lead to the formation of vertically-orientated cylindrical structures of gravity waves closely resembling those observed in optical emissions associated with transient luminous glows. These are believed to occur as a result of transfer of large amounts of charge (from clouds at altitudes of 5-10km) to the ground. Apart from the visual effects, these charge transfers are known to generate upper ELF Band signals (>300kHz). The Sprite path can also be located at high altitudes between the ionosphere and cloud tops. The luminous emission at low altitude is red. The likely explanation is gas breakdown by the additional electromagnetic fields of lightning discharges. Some Sprite 'bluish tendrils' were observed to extend down to 20-30km altitude. Horizontal magnetic field variations have also been observed in the frequency range of the earth-ionosphere cavity resonance. These phenomena have been studied recently in the USA, Germany and in the Antarctic.

SPRITES

2. Sprites are the older known phenomenon, first being reported 100 years ago. They last tens of milliseconds and can thus be sensed by the human eye. They are sometimes described as 'fan shaped' or

'carrot-like' in shape. They can extend laterally for several kilometres. Other observers have reported 'upward forks', due to divergence of the striations.

3. Electric field discontinuities can occur over stratiform clouds at 10-16km altitude and this is believed to be due to the positive cloud-to-ground discharges. Satellite-based instruments have also detected gamma-ray flashes (see para. 7, below). Current theories suggest that Sprites, Gamma-ray Flashes and Blue Jets are all types of discharge produced by a run-away air breakdown.

4. **Measurements** A TV slit spectrograph recently recorded 25 events and measured optical wavelengths in a band from 540 to 840µm, although other measures have spanned from 450-800 nanometer. The fleeting columns of luminosity have also been imaged by CCD cameras. Sprites are found to have a bright core less than 2km in horizontal dimension, they followed the associated lighting (below the (cumulonimbus) cloud) within a few milliseconds, and rose to peak intensity in 0 to 3 ms, fading a few tens of milliseconds later. Sprites can easily be observed from aircraft and from the ground, and have been seen from spacecraft.

5. More than 150 discharges measured (in the USA) in August 1993 extended, exceptionally, down to cloud tops below 20km altitude. In 1994, 56 Blue Jets were recorded at one location in just 22 minutes. They can extend from anvil cloud tops either partially or fully up to the ionosphere.

6. The peak intensity of the optical emissions is determined primarily by the removal of the thundercloud charge and its altitude. A vertically striated fine structure of sprites often repeatedly occur in the same place in the sky.

7. **Effect on RF Propagation** At least one researcher has considered red sprites to comprise an infinite vertical slab of plasmas with the ability to backscatter in the VHF/MF RF Bands. The sprite plasma conducting columns are known to produce wide-angle scattering of VLF signals. Further, rapid onset and rapid decay perturbations of sub-ionosphere propagation occurs. The sprite luminosity decays at a much faster rate than the perturbations. Propagation ducting is probably a by-product. Ground-based radar has been used to observe the effect of sprites on propagation in the vicinity of chaff, using both monostatic and bi-static configurations. Hence, sprite effects may be seen on radar.

TERRESTRIAL GAMMA FLASHES (TGFs)

8. A new phenomenon (discovered in the 1990s), known as TGFs, are probably also related to atmospheric lightning. However, the time-duration of TGF (estimated at up to 250µsec) is too short for human observation, which possibly limits at 280µsec and is not, therefore, pursued further in the UAP context (the reader is referred to the Working Paper on After-Images).

BLUE JETS

9. Blue Jet vertical velocities are ~100km.sec⁻¹ at about 40-50km altitude. Another, competitive, phenomenon ('Blue Starters') may also occur.

POSSIBLE UAP LINKS

10. Although the field 'trigger' levels and current flows involved in finally ionising the atmosphere to produce sprites and blue jets in visible form are large (assuming all other field conditions and particle conditions are ready), it is postulated that a situation could exist where the charged atmospheric conditions are at the point of transition in which an **added potential** might cause a trigger to occur. This has been briefly investigated because a ship's Master reported a visual UAP event when his radar was first switched-on (in the Baltic Sea). It is assumed, since this occurred on a merchant ship, that the RF was I Band (standard 9375MHz maritime search).

EXTERNAL ENERGISATION

11. The phenomenon is a gas ionisation process for which, when the right threshold conditions exist an additional field is required to trigger the event. It is believed that, for example, a remote, rather than close-by lightning charge could reach the pre-charged volume and cause the glow to be triggered. A short bibliography is at the end of this paper. Since the initial quantification of the effect is quite recent, the following key attributes are taken from the best available (and most relevant to this study) published papers. Further work would be needed to confirm the postulation that a radar (or laser in some cases) could cause the ionisation to occur, thus making a pre-charged but hitherto invisible mass become visible to the human eye. Although the possibility might be linked with sprites/blue jets it is recognised that the 'added' energy available from terrestrial (or airborne) sources will be low in comparison with the huge energy levels in electrical storms. However, the principle is established that any highly charged gas could finally reach ionisation point by the

addition of extra energy. Hence, it does not seem unreasonable that if swamp-gases, (if they are a component of earthlights), or even incompletely formed ball-lightning, might react to the addition of external energy. This, it is suggested, might account for the so-named 'close encounters of the fifth kind', where, it is claimed by ufologists that an airborne visual object appears to respond to, or be modified, by probing it with a terrestrial beam of energy. Since the shipping incident described at para. 11 above, was at I Band, the implications are that this is at **least** possible with I Band military radars (e.g. Air Intercept Radars) if the critical atmospheric conditions exist.

OBSERVATION OF SPRITES

12. It is clear that a visible and measurable phenomenon of red (Sprites), possible with blue offshoots ('tendrils') or blue (Blue Jet) columns exist; and that they can be seen:

- From aircraft, in particular, because they appear where high-flying aircraft are likely to be.
- Above severe thunderstorms.
- On occasions from ground-level when the cloud-breaks allow a sight-line.

The phenomena appear for a few milliseconds and could be reported as UAPs. Working Paper No. 4 confirms that the human eye will detect and possibly retain an after-image on the retina. Finally, they might be 'triggered' by a radar in the vicinity.

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WORKING PAPER NO. 25

OVERVIEW OF MAGNETIC FIELD EFFECTS ON HUMANS

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OVERVIEW OF MAGNETIC FIELD EFFECTS ON HUMANS

INTRODUCTION

1. As a result of research (and ignoring man-made air-objects which are frequently mis-reported as UAP and other natural though exceptional meteorological phenomena, such as cloud formations), there appears to be four types of electrical charge-related formations that can occur in the atmosphere, covered in the Working Papers Nos. 1,2,10,19 & 21:

- Ball Lightning
- Ionospheric Plasmas
- Earthlights
- Electrically-charged Aerosols.

It is known that visible and invisible fields can be sensed when close to a UAP. In the absence of any other postulations it is assumed that the fields are electromagnetic or magnetic (or both) in nature. Further away from the object only the emissions in the visible part of the electromagnetic spectrum are sensed; as is frequently the case by human observers, photographic film and video camera detectors. The results summarised are those of medical experiments in which the intention was to study the human brain response to external fields, particularly in the area of epilepsy. There is no UAP connection given in the scientific papers. The connection is made here, because of the apparent relevance to this study.

2. The fields investigated for medical purposes in Canada have some common characteristics, and the scenario which, in

'close encounters', reportedly produces 'alien' and similar descriptions, may be the result of the close proximity of one or more of these field types. The difficulty is that little, if any, instrumentation is available when these phenomena occur - hence suppositions rely on theory with few actual measurements on which to base firm evidence. It is clear that, while some screening from field effects can occur when a witness is in a vehicle, this may not be completely effective. Further, electrical/electronic equipment failure or poor performance or partial failure is often reported at the time, both in vehicle equipment, such as radios - including Police radios - and even ignition failure. For the radios, one theory is that a strong (magnetic) field off-tunes resonant circuits in radios which use ferrite-rod type antennas. Since radio components are normally in a metal box, the implication is that the field couples with the antenna, causing a larger than normal current to flow in the antenna and into the front-end receiver coils, mounted on the ferrite rod.

3. Using the near-field ranges, calculated at Working Paper No. 2, and the example magnetic field levels used to cause temporal lobe effects, it is possible to calculate the minimum energy level which must be at the source. Further, those reports where electrical equipment has been reported as unstable (noisy) or even unworkable until the UAP moved away, have always been scenarios where the UAP has been very close - even overhead. Assuming a free-space magnetic field attenuation, proportional to $1/R^2$ and a signal level (at the observer's position) of 1mG, then, for the ranges shown, the source power is calculated, below:

Range (m)	Power at Observer (m. Gauss)	Power at Source (m. Gauss)
1	1	1
5	1	25
10	1	100
20	1	400
25	1	625

NEUROLOGICAL RESPONSE TO MAGNETIC FIELDS

4. On several occasions Persinger, et al [1], carried out measurements on volunteers to assess the (medical/neurological) response to bio-frequency magnetic fields; while making concurrent EEG pattern readings on the subjects. In 1990 18 male and 18 female volunteers (University Students) with ages ranging from 18 to 25 years were exposed to 9Hz, 4Hz, and 16Hz fields, plus a sham (control) field. The field strength was varied 0.3mG to 1.0mG (100nT) and pulsed at both polarisations. The fields were generated by solenoids fed, via a filter circuit, with square waves. The resulting imaging effect was caused by the successive rising and falling edge of the square wave and the components 0.1 μ F, 5.19mH and 5.2 Ω resulted in an impulse, with rise-time <0.1msec. The experimental decrease returned to zero polarity within 0.3msec, proceeded through a maximum reversed polarity at 0.6msec

and then returned to the zero condition at 1.0msec. Thus, the amplitude of the maximum reversed polarity was 1/6 of the initial rise peak; with a positive and negative mirror at the beginning of each wave. Hence (in the first test case) a 4Hz square wave passed through the circuit, generated 4 initially positive and 4 negative pulses per second. The test chamber was opaque to any other radio interference.

5. **Temporal Lobe Activity** A significant temporal lobe activity was registered. These areas are the most electrically labile of the human brain. It was demonstrated that people who already possess high levels of activity in this area are likely to experience:

- Mystical or paranormal activities
- Fear
- 'Out of body' activities
- Tingling or vibration.

6. The psychological profile of such people is that they are naturally disposed towards inordinate interests in poetry, mystical or the paranormal, philosophical (religious) and a sense of special purpose, whereby infrequent or unusual events (such as transient social or astronomical events) acquire a special, personal, meaning. There are strong connections between temporal lobe response activity and epilepsy.

7. Major factors of interest are that the experiments were made in an acoustically screened (as well as Faraday) chamber to exclude sounds which could be detected and responded to by the temporal lobes. Hence, all responses were caused by

the only influence present - the magnetic fields.

8. Two further important factors are noted:

- No artefacts were present in the test area to visually suggest themes (for example a space theme is known to evoke 'alien' presence, a religious artifact is known to evoke reflections on death etc.).
- Elaborations and attributions are known to depend on the personality of the subject. People who display frequent temporal lobe signs generate more frequent and intense experiences.

The former was circumvented by placing the subjects in a plain chamber with low intensity red lighting. The second was, to an extent, reduced by taking an adequate population sample.

9. Instrumentation placed on the subject's head measured the temporal lobe bipolar electroencephalographic activity. Test results (which overlap with separate experiments with 85 volunteers, described at paper[1], below) are combined at Table 1. There was a general increase in all classes of experience when the fields were at 4Hz and 9Hz, compared with the 16Hz (and sham) values. It was noted that people who display more intuition (than sensing), perceiving (than judging) and feeling (than thinking), tend to display enhanced

temporal lobe signs. The intensity of the spinning and tingling were less than the other 'symptoms' reported.

10. In 1991 Persinger et al continued their neurological experiment, with human subjects. This time they were exposed to spatially-rotated complex magnetic fields applied across the temporal lobes of the brain. It was discovered that the fields markedly increased the interaction with the neuro-electrical ensembles. Several field frequencies and pulse patterns were used. The results indicate that a person's temporal lobe profile affects the types and intensities of experience reported when exposed for short periods to fields of this type. The full list of 'symptoms' produced is shown at the matrix at Table 1. They appear to be amazingly similar to those reported by people who have had close encounters with a UAP. The words used in the Table are those reported by the 85 male and female volunteers (20 to 37 years).

11. **Magnetic Flux Levels** The magnetic field strength was 1mG (100nT). A 16Hz pulsed wave generated more experiences of thought intrusion than a 4Hz wave. A **positive** feedback ringing (also at 4Hz) evoked more visual memories and image than the mirror image of the same wave. The effects included vivid visual sensations, memory fragments, a sense of intense meaning, intrusion of ideas or images, mystical experiences and alterations of boundaries defining 'self'.

12. It was deduced that an applied magnetic sine wave would be minimally effective (compared with the filtered square wave used) **unless** the

current densities are sufficient to produce potentially dangerous disruptions in neuronal assemblies.

13. During the experiments the 1Hz to 1kHz magnetic ambient background level was 0.025mG (2.5nT) and hence was negligible. The **rotating** magnetic field was either applied in a ringing or in a pulse burst format (see Fig. 1). The field spatial rotation, presented with four solenoids, comprised patterns of four 4 per second rotated once every two seconds. The research showed, once again, that the phenomenological profile of a person within the experimental setting is a function of his (or her) temporal lobe sensitivity, the demand characteristics of the setting and the magnetic field patterns.

14. The conclusions of the experiments showed that:

- Magnetic fields, rotated bilaterally once every two seconds (over the subject's temporal region) evoked stronger and more frequency experiences than when the field was static.
- Moving yellowish-green and purplish lights were only reported when the field was 'ON'.
- The only 'frequency-specific' effect (within the 4-16Hz region used) was in the enhanced number of thought intrusions when at 16Hz, rather than at 4Hz.

- Smells were reported (when clearly there were none in the test-chamber in reality).
- Normal people, placed in exotic introspective-oriented settings, report experiences that suggest temporal lobe signs and symptoms.
- There is some suggestion that effects might be cumulative.
- The sensitivity of time response as well as what is 'seen or felt' is likely to be conditioned by the subject's personality.

15. In 1996 another experiment was made[3] when another 33 subjects were exposed to four test conditions, a control (sham), left lobes, right lobes and both left and right together. The field level was 10mG (1 microT) and with 1mG (or 0.1 microT) applied on the other side. Exposure periods lasted 15 minutes (Three segments of five mins on, five mins off). The objective was to investigate long term memory effects. The group whose **left hemispheres** had been exposed exhibited approximately **twice** the number of accurate ideas relative to other test conditions. The results show that the complexity of the 'signature', or the 'information' within a magnetic field may be more important than its intensity.

KEY FINDINGS

16. The key question is what does this all mean in the UAP context? The

following observations are considered important.

(a) As seen at Table 1 the effects on a human of weak magnetic fields, used for the neurological experiments described, are uncannily similar to those reported by witnesses who have had 'close encounters' with a UAP. The effects experienced depend upon the phenomenological profile of the person.

(b) If a human brain is affected in this particular way it seems logical that a UAP might be emitting similar levels of magnetic energy, since it produces the same effect on an observer.

(c) In the wider context the 'alien', 'time lost', 'spaceship' and other descriptions only ever occur when the observer is very close to the UAP - implying that the human is probably within the UAP near-field and that magnetic (or electro magnetic) emissions are given off in which at least some fall within the energy levels given, at the point where they reach the observer. Clearly, if the observer is some distance away, to achieve an adequate level the signal source must be greater and attenuated by the time it magnetically couples with the subject.

(d) A magnetic field is not the only emission from a UAP, as visible colour emissions are seen by observers at all distances and, on occasions heat is also reported. A spectrum of emissions is, reportedly, present during the medical experiments carried out.

The magnetic field strengths used on the human volunteers, although low, had a dramatic effect. It seems likely that very much stronger source fields must emanate from UAPs if:

- The memory effects last longer.
- The magnetic energy is, reportedly, sufficient to disrupt electronic and electrical equipment, some metres from the UAP.

17. The magnetic field from a UAP could be directional (even highly so) - hence relative aspect of an observer or equipment nearby, to peaks and nulls of magnetic field, might also determine the local effects. The orientation (left or right temporal lobes or both) of the humans to the received direction might be critical.

18. With reference to Table 1 it should be noted that these responses were obtained in a test chamber with zero visual stimulation. If the subject **was** confronted with a visual stimulation in the form of a nearby UAP it can easily be appreciated how the 25 responses listed could, however unwillingly, fit into an 'extra-terrestrial' scenario in the mind of the subject. It is clear that the effect could

be sufficiently vivid as to be so real to the witness(es) concerned to warrant a UAP report to the authorities. In 20 out of 25 instances the reports due to the magnetic fields in the test chamber tally with effects felt and reported during close proximity to a UAP. Close encounters are infrequent; witnesses at greater distances do not report these effects. It seems logical to conclude that they are at a range where the field energy is negligible. If the effect is caused purely by a magnetic field, then it seems likely that the field exists between the UAP and earth, with the flux lines 'leaking' to earth sensibly mostly beneath the object, with some fringing effects.

COMPARISON WITH THE EARTH'S NATURAL MAGNETIC FIELD

19. Working Paper No. 12 briefly reports on the natural magnetic field to which every citizen is exposed. It is noted that this amounts (average at mid latitude for the UKADR) to a gamma field value of about 48,850. [Also expressed as 0.485 Gauss or 48,500n Tesla]. Hence, as noted at para 4 above, the bio-magnetic field was only 100nT (i.e. nearly 500 times less than the natural field). **The key observation is that although very weak in comparison, unlike the earth's field, the experimental field was pulsed/rotated.** It therefore seems possible that fields produced by one or more plasma types listed at paragraph 1, above and for example, a plasma conceptually produced by a meteor may radiate. It may also 'pulse' (though, of course, not necessarily at the same rate observed visually; where witnesses very close to UAP events

often report 'pulsating lights' and even 'pulsating sounds').

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[2] M.A Persinger et al. "Differential Effects of Waveforms and the Subjects Possible Temporal Lobe Signs.....Magnetic Fields". J of Bio-Electricity. 10 141-184 1991

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Experience Number	Magnetic Field Experiments	% of Occasions	Reported UAP Effect Correlates
1	'Felt Dizzy or Odd' ^[2]	80	✳
2	'Felt presence of someone or something' ^[4]	36	✳
3	'Felt Tingling Sensations'	76	✳
4	'Saw Vivid Images' ^[3]	65	✳
5	'There were pleasant vibrations'	67	-
6	'I felt as if I had left my own body (detached from)'	46	✳
7	'I experienced anger'	20	[7]
8	'Experienced sadness'	37	[7]
9	I heard a ticking sound'	50	✳
10	'There were odd smells'	9	✳
11	'There were odd tastes in my mouth'	13	✳
12	'I felt as though I was somewhere else'	69	✳
13	'Experienced childhood thoughts'	42	[7]
14	'Same idea kept recurring'	77	✳
15	'Felt as though spinning' ^[1]	36	✳

Experience Number	Magnetic Field Experiments	% of Occasions	Reported UAP Effect Correlates
16	'Dream-like images'	32	✓
17	'Lights varied in intensity'	16	✓
18	'Experienced fear or terror'	40	✓
19	'I felt the experiences did not come from my own mind'	20	✓
20	'I cannot move'	[6]	✓
21	'Colours blue-purple' ^[5]	[6]	✓
22	'Colours yellow-golden' ^[5]	[6]	✓
23	'red-yellow' ^[5]	[6]	✓
24	'I am moving forward through a closed space on all sides'	[6]	✓
25	'Floating'	[6]	✓

- Notes:
- [1] "I see something mechanical turning round and round"
 - [2] "I am flying in the sky"
 - [3] "I see bats and birds flying"
 - [4] "There is something in here with me"
 - [5] "Colours are seen in order, first No. 21, then 22, then 23".
 - [6] No percentages were given in the results published
 - [7] The experiences 7, 8, 13 are not observed in any UK UAP reports. It is, of course, possible that these responses are suppressed by the fact that (unlike the medical experiments) UAP witnesses are additionally confronted with the strong visual stimulus of a steady or fluctuating bright white or coloured object in close proximity.

TABLE 1: CORRELATION OF MAGNETIC EXPERIMENTS AND UAP REPORTS
 25-8

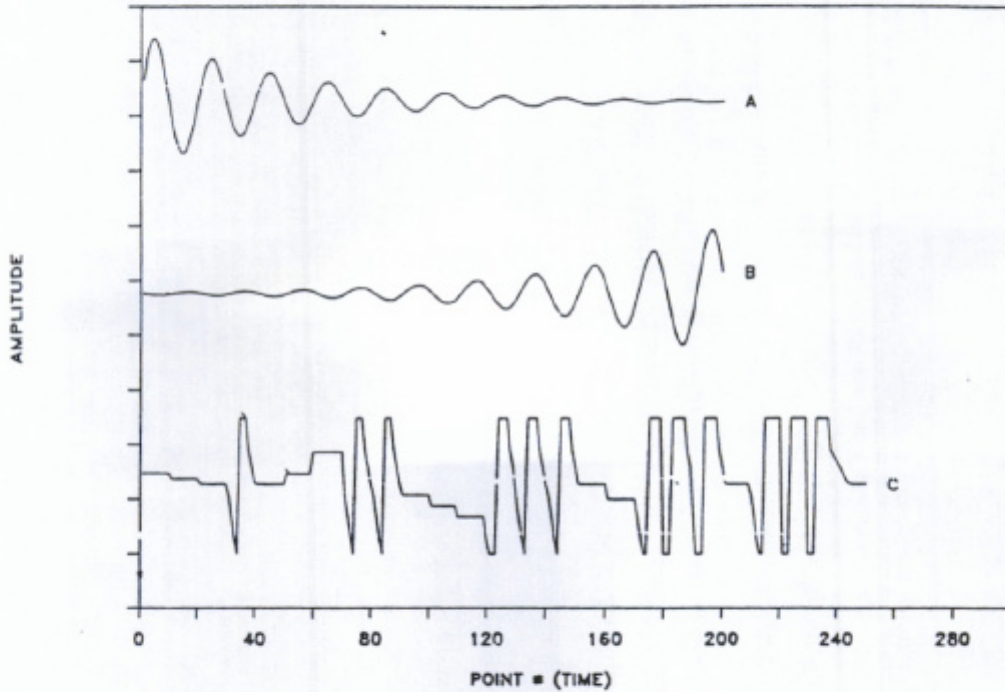


FIGURE 1: RINGING & BURST MODE MAGNETIC MODULATIONS

NOTE: HORIZONTAL SCALE IN MILLISECS

