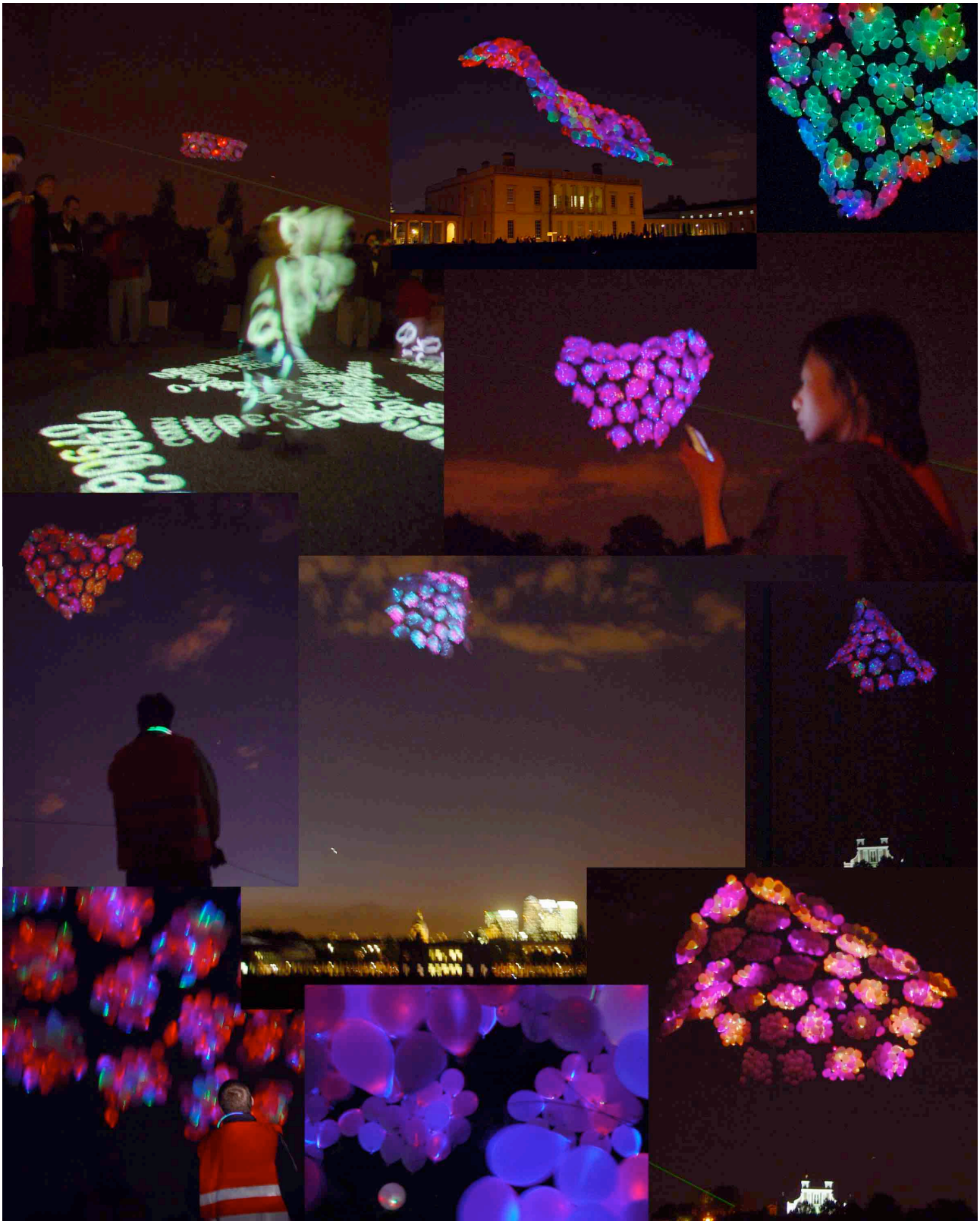
Sky Ear

By Usman Haque
www.haque.co.uk
Final Report, October 2004



With the financial assistance of The Daniel Langlois Foundation for Art, Science, and Technolgy

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SKY EAR FINAL REPORT

Sky Ear has now flown twice and it will fly again!

The maiden flight was in early July 2004 in Fribourg Switzerland; it flew as part of the Belluard Bollwerk International (for which it won the Creation Prize, 2004). The second flight, loaded to full capacity with 37 phones and 1000 sensors and balloons, took place on September 15, 2004 at the National Maritime Museum, Greenwich, London.

After three years of dreaming and planning and more than one year of full-time design, construction and preparation, finally the work was done, the test-flights over and the weather cleared for us. Sky Ear broke free from the confines of gravity and drifted like a glowing jellyfish above us....

Project history

The story begins in my studio in Japan several years ago. I was wandering around trying to find good reception on my mobile phone. The indicator bars on the phone screen went up and down as I moved from one side of the room to the other, and fluctuated even more as I wandered around the building and the field outside. I started to imagine the undulating qualities of an invisible topography that surrounded me: the varying electromagnetic fields (EMF) that are present everywhere and that guided me to certain parts of the room and certain areas of the complex.

I realised that these intangible phenomena affect the way we related to space and to each other in much the same way that traditional architectural elements do -- they make us move to particular parts of a building, they condition the movements we make and how we make them and, through devices like mobile phones, they have a direct impact on the way we associate with other people. Apart from issues arising out of being in contact virtually anywhere, anytime, the mobile technologies through which we conduct our daily lives have made us far more aware of the electromagnetic environment that envelops us.

We are concerned about the health effects of electromagnetic radiation (from power lines or mobile phone handsets) and this has further spatial implications. Yet these waves often exist as natural phenomena in the form of radio waves emanating from distant stars, gamma rays coming from elements here on earth or even electrical waves from inside our own skulls. Humans have only recently begun contributing to the cacophony with their pagers, medical devices, televisions broadcasts and mobile phones.

This is an abundant, invisible territory, that is altered in shape and intensity by both natural and human-constructed landscapes. Interactions with built fabric are even more clear with the implementation of wireless computer networks, for example the 802.11 standard that is increasingly being used in homes and offices to create local area networks. In such networks the positions of furniture, the thickness and material qualities of walls, doors and windows or the distance from a base station contribute to the varying quality of a network connection, and therefore feedback on the way we use such spaces. These variations in field strength suggest a richly textured ethereal cartography of space that affects us but which we only know about through use of our instruments.

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Sky Ear design process

With Sky Ear, I wanted to give form to this space, to make visible the invisible. The original concept was to create a "radar sweep" that would move through space and light up as it encountered varying intensities of EMF. I planned to create a large structure, of about 25m in diameter, that would float up into the sky sampling the electromagnetic environment as it moved, and changing colours as it encountered different qualities of space. I realised that by embedding mobile phones inside the cloud and then calling into them, one could actually change the local EMF to create different patterns of response.

The final design was a carbon fibre frame consisting of 37 circles joined to form a non-rigid structure to which 1000 extra-large helium balloons are attached. The balloons function both as buoyancy/flotation devices and as diffusers for the 6 ultra-bright LED lights (which mix to make millions of colours) controlled by individual sensors inside each balloon. The balloons can communicate with each other via infra-red; this allows them to send signals to create larger patterns across the entire Sky Ear cloud.

As visitors call into the different mobile phones in the cloud, they listen to the distant electromagnetic sounds of the sky (called whistlers and spherics, which are the audible equivalent of the Aurora Borealis). Their mobile phone calls change the local electromagnetic topography and cause disturbances in the EMF inside the cloud that alters the glow intensity and colour of that part of the balloon cloud. Feedback within the sensor network creates ripples of light reminiscent of rumbling thunder and flashes of lightning.

The cloud shows both how a natural invisible electromagnetism pervades our environment and also how our mobile phone calls and text messages delicately affect the new and existing electromagnetic fields. As an art project, Sky Ear encourages people to become creative participants in an electromagnetic performance; as an architecture project, Sky Ear makes visible our daily interactions with the invisible topographies of hertzian space.

Overview of the report

This document should be read as extension of the Interim Report, submitted in December 2003. It therefore does not cover material already discussed then (overviews of experiments covered up to the end of 2003). Instead this report documents subsequent experiments, though not exhaustively – only the most important test flights and experiments are included here.

In addition, this report includes overviews of the two flights, publicity and press clippings from before and after the flight, and drawings used during the design and production process. It concludes with a breakdown of the expenditure on the project.

Finally, it will be noticed that the last experiment ends with recommendations for alterations necessary for a future flight. This is because the project Sky Ear is an on-going work and has no definite end. It will continue to grow and change as new venues and funding opportunities are found.

It is with immense gratitude that I thank the Daniel Langlois Foundation for Art, Science and Technology for the support that made this project possible. The entire process has been a defining experience for me and everything I do from now will be affected by it. Thank you for everything!

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Sections

Additional material

Further information about the project and its process can be found at:

http://www.haque.co.uk/skyear

In particular, a Quicktime movie documentary of the Fribourg flight is located at:

http://www.haque.co.uk/skyear/final-skyear-large.mov

High resolution photographs from Fribourg are in this folder:

http://www.haque.co.uk/skyear/hires/

And photos from the London flight here:

http://www.haque.co.uk/skyear/hires/NMM

Archive documentation of the Fribourg webcast is here:

http://www.haque.co.uk/skyear/webcast.mov

Articles online about Sky Ear:

http://architettura.supereva.it/artland/20040918/index.htm
http://telephonyonline.com/ar/telecom_talk_broadband_economy_56/
http://www.thefeature.com/article?articleid=100552
http://www.sciencemag.org/cgi/content/summary/304/5671/677b

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SKY EAR FULL SCALE EXPERIMENT II (LARGE BALLOONS)

4mx4m net (multi-mono netting, 7cm mesh size, total weight 344g)
4 tethering ropes (60m length each, size 6N, 170kg break strain, 2.9g/m)
100 Standard White Balloons (16" Qualatex with safetite disc)
16 Standard White Balloons (24" Qualatex with safetite disc)
Spur Gear Hand winch (Model W06 S512 320Kg pulling capacity)
50 Kg hanging scales
6 event staff (1 Choreographer, 4 pilots, 1 photographer)
6 walkie talkies (Binatone MR600 handsets)

A full-scale (1/10th size) 4mx4m prototype of the balloon filled net structure was deployed on-site at the National Maritime Museum on the lawn in front of Queens House. The local weather report indicated wind speed of approximately 15mph.

One hundred 16" balloons were placed loosely inside the net bag. A further sixteen 24" balloons were arranged in a 4x4 grid fixed to the top of the net. Various techniques were used to attempt to fly the cloud. Observations were made on the ease of launch and relative success of each launch strategy.

Again, one person choreographed the movements of the four 'pilots'. Communication was via walkie-talkies with hands-free headsets.

The total weight at full deployment (accounting for ropes, netting, balloon, safetite discs, etc. in addition to buoyancy of the helium) provided a net lift of approx. 4.5 kg. This was greater than the last full size experiment and more closely matched the expected proportional lift in the final structure.

During the experimentation, at various intervals, several of the balloons were popped in order to test the cloud under varying lift and surface area conditions.

As an on-site event, this experiment was also undertaken to make approximate calculations of total inflation time required and to determine the efficiency of using walkie talkies to communicate and coordinate.

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SETUP

The net was quite badly buffeted by the wind during setup even though wind conditions were relatively good. A number of balloons were punctured as they hit the floor or columns in the collonade that was used as preparation area. It was eventually decided to finish the inflation process outside of the columns. Some balloons were lost when they escaped before being attached or placed inside the net.

With three people working, it took approximately one and a half hours to inflate, seal, connect and insert all 116 balloons.




In the final event it is expected that much of the preparatory work will be done prior to the event in order to decrease set up time. One possibility for coordinating the whole inflation/setup process could be to have several 4mx4m net bags made (e.g. 25 for a 5x5 grid). Each of these will be prepared separately by teams of 1 or 2 people. Just before launch these 25 bags will be joined together.

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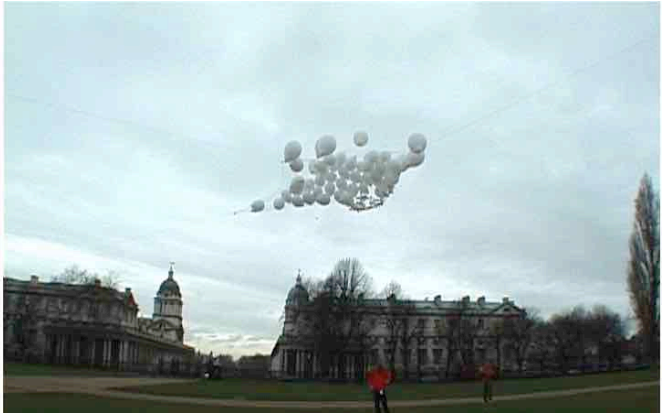
LAUNCH STRATEGIES

1. Vertical
The balloon net was placed between the four pilots placed at the corners of a large square and released into the air. The net rose steadily as long as pilots paid out rope quickly enough. However, as soon as the net reached the stronger air currents coming off the top of nearby buildings it was buffeted down again.

2. Diagonal, in the direction of the wind
The balloon net was placed outside the pilots' square at a distance of approximately 20m with wind coming behind it. The net was released and allowed to rise up as it drifted towards the pilots with the wind. The maximum height achieved was approximately 20m, but as soon as the net passed vertically over the pilots square and continued to drift beyond it, tension in the tethers caused it to sink once again.



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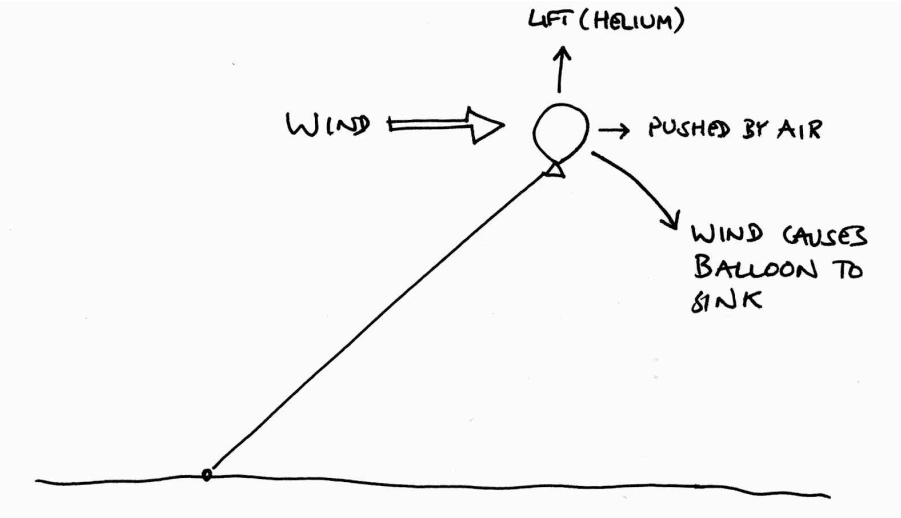
3. Moving launch
Set up was similar to Launch strategy 2, but pilots ran with the net as it rose. This was unsuccessful because it was difficult to coordinate speeds between the pilots (the net tended to drag behind) and they rapidly ran out of room to manoeuvre.

Though wind conditions were much better than in the previous experiment, it proved much more difficult to raise this version of the cloud much higher than 15 or 20 metres. This was due in part to wind shears that appeared to be arising at the top of surrounding buildings. In order to counteract the wind force, at several stages a number of balloons were released or popped in order to provide the balloons with more room to move inside the net and to decrease surface area of the cloud. This was not generally successful because the net lost correspondingly large amounts of vertical lift.

However, the lift problem was also largely due to a general problem with tethering floating structures: a sideways force applied to a rising balloon which is fixed at one point will always tend to push the balloon downwards.



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It is not clear how this might best be surmounted. One possible solution may be to craete a flat clear surface on the underside of the net to create a more aerodynamic surface so that the cloud may be flown like a kite.

At the end of this document are sketches of possible alternative configurations for an EMF sensing cloud. It may be useful to model the movements of balloons in wind using ping pong balls in a bathtub.

WALKIE TALKIES

Though much better than the previous attempts at communicating by shouting across the field, the walkie talkies employed were still unsatisfactory.

First, sound quality was not sufficient to ensure good communication in a stressful situation. Second, they do not allow simultaneous talking and listening. As the launch will require 5 people coordinating with each other it is important for everyone to be able to hear each other and talk as necessary with free hands. The Binatone handsets do allow for handsfree talking, but whenever anyone coughed or if wind spiked in the microphone, everyone else's communication was obstructed.

As an alternative, a children's two-channel headset was tested which gave much better results: simultaneous two way communication was possible and the sound was clear. However, the sound dissolved into static at a distance of just over 20m rendering them unsuitable for the final event, where pilots could be spread at a distance of approximately 60-80m across the lawn.

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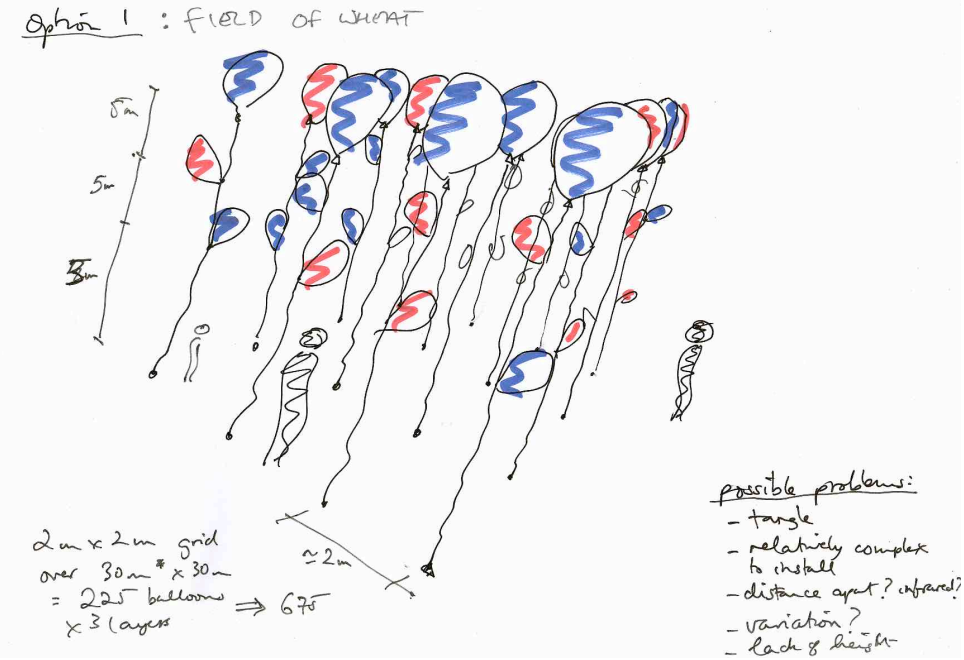
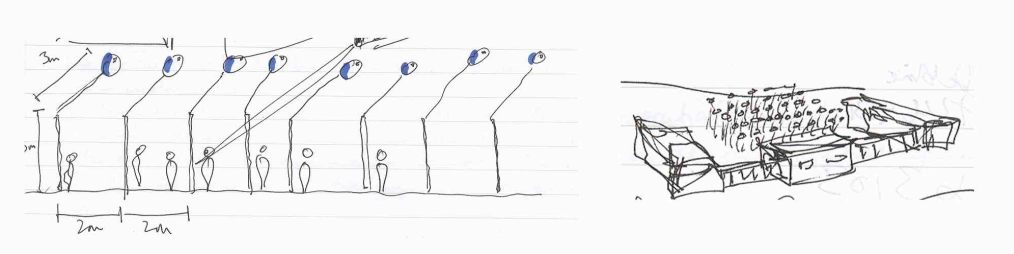
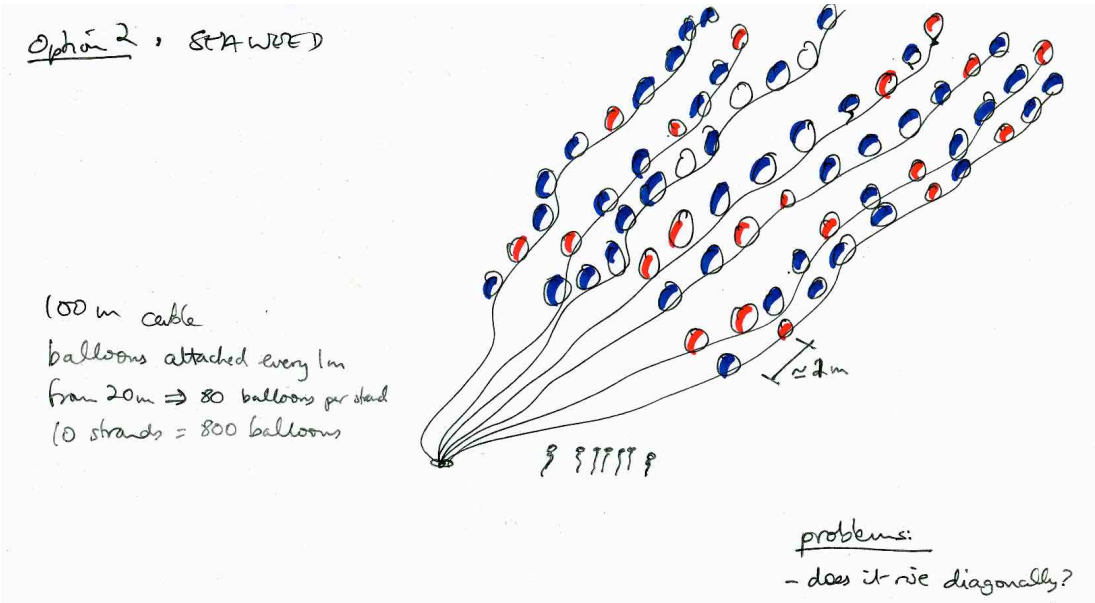
OTHER OPTIONS







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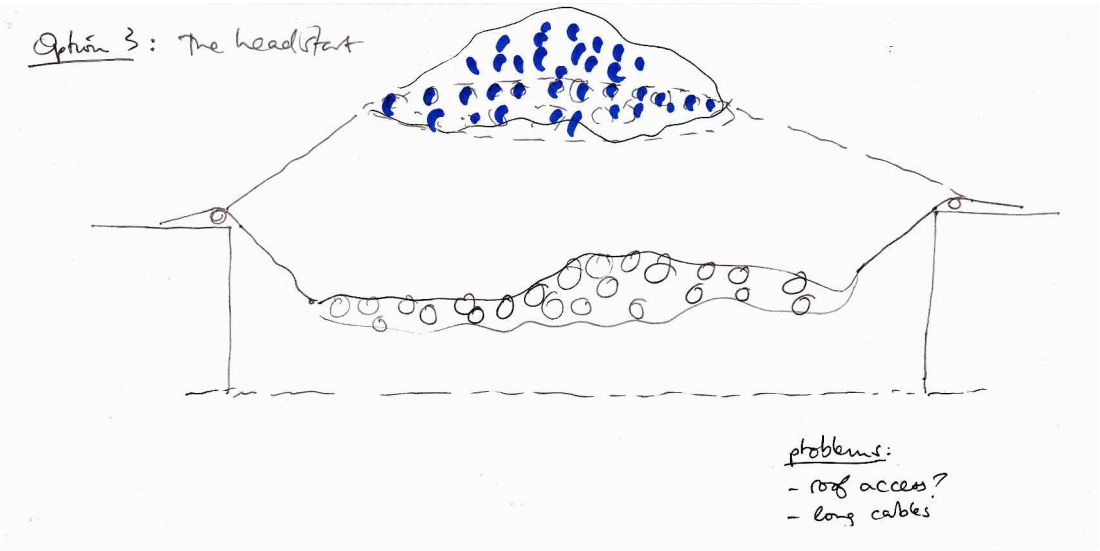

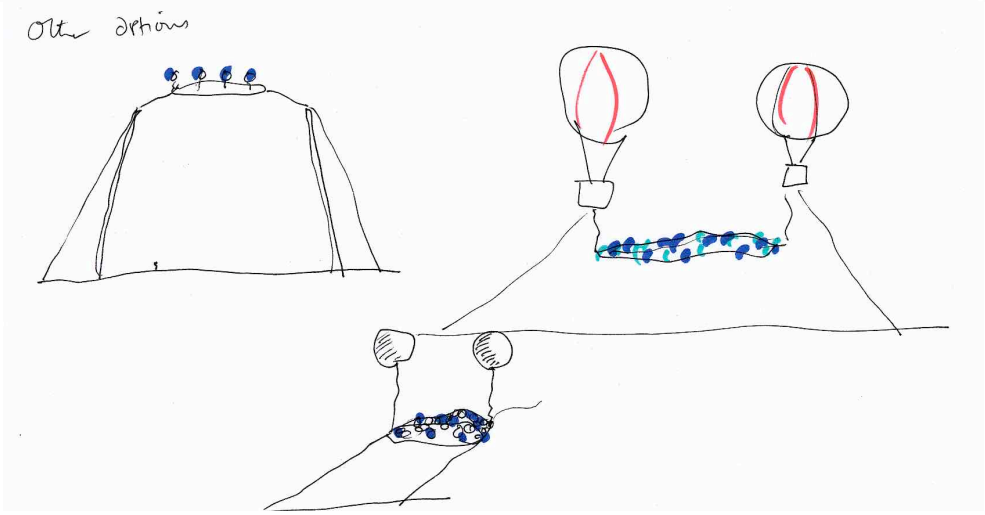

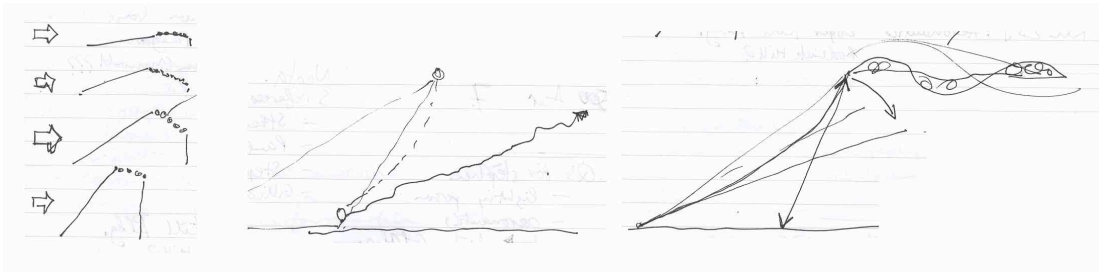

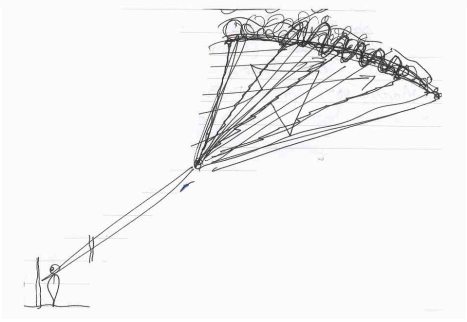

Invisible topographies

Usman Haque

Mobile phones are not only communication tools, but also sensors of the invisible electromagnetic environment that surrounds us, making us aware of what has been called "hertzian" space. London-based architect Usman Haque, who designs interactive architecture systems and researches how people relate to each other and their spaces, introduces us to hertzian space: his art project "Sky Ear" reveals the richness of our electromagnetic habitat.

Usman Haque's site http://www.haque.co.uk

Like the banks of the River Nile, the boundaries of art and architecture are constantly changing. They expand and recede, cover new territory and expose old presumptions. As their boundaries shift, the distinctions between art and architecture become less clear. Architecture, the design of spatial experience, and art, the production of cultural experience, have not for several centuries shared as much common ground as they do now.

The overlapping territories of art and architecture have come about in large part because of technological developments that upset conventional understandings of spatiality. Traditional dichotomies between audiences and performers, designers and users, architects and occupants are less evident than they used to be. Wireless technologies in particular have challenged our relationship to designed space because they encourage us to think not of static silent structures that surround us but rather of fluid dynamic fields beyond the edge of our natural perceptions, fields within which we are all consumers and all contributors.

Mobile communication has relied equally on scientific and cultural evolution and has prompted a distinct shift in the way we relate to space and the way we relate to each other. Apart from issues arising out of being in contact virtually anywhere, anytime, the mobile technologies through which we conduct our daily lives and businesses have made us far more aware of the electromagnetic environment that envelops us.

Electromagnetic waves exist just about everywhere in our atmosphere. Visible light is a form of electromagnetic radiation, as are infrared and x-rays. Even radio and television broadcasts and the microwave wavelengths of mobile phones are part of the electromagnetic spectrum. Electromagnetic waves can be detected and measured using a gaussmeter; the intensity of an electromagnetic field varies greatly with the distance from the source and the material qualities of the substances (walls, air, windows) in between.

While we have been concerned about the health effects of electromagnetic radiation (from power lines or mobile phone handsets), these waves often exist as natural phenomena in the form of radio waves emanating from distant stars, gamma rays coming from elements here on earth or even electrical waves from inside our own

skulls. Humans have only recently begun contributing to the cacophony with their pagers, medical devices, television broadcasts and mobile phones. This abundant invisible territory, a topography that is altered in shape and intensity by both natural and human-constructed landscapes, has been called "hertzian space" by industrial design theorist Anthony Dunne. He has observed that hertzian space is often ignored by designers saying, in Hertzian Tales, that the "material responses to immaterial electromagnetic fields can lead to new aesthetic possibilities for architecture."

Most of us are familiar with buildings where signal strength is variable, or rooms where mobile calls are possible in one corner though it is impossible in another even to make a connection. There are areas in some buildings where one mobile company's network penetrates while others are unable to. These interactions with built fabric are even more clear with the implementation of wireless computer networks, for example the 802.11b standard that is increasingly being used in homes and offices to create local area networks. In such networks, the positions of furniture, the thickness and material qualities of walls, doors and windows or the distance from a base station contribute to the varying quality of a network connection. These variations in field strength suggest a richly textured ethereal cartography of hertzian space, a real (i.e. non-virtual) space that affects us but which we only know about through use of our instruments.

Our mobile phones have, in the form of a signal strength indicator, sensors that measure this invisible electromagnetic radiation as we drift from cell to cell of a mobile phone network or from room to room among the varying densities of a building's construction materials. These simple devices, acting as gaussmeters, indicate the network durability of our phones and prompt us to imagine mapping out the contours of mobile phone microwave intensity (or hertzian microclimates) around furniture in a room or buildings in a city.

Through such use of our phones we have become more aware of the interactions between what might be called 'hardspace' and 'softspace'. Hardspace, like the hardware of a computer, refers to the solid, static structure of our built environment: the walls, the floors, the roof. Softspace, again paralleling computer software, refers to the ephemeral qualities that make up our experience of space, including smells, sounds, temperatures and of course electromagnetic waves.

We are aware that hardspace affects our ability to make mobile phone calls because it has a direct effect on the electromagnetic intensity of the signal; what we often forget however is that the very act of making a mobile phone call also changes hertzian space because the phone itself becomes a transmitter of microwaves. We notice a materialisation of this process while talking on a landline: a few seconds before a nearby mobile phone makes or receives a call a distinct galloping beat is heard on the landline handset as the impinging microwaves penetrate the wired connection and ripple local hertzian space. Flashing stickers and accessories can be added to mobile phones to light up when a call is made or received. Such

inexpensive devices are passive inductors of particular microwave radiation and function as consumer-friendly indicators of increased electromagnetic intensity.

These phenomena have helped blur boundaries between art and architecture because operating creatively in hertzian space requires the exploration of concepts and correlations that have never before been encountered, particularly with regard to their effect on cultural activity. We begin to read cities as more than just a collection of destinations – they are overlapping fields of differing experiences and logics. We are able to explore a ghostly poetic ecology that exists just beyond our familiar perceptual limits (see, for example, "Lost Cat" and "Stampede" by Ben Hooker and Fiona Raby, in which people track a cat or a herd of reindeer moving through hertzian space; "Urban Tapestries" by Proboscis, a framework for location-based mobile content; "Spatial Memory Architecture" by Hoshi Takuya where people store memories in three dimensional hertzian space throughout a city; "Remain in Light" by Haruki Nishijima, where an electronic insect "net" is used to capture electomagnetic waves discovered while walking round a city).

Flirt/Stampede
http://www.interaction.rca.ac.uk/research/projects_card/flirt/text.html

Urban Tapestries
http://www.urbantapestries.org

Spatial Memory Architecture
http://vision.mdg.human.nagoya-u.ac.jp/isea/program/E/artists/a432.html

Remain in Light
http://www.fundacion.telefonica.com/at/vida/paginas/v4/eharuki.html

The fact that such explorations often have no immediate commercial application tends to make us place them in the domain of art. However, since there is an explicit effect on the nature of our relationship to space, and since architecture is in some sense the choreography of spatial relations, it would suggest that operating within hertzian space entails architectural processes and conceptualisations.

To investigate these themes, I have developed several projects involving mobile phones, the first of which in 2000 was a performance/installation entitled "Japanese Whispers". In this project, 20 mobile phones were laid nose-to-toe in a circle. Calls between the phones were initiated in a variety of patterns (neighbour to neighbour or across the circle) and the ambient sounds and voices of participants were input into the mouthpieces to be propagated through the phones and mobile phone network. The resulting feedback loop delayed and distorted the sounds through the iterative process of being digitised, transmitted, output and re-digitised. While not exploring the features of hertzian space itself, the aim of the project was to look at how the communication process is affected by translations from the physical medium to the hertzian medium and back again.

Japanese Whispers and other works http://www.octodog.com/usman

Now, following on from previous investigations and experiments into the qualities of softspace (including smell, sound and temperature) I have been developing a project named "Sky Ear" to explore the hertzian habitat above Greenwich Park in London. London has a diverse and vibrant hertzian culture, with mobile phone calls overlapping text messages, combining television broadcasts with garage door openers that interfere with radio transmissions which transmit from wireless laptops, etc. – a tumultuous electromagnetic space.

In order to chart this unexplored territory, shortly before dusk in Spring 2004, the Sky Ear cloud will be released from its ground moorings and slowly float up into the sky sampling the electromagnetic spectrum as it rises, rather like a vertical radar sweep. The cloud, made up of several hundred glowing helium balloons, will be embedded with mobile phones. The balloons will contain miniature sensor circuits (simple gaussmeters) that detect levels of electromagnetic radiation at a variety of frequencies. When activated, the sensor circuits will cause ultra-bright blue LEDs to illuminate. The cloud will glow and flicker brightly as it passes through varying radio and microwave spaces.

As visitors to the event call into the cloud to listen to the distant electromagnetic sounds of the sky, their mobile phone calls will change the local hertzian topography; these disturbances in the electromagnetic fields inside the cloud will alter the glow intensity of that part of the balloon cloud. Feedback within the sensor network will create ripples of light reminiscent of rumbling thunder and flashes of lightning. People may find that they are in the process collaborating with others to create patterns of light activity across the surface of the cloud.

The cloud will show both how a natural invisible electromagnetism pervades our environment and also how our mobile phone calls and text messages delicately affect the new and existing electromagnetic fields. As an art project, Sky Ear encourages people to become creative participants in a hertzian performance; as an architecture project, Sky Ear makes visible our daily interactions with the invisible topographies of hertzian space.

Sky Ear will be open to the public and is financially assisted by the Daniel Langlois Foundation for Art, Science and Technology.

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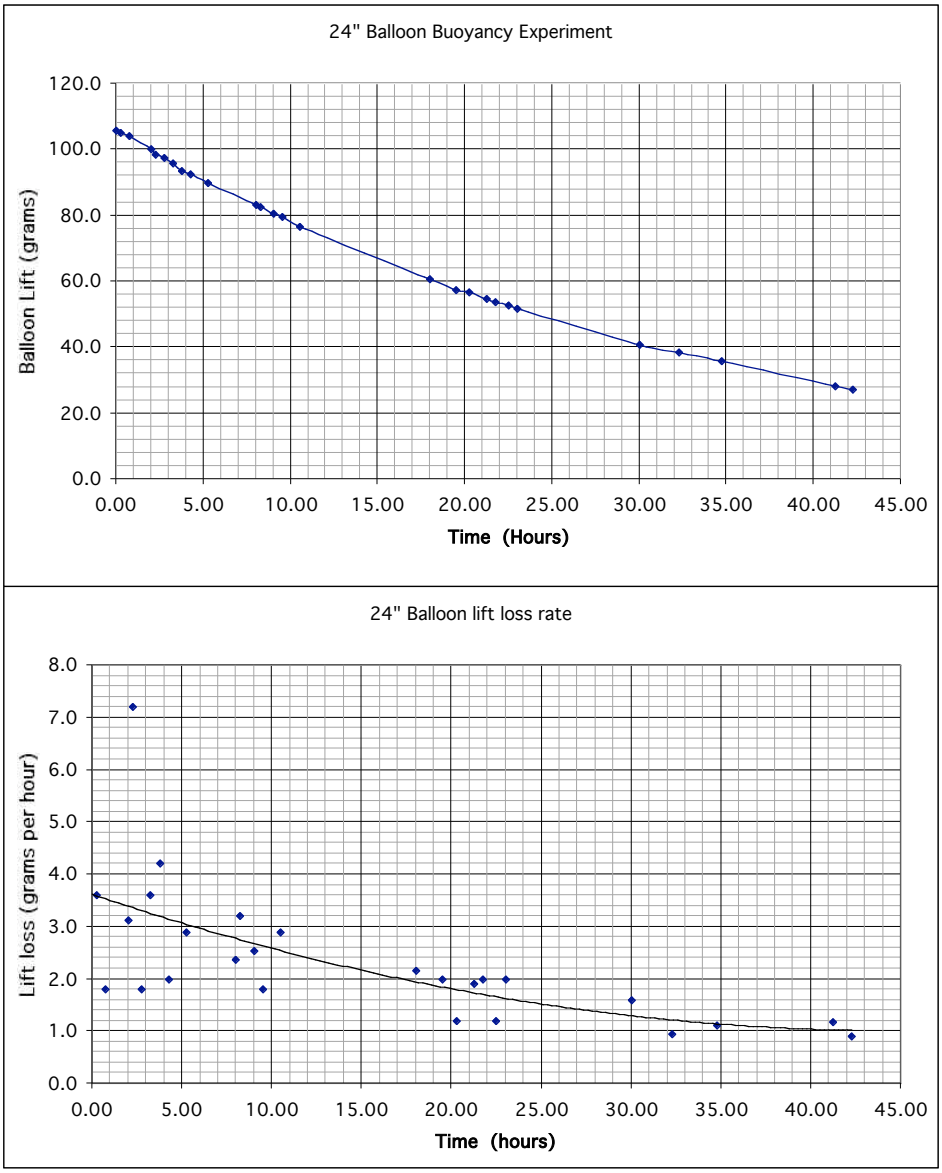
HELIUM DISSIPATION EXPERIMENT

Setup time during the final event will be minimised by preparing as much as possible in the days before. However, helium inflation will have to be carried out on the day because of the relatively high quantities that are dissipated over the hours between inflation and actual launch.

It is vital to determine the precise amount of dissipation in order to ensure that the cloud can still lift once all balloons have been inflated; e.g. if it takes 4 hours to inflate all the balloons, those that were inflated at the beginning need to remain buoyant enough to continue to lift themselves and the weight of electronics, tethers, mobile phones etc.

A series of experiments were undertaken to determine the rate of helium dissipation in two different sizes of balloon.



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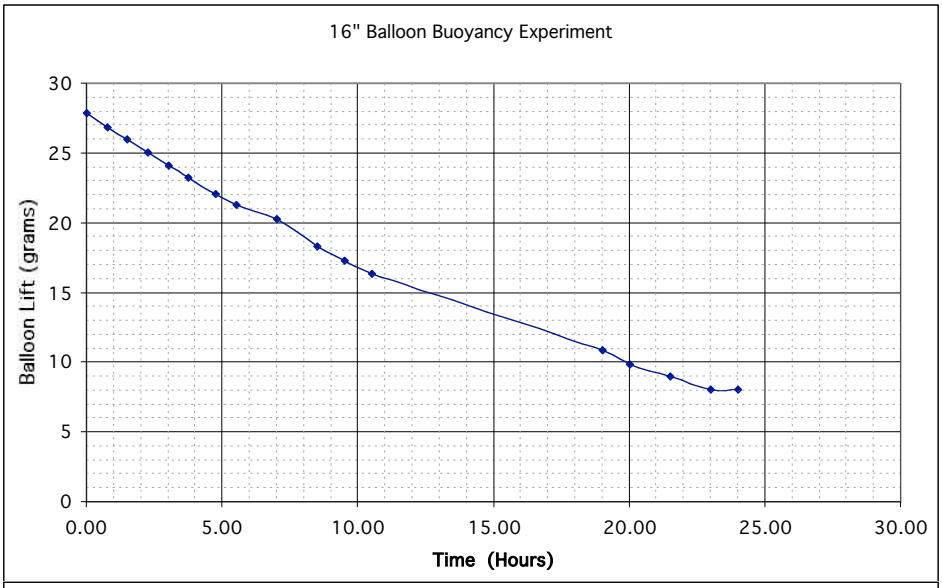

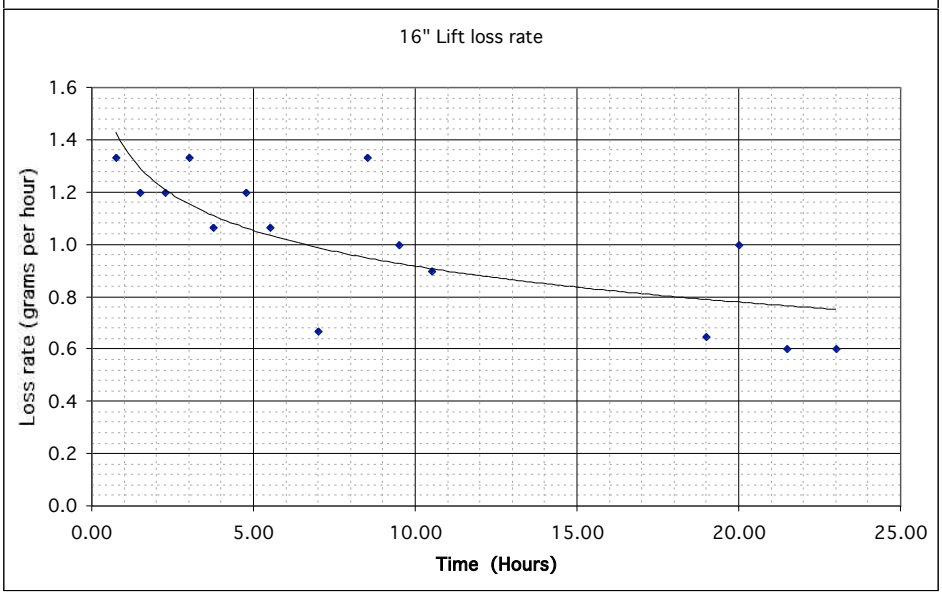

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SKY EAR FULL SCALE EXPERIMENT II (LARGE BALLOONS)

4mx4m net (multi-mono netting, 7cm mesh size, total weight 344g)
3 tethering ropes (60m length each, size 6N, 170kg break strain, 2.9g/m)
16 Standard White Balloons (24" Qualatex with safetite disc)
10m carbon fibre rods (four 8mm x 4.7mm tubes with 12.7mm x 8.5mm connectors)
3 event staff

PART 1: SINGLE RING

Following a discussion with Michael Graham, Professor of Unsteady Aerodynamics, Imperial College London, it was decided to experiment with a semi-rigid structure.

A disc "sandwich" was created using a carbon fibre ring of 3.3m diameter. This ring stretched taut the netting and the balloons were placed inside the net before inflating. This combination created a more rigid structure which, in profile, resembled a wing. It was therefore much more aerodynamic and worked best in light wind. It proved much easier than previous experiments to raise above 50m.

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The structure was deployed on-site at the National Maritime Museum within Greenwich Park, London, which was determined to be a more appropriate lift-off site than the front lawn because of its scale and proximity to the Royal Observatory.

Using a photomontage it was possible to estimate the scale of the final structure in the context of Greenwich Park:

Setup was much smoother and more manageable with the rigid structure. It is not yet certain whether final setup procedures will involve inflating separate rings and then joining them together or whether it would be better to attach all the rings prior to inflation.

PART 2: MULTIPLE RINGS

Following the success of the single-ring experiment a further trial was undertaken with multiple rings.

Decent lift was achieved, though the rings occasionally folded in on themselves. It is expected that such movement will be desirable in the final structure in any case to give more animation to the flight of the cloud.

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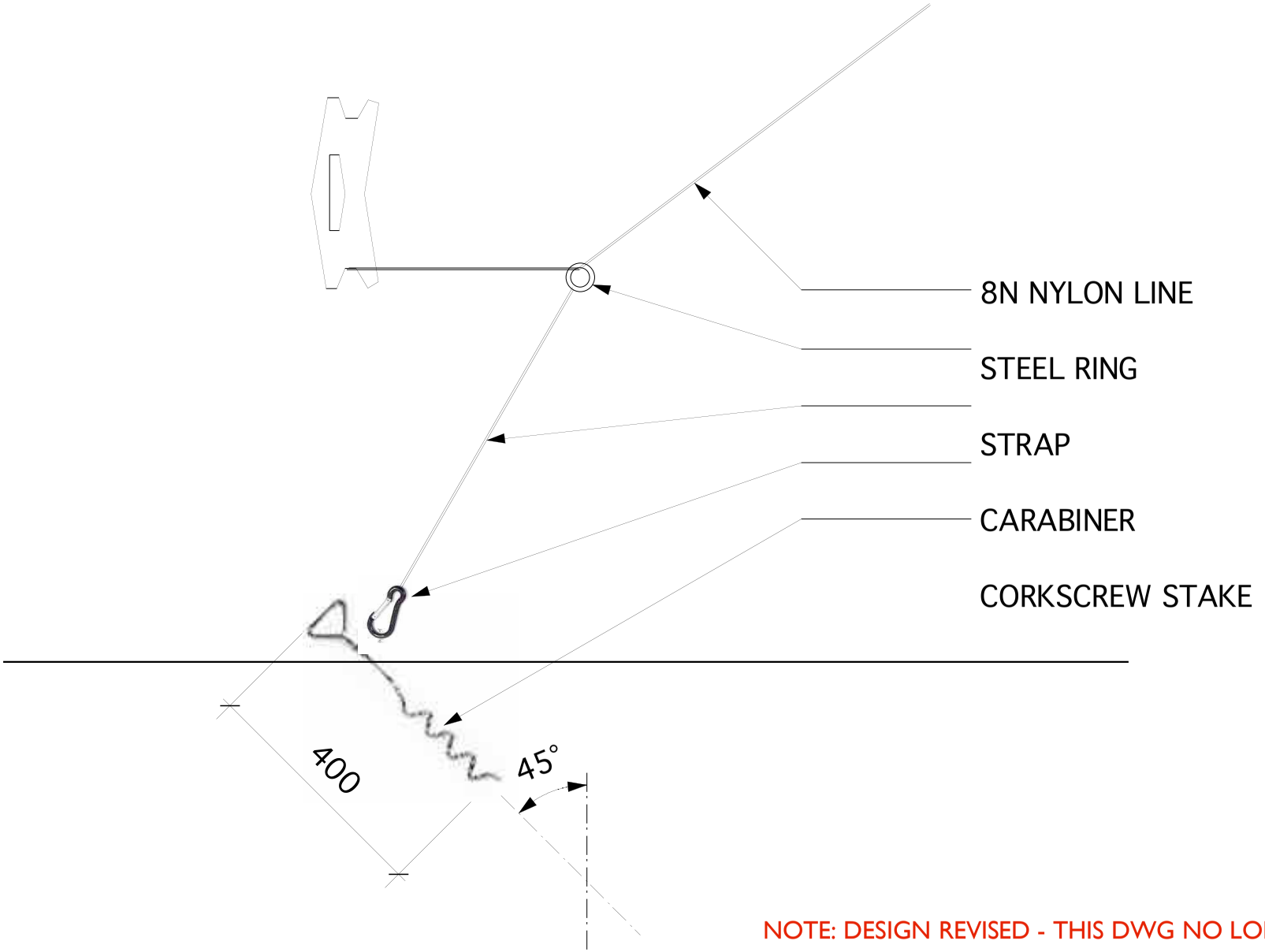

NOTE: DESIGN REVISED - THIS DWG NO LONGER CURRENT

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SKY EAR: EMF / MOBILE PHONE BALLOON CLOUD

DATE	SCALE	TITLE	NO.
REVISED	1:10	TETHER DETAIL	

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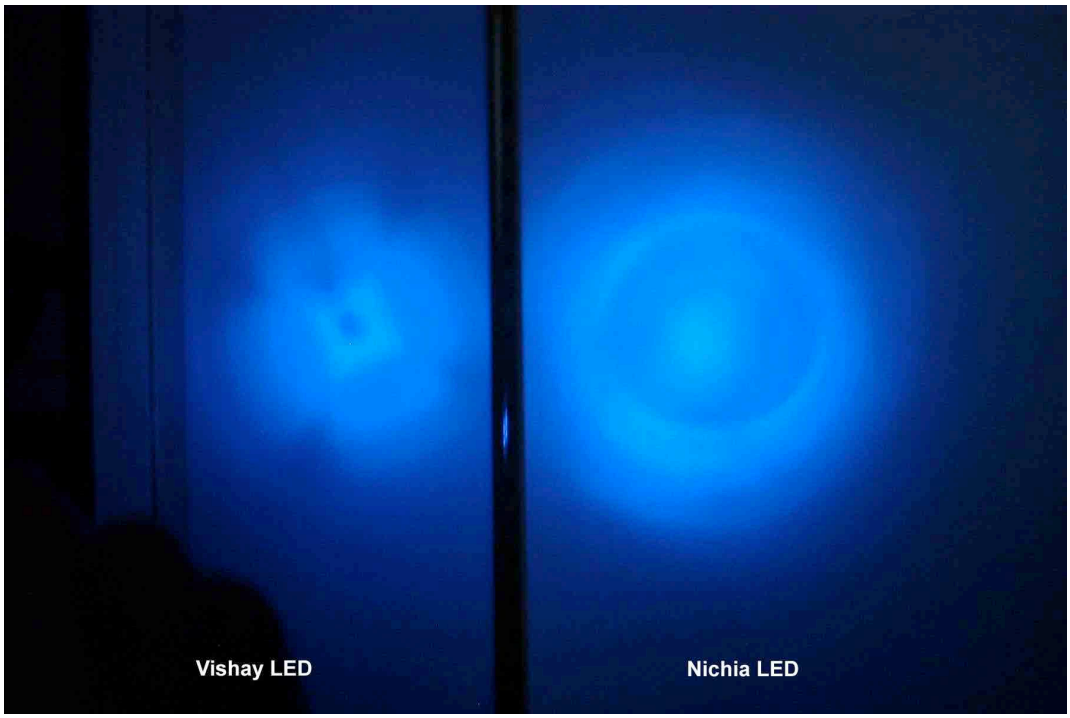
LED QUALITY/BRIGHTNESS EXPERIMENTS

It became apparent that LEDs from different companies varied widely in quality, brightness and illumination spread. A number of experiments were carried out to assess the various blue LED possibilities.



(Note, following production: despite rigorous testing of samples prior to the purchase of LEDs used on the final boards we were disappointed with the illumination spread of the red LEDs. Samples had been provided with smooth illumination pattern. However the LEDs provided in the final bulk purchase all had a visible square as in the pattern on the left above).

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SKY EAR BOARD PRODUCTION

The Sky Ear boards (including RF sensor, microcontroller, B2B network and LED output) are produced by Seth Garlock, Senseinate, Inc, in New York, USA. The boards are sent back and forth across the Atlantic during the design phase so that extensive testing and experimentation can be carried out.

Below are images from the design and production process.

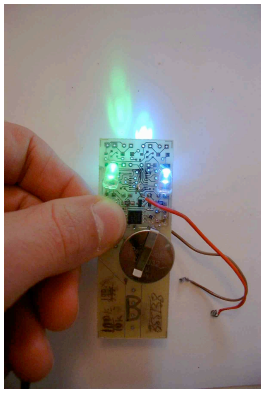
Prototype board.

LED output

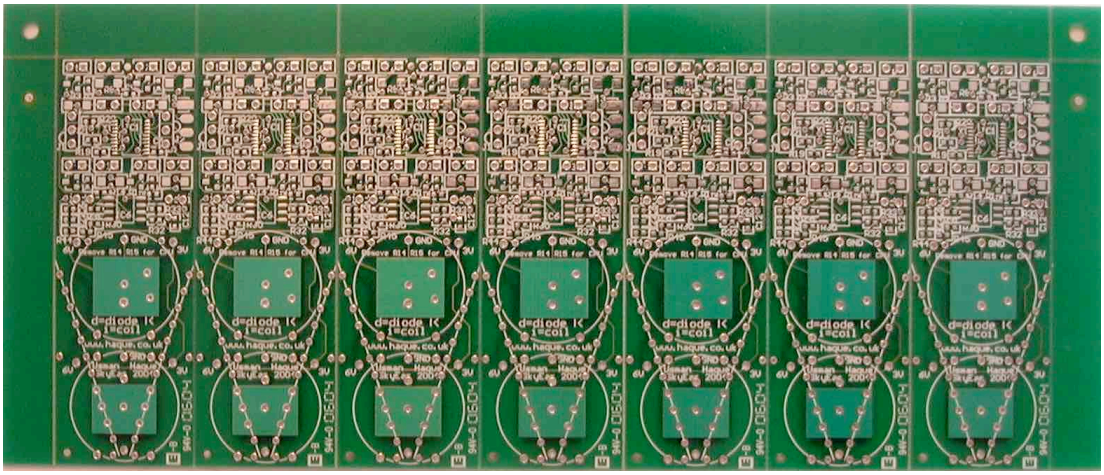
Unpopulated “Intelligence” section
(Texas Instruments MSP430F1121AIPW)

RF sensor

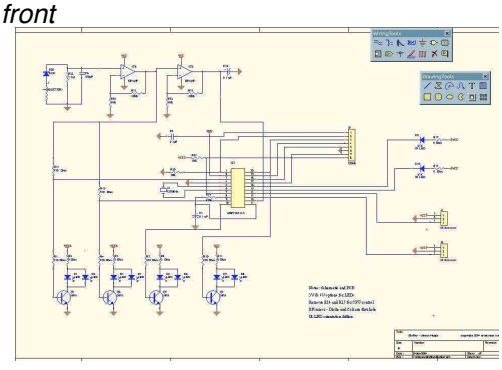
Two 3v batteries

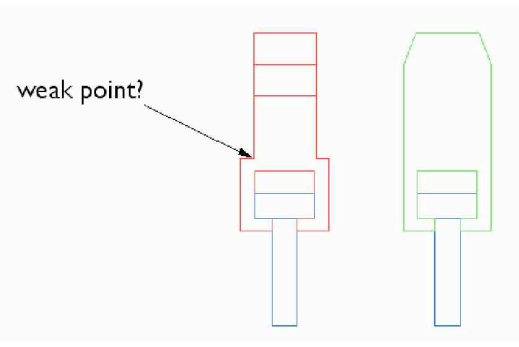


Final production boards (unpopulated)



front





Circuit diagram and attachment diagram

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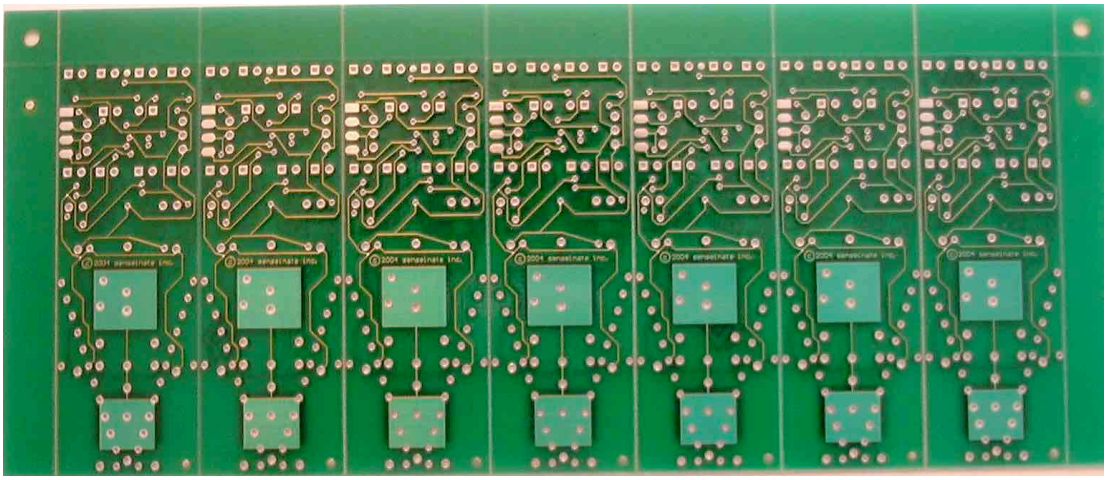
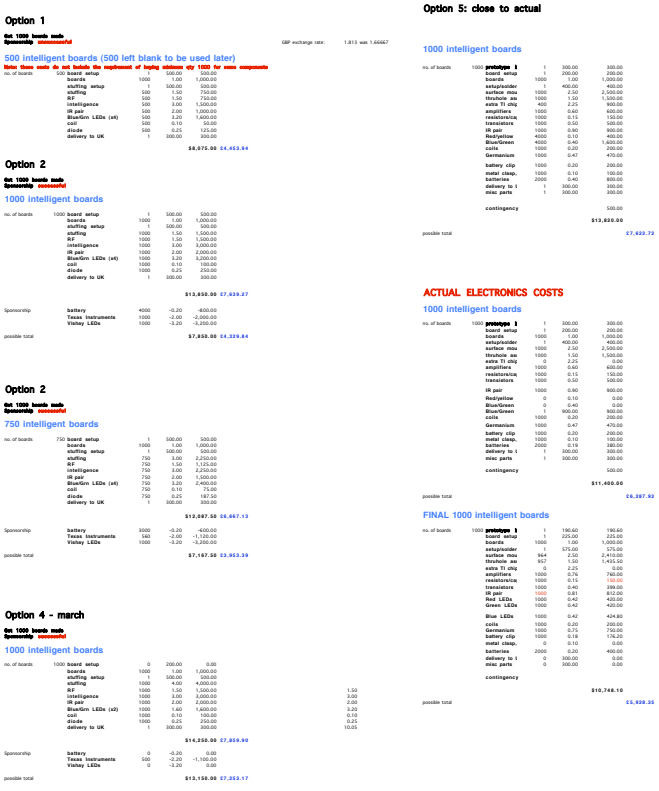


back

Parts list and budget options

Part Type	Designator	Footprint
0 Ohm	R8	1206
0 Ohm	R13	1206
0 Ohm	R17	1206
0 Ohm	R11	1206
0 Ohm	R2	1206
0 Ohm	R5	1206
0.1 uF	C4	603
0.1 uF	C12	603
0.1uF	C5	603
0A91	D20	RAD0.4
100K	R31	603
100K	R33	603
100pF	C6	603
10K	R20	603
10K	R30	603
10K	R21	603
10K	R32	603
3.3M	R22	603
32768Hz	X1	XTAL1
330 Ohm	R14	603
330 Ohm	R15	603
330 Ohm	R1	603
330 Ohm	R10	603
330 Ohm	R7	603
330 Ohm	R4	603
470k	R19	603
CON8	J5	
INDUCTOR1	L1	RAD0.6
IR LED	D10	RAD0.1
IR LED	D9	RAD0.1
IR Receiver	J2	TO-126
IR Receiver	J1	TO-126
LED	D8	RAD0.1
LED	D7	RAD0.1
LED	D6	RAD0.1
LED	D3	RAD0.1
LED	D4	RAD0.1
LED	D5	RAD0.1
LED	D2	RAD0.1
LED	D1	RAD0.1
MSP430X11X	IC1	SOJ-20
NPN	Q4	SOT-23
NPN	Q3	SOT-23
NPN	Q1	SOT-23
NPN	Q2	SOT-23
OPAMP	IC6	SO8



Option 1

Est. 1000 boards made
Sponsorship successful

GBP exchange rate: 1.813 was 1.66667

500 intelligent boards (500 left blank to be used later)
Note: these costs do not include the requirement of buying minimum qty 1000 for some components

no. of boards	500	board setup	1	500.00	500.00
		boards	1000	1.00	1,000.00
		stuffing setup	1	500.00	500.00
		stuffing	500	1.50	750.00
		SI?	500	1.50	750.00
		intelligence	500	3.00	1,500.00
		IR pair	500	2.00	1,000.00
		BlueGrn LEDs (x6)	500	3.20	1,600.00
		coil	500	0.10	50.00
		diode	500	0.25	125.00
		delivery to UK	1	300.00	300.00
					$6,675.00 £4,453.94

Option 2

Est. 1000 boards made
Sponsorship successful

1000 intelligent boards

no. of boards	1000	board setup	1	500.00	500.00
		boards	1000	1.00	1,000.00
		stuffing setup	1	500.00	500.00
		stuffing	1000	1.50	1,500.00
		SI?	1000	1.50	1,500.00
		intelligence	1000	3.00	3,000.00
		IR pair	1000	2.00	2,000.00
		BlueGrn LEDs (x6)	1000	3.20	3,200.00
		coil	1000	0.10	100.00
		diode	1000	0.25	250.00
		delivery to UK	1	300.00	300.00
					$13,850.00 £7,639.27
Sponsorship		battery	4000	-0.20	-800.00
		Texas Instruments	1000	-2.00	-2,000.00
		Vishay LEDs	1000	-3.20	-3,200.00
possible total					$7,850.00 £4,329.84

Option 2

Est. 1000 boards made
Sponsorship successful

750 intelligent boards

no. of boards	750	board setup	1	500.00	500.00
		boards	1000	1.00	1,000.00
		stuffing setup	1	500.00	500.00
		stuffing	750	3.00	2,250.00
		SI?	750	1.50	1,125.00
		intelligence	750	3.00	2,250.00
		IR pair	750	2.00	1,500.00
		BlueGrn LEDs (x6)	750	3.20	2,400.00
		coil	750	0.10	75.00
		diode	750	0.25	187.50
		delivery to UK	1	300.00	300.00
					$12,587.50 £6,947.13
Sponsorship		battery	3000	-0.20	-600.00
		Texas Instruments	540	-2.00	-1,130.00
		Vishay LEDs	1000	-3.20	-3,200.00
possible total					$7,167.50 £3,953.39

Option 4 - march

Est. 1000 boards made
Sponsorship successful

1000 intelligent boards

no. of boards	1000	board setup	0	200.00	0.00	
		boards	1000	1.00	1,000.00	
		stuffing setup	1	500.00	500.00	
		stuffing	1000	4.00	4,000.00	
		SI?	1000	1.50	1,500.00	1.50
		intelligence	1000	3.00	3,000.00	3.00
		IR pair	1000	2.00	2,000.00	2.00
		BlueGrn LEDs (x2)	1000	1.60	1,600.00	3.20
		coil	1000	0.10	100.00	0.10
		diode	1000	0.25	250.00	0.25
		delivery to UK	1	300.00	300.00	10.05
					$14,250.00 £7,859.90	
Sponsorship		battery	0	-0.20	0.00	
		Texas Instruments	590	-2.00	-1,180.00	
		Vishay LEDs	0	-3.20	0.00	
possible total					$13,150.00 £7,253.17	

Option 5: close to actual

1000 intelligent boards

no. of boards	1000	prototype 1	1	300.00	300.00
		board setup	1	200.00	200.00
		boards	1000	1.00	1,000.00
		setup/solder	1	400.00	400.00
		surface mou	1000	2.50	2,500.00
		thruhole ass	1000	1.50	1,500.00
		extra TI chip	400	2.25	900.00
		amplifiers	1000	0.60	600.00
		resistors/cap	1000	0.15	150.00
		transistors	1000	0.50	500.00
		IR pair	1000	0.90	900.00
		Red/yellow	4000	0.10	400.00
		Blue/Green	4000	0.40	1,600.00
		coils	1000	0.20	200.00
		Germanium	1000	0.47	470.00
		battery clip	1000	0.20	200.00
		metal clasp,	1000	0.10	100.00
		batteries	2000	0.40	800.00
		delivery to i	1	300.00	300.00
		misc parts	1	300.00	300.00
		contingency			500.00
					$13,820.00
possible total					£7,622.72

ACTUAL ELECTRONICS COSTS

1000 intelligent boards

no. of boards	1000	prototype 1	1	300.00	300.00
		board setup	1	200.00	200.00
		boards	1000	1.00	1,000.00
		setup/solder	1	400.00	400.00
		surface mou	1000	2.50	2,500.00
		thruhole ass	1000	1.50	1,500.00
		extra TI chip	400	2.25	900.00
		amplifiers	1000	0.60	600.00
		resistors/cap	1000	0.15	150.00
		transistors	1000	0.50	500.00
		IR pair	1000	0.90	900.00
		Red/yellow	0	0.10	0.00
		Blue/Green	0	0.40	0.00
		Blue/Green	0	900.00	900.00
		coils	1000	0.20	200.00
		Germanium	1000	0.47	470.00
		battery clip	1000	0.20	200.00
		metal clasp,	1000	0.10	100.00
		batteries	2000	0.19	380.00
		delivery to i	1	300.00	300.00
		misc parts	1	300.00	300.00
		contingency			500.00
					$11,400.00
possible total					£6,287.92

FINAL 1000 intelligent boards

no. of boards	1000	prototype 1	1	190.60	190.60
		board setup	1	225.00	225.00
		boards	1000	1.00	1,000.00
		setup/solder	1	575.00	575.00
		surface mou	964	2.50	2,410.00
		thruhole ass	957	1.50	1,435.50
		extra TI chip	0	2.25	0.00
		amplifiers	1000	0.74	740.00
		resistors/cap	1000	0.15	150.00
		transistors	1000	0.40	399.00
		IR pair	1000	0.81	810.00
		Red/yellow	1000	0.42	420.00
		Green LEDs	1000	0.42	420.00
		Blue LEDs	1000	0.42	424.80
		coils	1000	0.20	200.00
		Germanium	1000	0.75	750.00
		battery clip	1000	0.18	176.20
		metal clasp,	0	0.10	0.00
		batteries	2000	0.20	400.00
		delivery to i	0	300.00	0.00
		misc parts	0	300.00	0.00
		contingency			
					$10,748.10
possible total					£5,928.35

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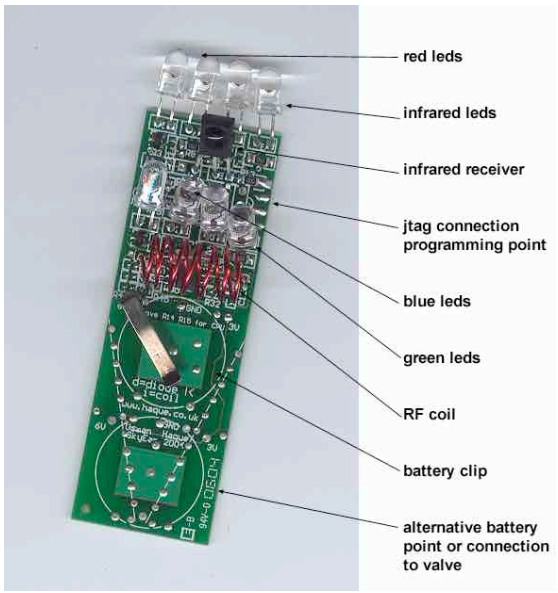
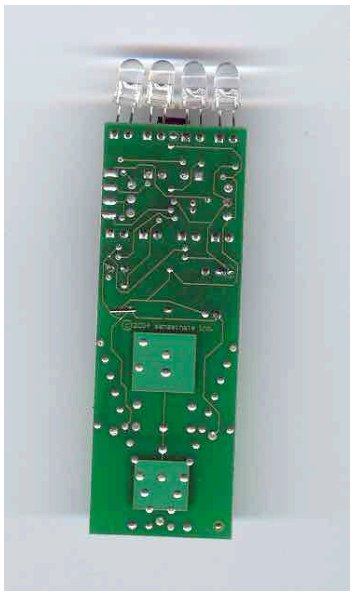
Fabrication

Final boards





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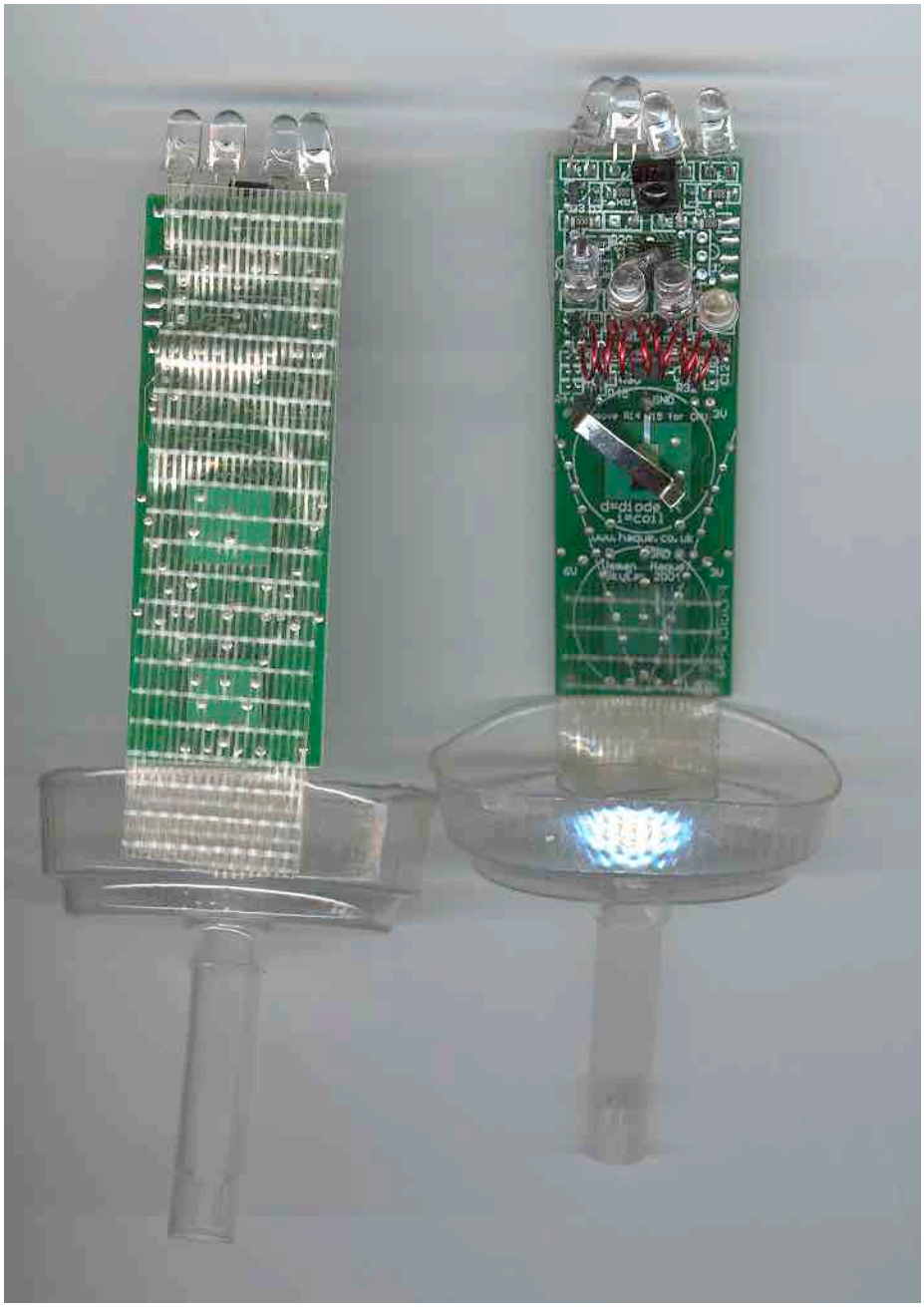
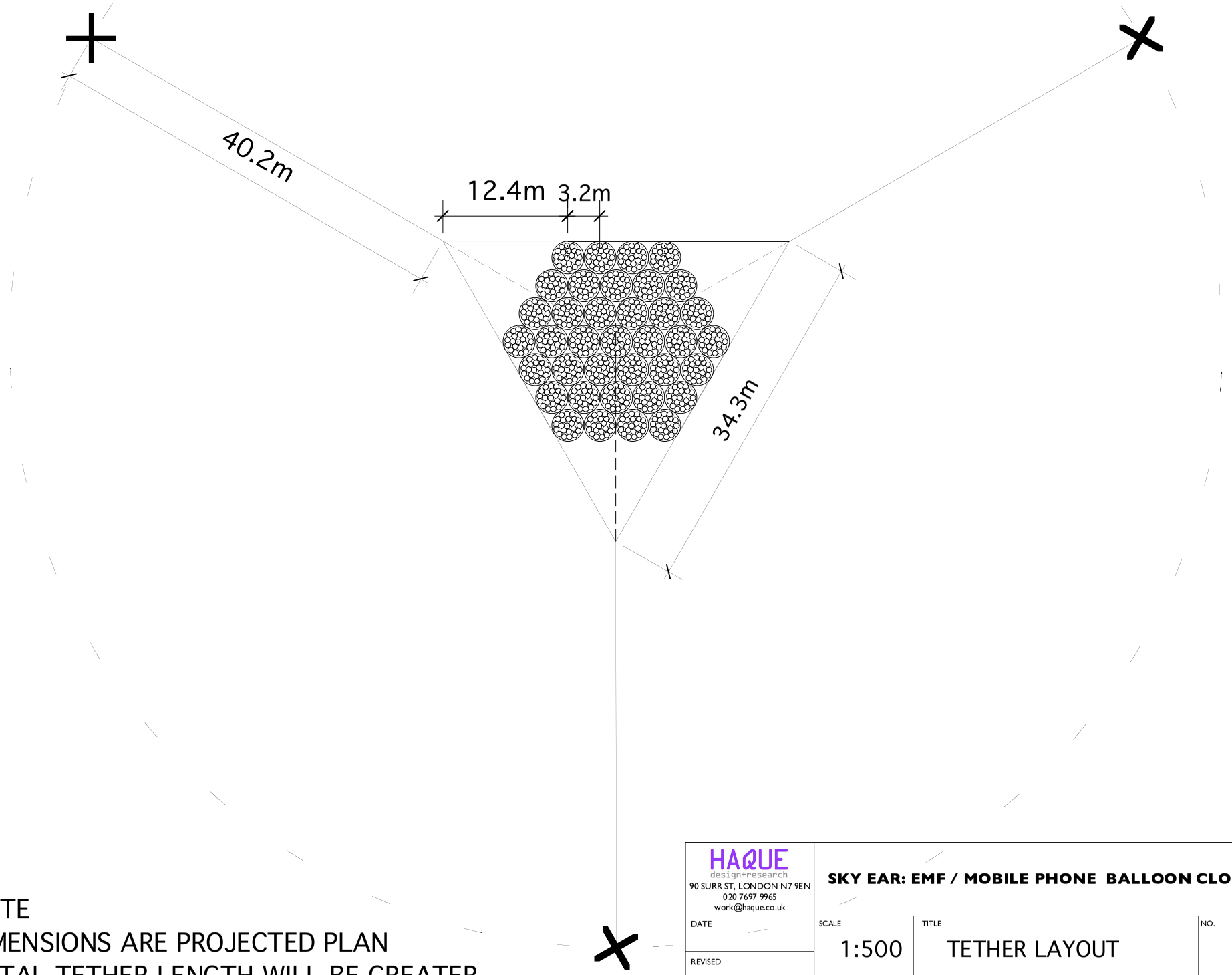


Sky Ear board attached to valve with fibreglass tape (for durability and flexibility)



NOTE
DIMENSIONS ARE PROJECTED PLAN
TOTAL TETHER LENGTH WILL BE GREATER

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SKY EAR: EMF / MOBILE PHONE BALLOON CLOUD

DATE	SCALE	TITLE	NO.
REVISED	1:500	TETHER LAYOUT	

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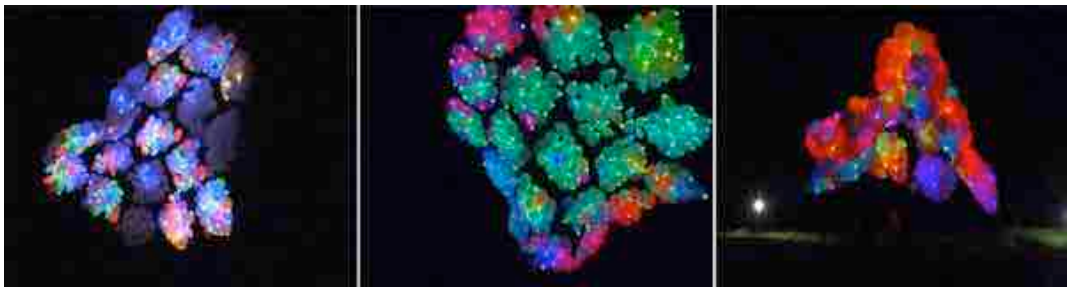
SKY EAR: FIRST FULL LAUNCH

Following an aborted flight attempt on May 4, 2004 (cancelled due to bad weather), an invitation was received from the Belluard Bollwerk International in Fribourg Switzerland to fly Sky Ear on July 4, 2004.

The core team (Usman Haque, Susan Haque, Ai Hasegawa, Ben Pirt, Shade Abdul) arrived in Fribourg on the evening of July 2nd. Setup began on the morning of the 3rd , when carbon fibre rings were assembled, local mobile phones were prepared, helium cylinders were tested and the site was visited. Final setup on the 4th involved preparing the electronics (each board required 2 batteries), construction of the entire carbon fibre/net mega-structure and inflation of the balloons with sensors.

Below are photographs of the event (video is available from the website at www.haque.co.uk/skyear/swiss) followed by an evaluation of the process.



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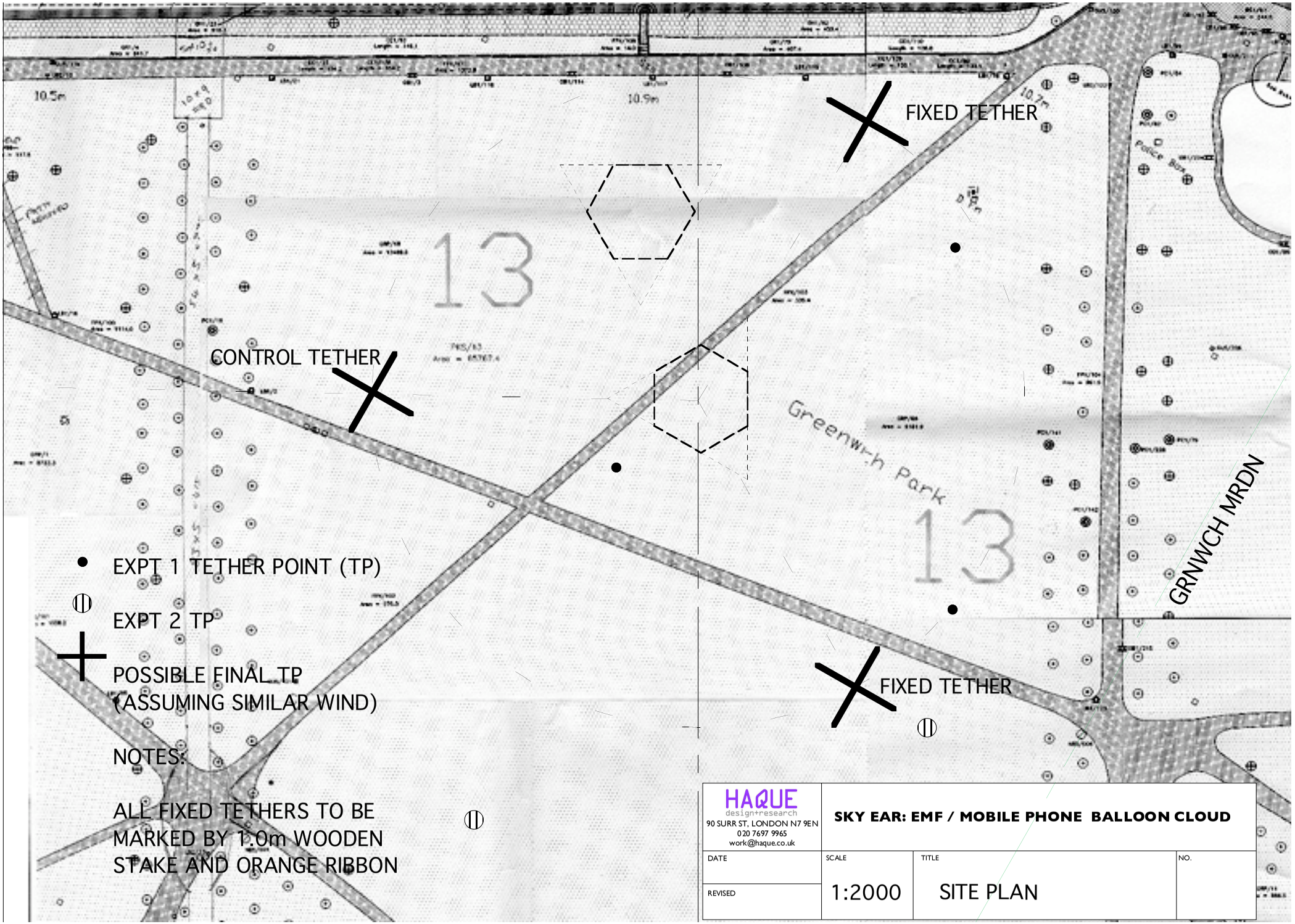
OBSERVATIONS

Overall the event was a good success. The audience was relatively small (about 200 people) but the general feeling was quite intimate. People sat on blankets on the park lawn and watched the cloud fly by overhead. The setup process was relaxed, aided by about 12 students from a nearby college who carried out the inflation process. The entire event from setup to pulldown was webcast (archive of this footage available on the website).

There were however, a number of problems that need to be dealt with before the next flight:

1. Finding the tether points was almost impossible in the dark – the glow sticks used were inadequate because they got lost in the grass.
2. Communication between the tether points was difficult – the walkie talkies did not work as well as hoped (partly due to the different languages being spoken!) and frequently fell on the ground, to be lost in the darkness. For the next flight, vests with hooks must be used and each tether handler must have a torch.
3. There were not enough people at the tether points, sometimes only one person. Ideally we need three people at each of the three points, and these people must be well-briefed beforehand.
4. Though it was desirable to have the audience as close as they were, this also created the problem of people occasionally interfering with the cables. This could be dangerous.

The event lasted about 2.5 hours and cleanup was completed in less than 1 hour.



EXPT 1 TETHER POINT (TP)

EXPT 2 TP

POSSIBLE FINAL TP
(ASSUMING SIMILAR WIND)

NOTES:

ALL FIXED TETHERS TO BE MARKED BY 1.0m WOODEN STAKE AND ORANGE RIBBON

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SKY EAR: EMF / MOBILE PHONE BALLOON CLOUD

DATE	SCALE	TITLE	NO.
REVISED	1:2000	SITE PLAN	

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SKY EAR: FULL FLIGHT

With the success of the full flight in Switzerland in July 2004, planning went forward to fly Sky Ear as originally planned in Greenwich Park, London on September 15, 2004.

The core team was this time smaller than the Fribourg flight but more volunteers assisted in the setup procedure. Adequate numbers of tether handlers were also used and these ensured a safe and non-tiring flight.

The event was attended by about 3,500 members of the public, having been written about in articles in the Independent Newspaper (“Pick of the week”) and Time Out (“Don’t Miss”). The entire process went smoothly, apart from an error in the electronics during setup which may have been due to the bright sunshine interfering with the infrared receivers or may have been due to a software bug in the timing (the programs were started 24 hours before liftoff). Over 1,000 calls were made into the cloud.

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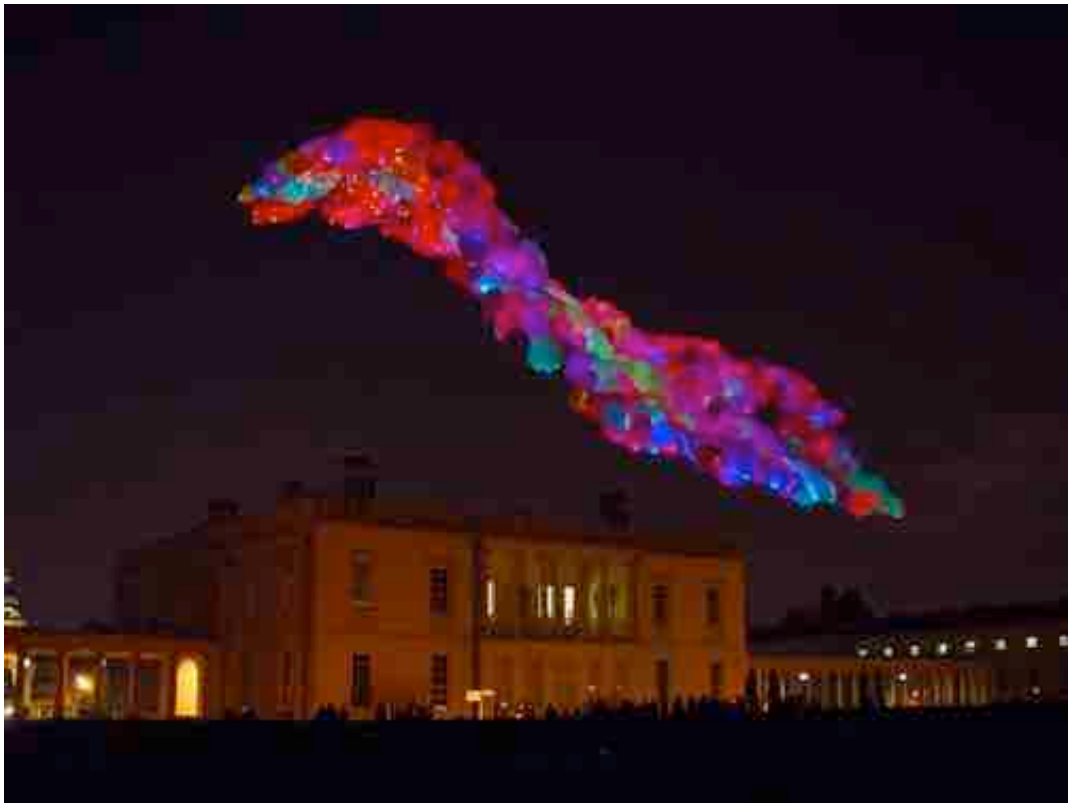

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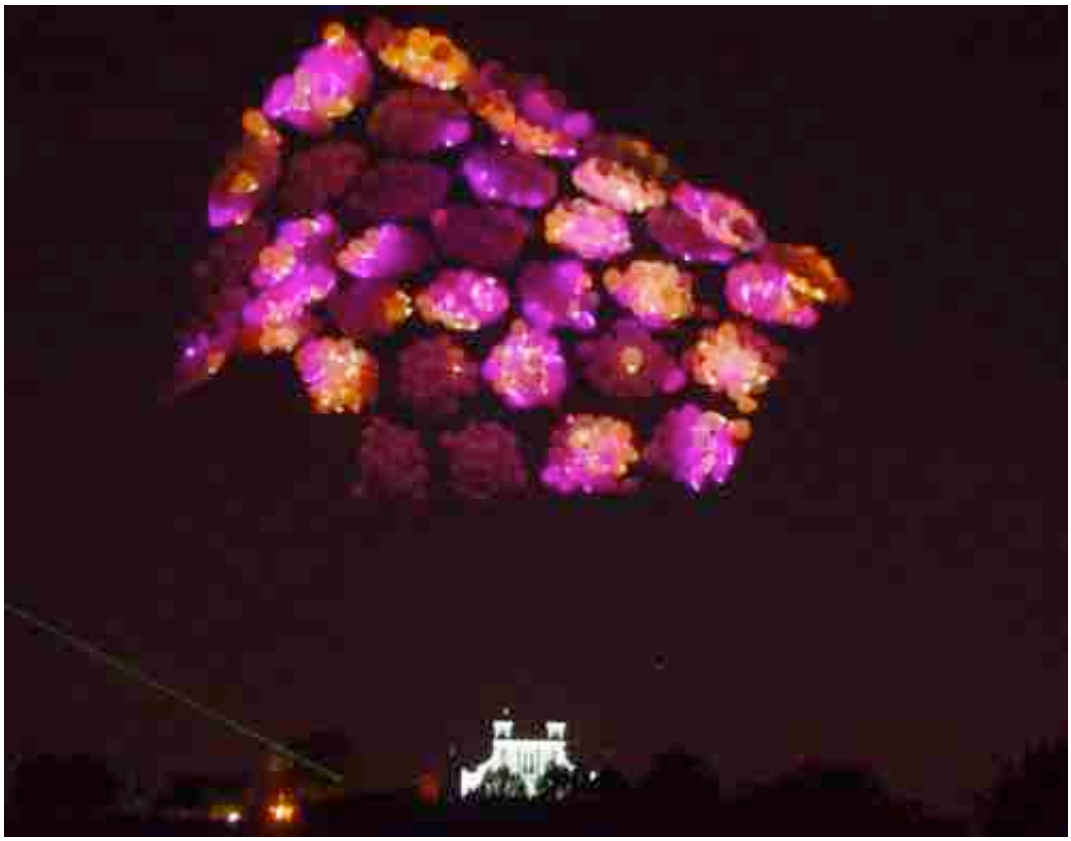

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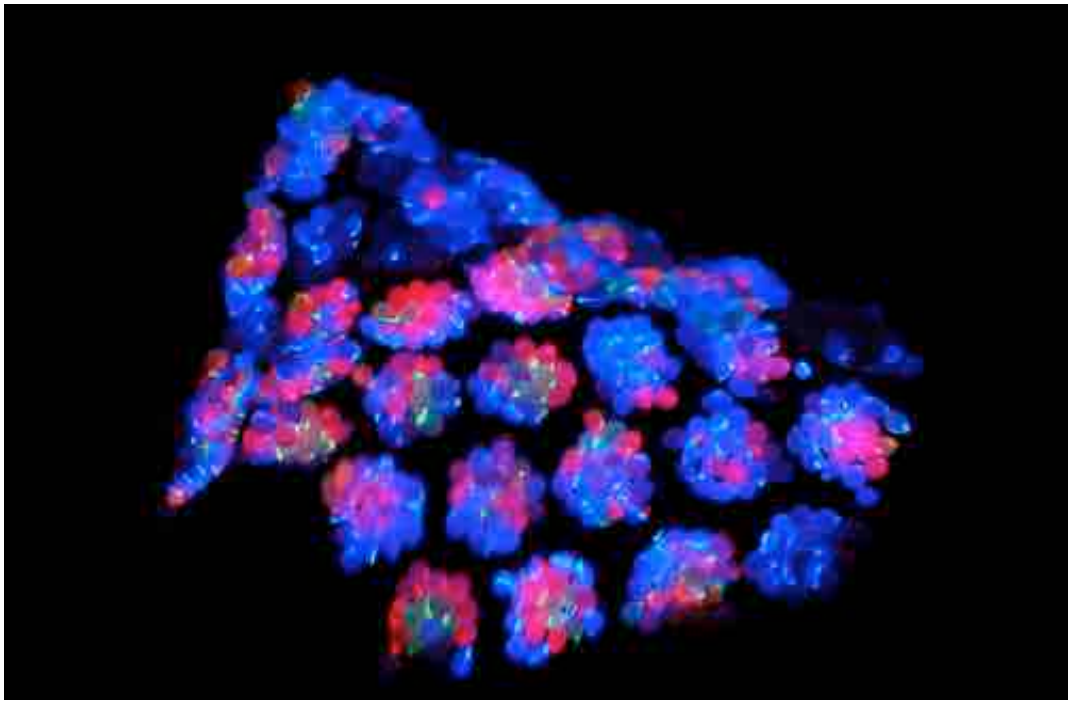

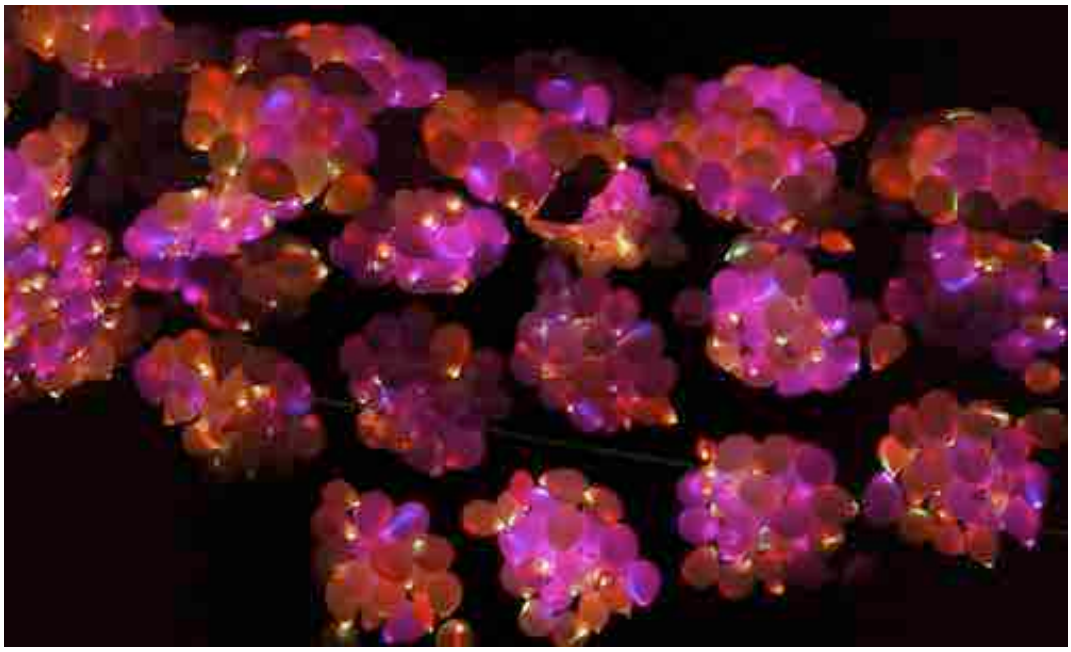

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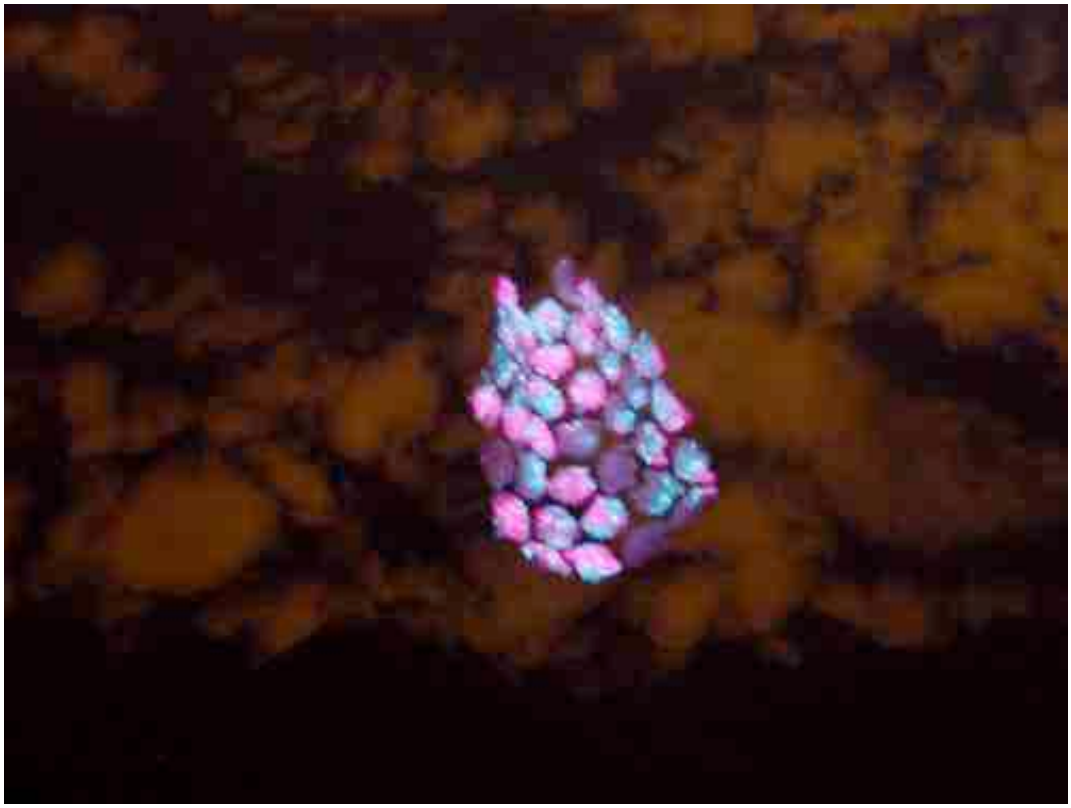

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OBSERVATIONS

1. Lift-off procedure: could be done more smoothly. When moving the structure from its moorings to the flight triangle, it was difficult to disconnect the cables. The cloud lifted high too quickly and had to be brought down again to switch on all the boards using the remote control devices.

2. Tether handles: must be stronger. Made of wood, they are the weakest point in the system.

3. Food organisation: the one thing that did not happen smoothly was feeding the volunteers. Some were not aware that food was available; some items of food ran out before people could eat and, in general, it was disorganised. It is vital to keep volunteers (and core team-members!) well-fed and thirst-quenched not just because it makes for a more enjoyable experience but also because the process becomes much more efficient.

4. Tether handling and communication: the process was much more efficient than the flight in Fribourg, partly aided by the beautiful, windless weather. Communication with the walkie talkies became relatively fluent and with three handlers at each point everyone was generally relaxed. The hook-and-flashlight kit worked well. However, it may be useful to develop a rigid steering bar to attach the tethers (as in flying large kites) so that the load is distributed equally among all three tether handlers at each point.

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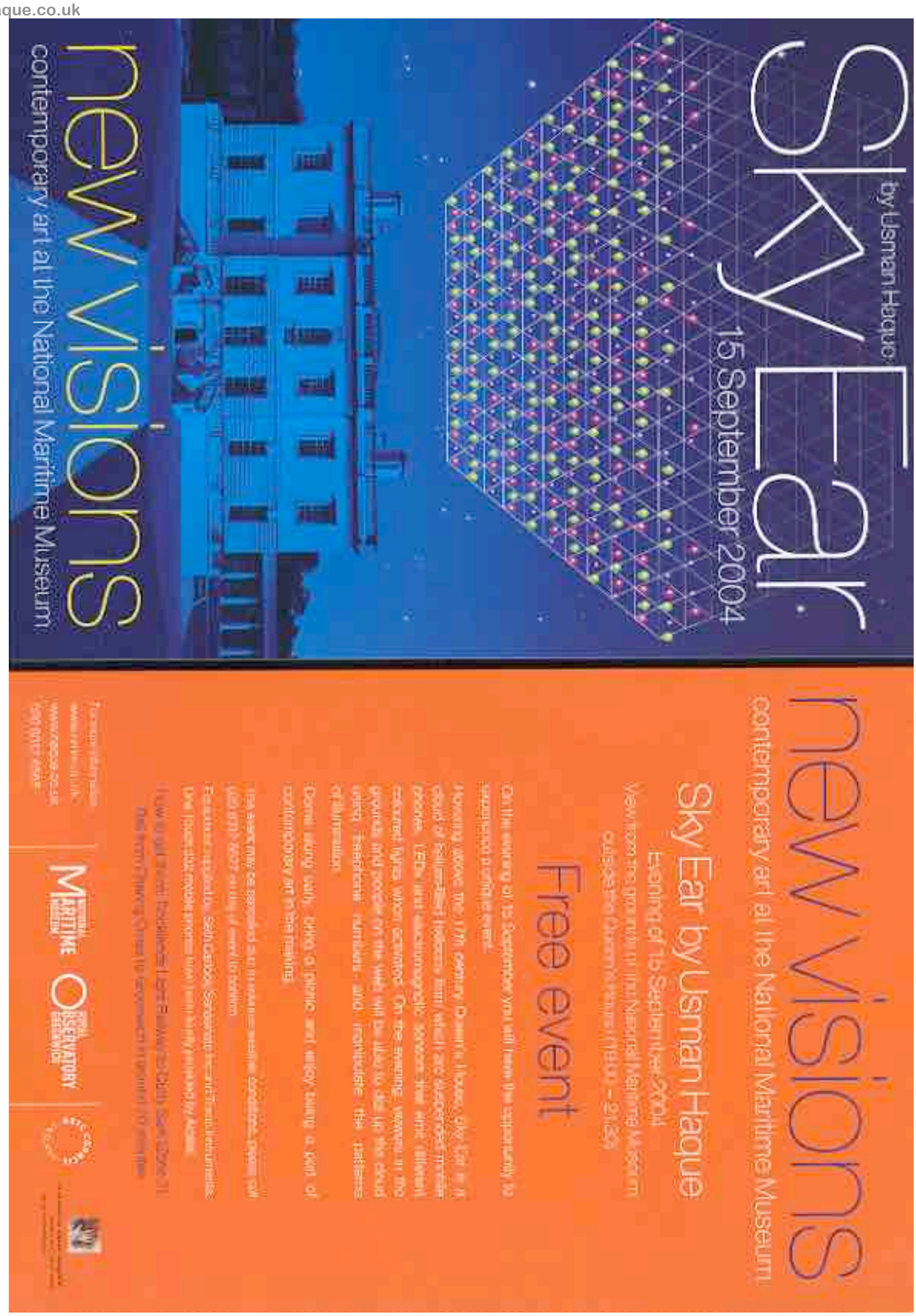

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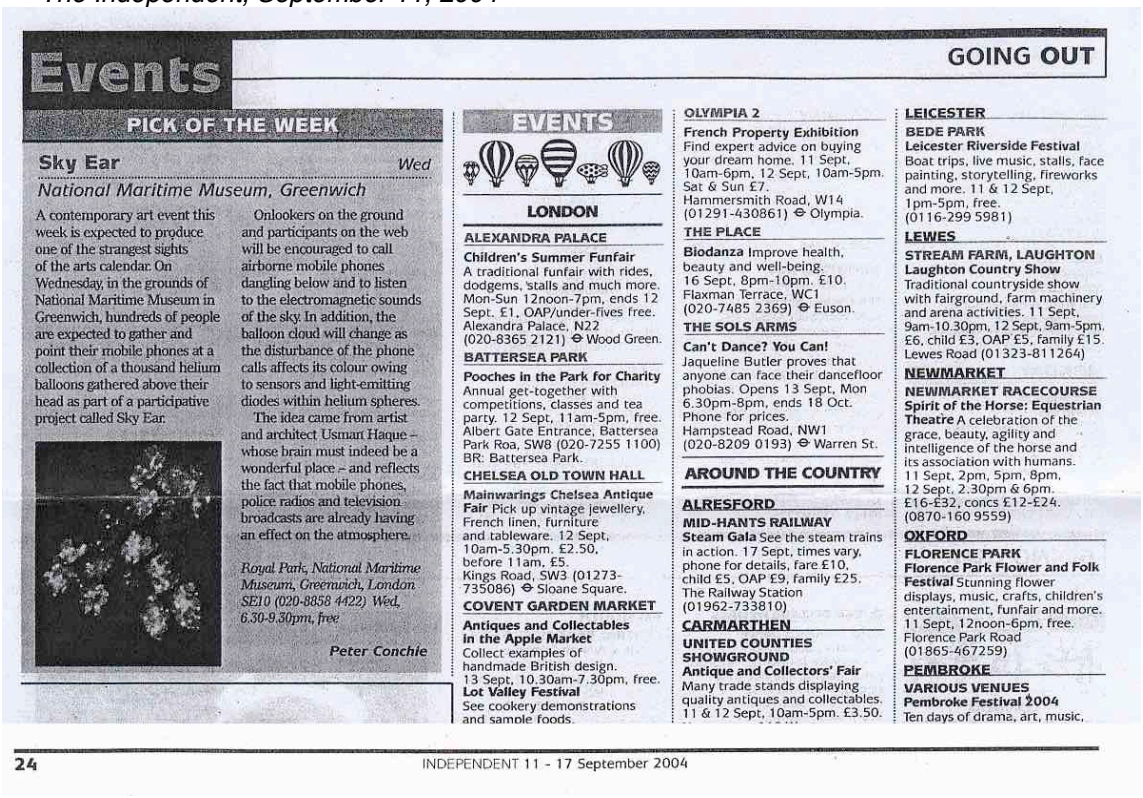
PRESS CLIPPINGS

Pre-event

The Independent, September 11, 2004



Events

GOING OUT

PICK OF THE WEEK

Sky Ear Wed

National Maritime Museum, Greenwich

A contemporary art event this week is expected to produce one of the strangest sights of the arts calendar. On Wednesday, in the grounds of National Maritime Museum in Greenwich, hundreds of people are expected to gather and point their mobile phones at a collection of a thousand helium balloons gathered above their head as part of a participative project called Sky Ear.

Onlookers on the ground and participants on the web will be encouraged to call airborne mobile phones dangling below and to listen to the electromagnetic sounds of the sky. In addition, the balloon cloud will change as the disturbance of the phone calls affects its colour owing to sensors and light-emitting diodes within helium spheres.

The idea came from artist and architect Usman Haque – whose brain must indeed be a wonderful place – and reflects the fact that mobile phones, police radios and television broadcasts are already having an effect on the atmosphere.

Royal Park, National Maritime Museum, Greenwich, London SE10 (020-8858 4422) Wed, 6.30-9.30pm, free

Peter Conchie

EVENTS

LONDON

ALEXANDRA PALACE

Children's Summer Funfair A traditional funfair with rides, dodgems, stalls and much more. Mon-Sun 12noon-7pm, ends 12 Sept. £1, OAP/under-fives free. Alexandra Palace, N22 (020-8365 2121) ⊖ Wood Green.

BATTERSEA PARK

Pooches in the Park for Charity Annual get-together with competitions, classes and tea party. 12 Sept, 11am-5pm, free. Albert Gate Entrance, Battersea Park Roa, SW8 (020-7255 1100) BR: Battersea Park.

CHELSEA OLD TOWN HALL

Mainwarings Chelsea Antique Fair Pick up vintage jewellery, French linen, furniture and tableware. 12 Sept, 10am-5.30pm. £2.50, before 11am, £5. Kings Road, SW3 (01273-735086) ⊖ Sloane Square.

COVENT GARDEN MARKET

Antiques and Collectables in the Apple Market Collect examples of handmade British design. 13 Sept, 10.30am-7.30pm, free.

Lot Valley Festival See cookery demonstrations and sample foods.

OLYMPIA 2

French Property Exhibition Find expert advice on buying your dream home. 11 Sept, 10am-6pm, 12 Sept, 10am-5pm. Sat & Sun £7. Hammersmith Road, W14 (01291-430861) ⊖ Olympia.

THE PLACE

Biodanza Improve health, beauty and well-being. 16 Sept, 8pm-10pm. £10. Flaxman Terrace, WC1 (020-7485 2369) ⊖ Euson.

THE SOLS ARMS

Can't Dance? You Can! Jaqueline Butler proves that anyone can face their dancefloor phobias. Opens 13 Sept, Mon 6.30pm-8pm, ends 18 Oct. Phone for prices. Hampstead Road, NW1 (020-8209 0193) ⊖ Warren St.

AROUND THE COUNTRY

ALRESFORD

MID-HANTS RAILWAY Steam Gala See the steam trains in action. 17 Sept, times vary, phone for details, fare £10, child £5, OAP £9, family £25. The Railway Station (01962-733810)

CARMARTHEN

UNITED COUNTIES SHOWGROUND Antique and Collectors' Fair Many trade stands displaying quality antiques and collectables. 11 & 12 Sept, 10am-5pm. £3.50.

LEICESTER

BEDE PARK Leicester Riverside Festival Boat trips, live music, stalls, face painting, storytelling, fireworks and more. 11 & 12 Sept, 1pm-5pm, free. (0116-299 5981)

LEWES

STREAM FARM, LAUGHTON Laughton Country Show Traditional countryside show with fairground, farm machinery and arena activities. 11 Sept, 9am-10.30pm, 12 Sept, 9am-5pm. £6, child £3, OAP £5, family £15. Lewes Road (01323-811264)

NEWMARKET

NEWMARKET RACECOURSE Spirit of the Horse: Equestrian Theatre A celebration of the grace, beauty, agility and intelligence of the horse and its association with humans. 11 Sept, 2pm, 5pm, 8pm, 12 Sept, 2.30pm & 6pm. £16-£32, concs £12-£24. (0870-160 9559)

OXFORD

FLORENCE PARK Florence Park Flower and Folk Festival Stunning flower displays, music, crafts, children's entertainment, funfair and more. 11 Sept, 12noon-6pm, free. Florence Park Road (01865-467259)

PEMBROKE

VARIOUS VENUES Pembroke Festival 2004 Ten days of drama, art, music,

24 INDEPENDENT 11 - 17 September 2004

Time Out, London, September 8, 2004

... and don't miss

WEDNESDAY 15

FREE **Sky Ear**

It may be term time now but that doesn't mean the fun's over. This evening event at the National Maritime Museum is not specifically aimed at kids but it's got huge appeal for the mobile-phone-permanently-glued-to-ear generation. Part of the museum's contemporary art project, 'New Visions', 'Sky Ear' will involve 1,000 helium balloons with mobile phones attached being released into the air above the museum's lawns. Artist Usman Haque, whose multimedia installations and performances draw heavily on his training as an architect, will ask the watching crowd and people on the web to ring the airborne phones, in order to listen to the electromagnetic sounds of the sky, which are generated by distant storms or man-made by mobiles, police radios and television broadcasts. The balloons, which contain sensors and light emitting diodes (LEDs), will change colour in response to the atmosphere's electromagnetic waves. And what about getting the homework done? Well, canny kids will have explained in advance how the project combines art with science and persuaded their teachers that the evening's outing constitutes an educational activity. *National Maritime Museum Romney Rd, Greenwich, SE10. www.haque.co.uk./skyear. Cutty Sark DLR. Wednesday 15 7-9.30pm.*

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Post-event

The Independent on Sunday, September 19, 2004

TALK OF THE TOWN

Openings, closings, people and places

ARIAL ART

Hey, you, get off of my electromagnetic cloud

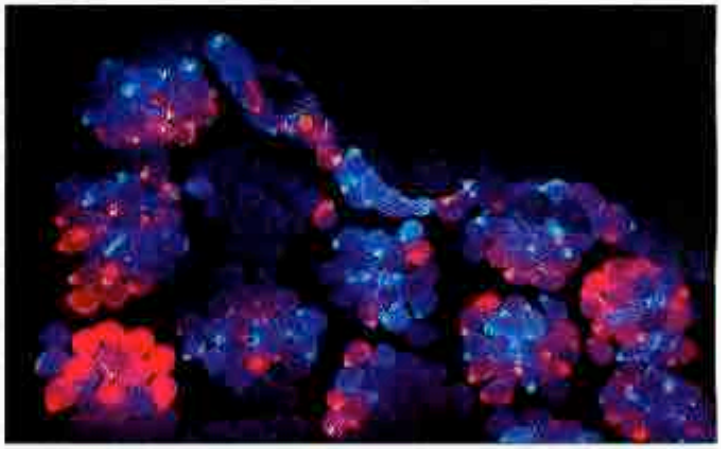
Tonight, a thousand balloons will rise into the night sky over Greenwich, creating an electromagnetic cloud of many colours." As art projects go, this one was ambitious. And when I arrived at the Queen's House at Greenwich, London, it seemed like an empty boast. Night was falling, crowds were milling, but the "cloud" was only a rubber net on the ground. Volunteers were still frantically inflating balloons, under the urgent direction of the artist Usman Haque, who flinched each time a balloon burst, which was frequently. How could an electromagnetic cloud rise out of this chaos?

Yet, as the last of the light left the sky, the artist's voice came loudly over the tannoy. "We have lift-off." Dogs stopped chasing each other. The crowd hushed. And gently, gracefully up from the grass rose a large white mass of balloons, like a phantom eiderdown. "Aaaah," said the crowd. The eiderdown promptly sank back down to the ground. "Ohhh," said the crowd.

Fifteen minutes later, and things were getting critical. I spoke to the project's engineer, who was watching nervously from the Greenwich shrubbery. He explained that each balloon had been filled with six colourful light-emitting diodes, plus a mobile-phone receptor. "The cloud will act like a radar sweep, changing colour according to the electromagnetic activity in the sky. Well, it will if it ever gets airborne..."

The crowd was willing the thing to rise – out of chilly impatience as much as a desire to see the colour of radio waves. And the coy wind finally took it up, into the indigo sky where it swayed gently, like a weed underwater. Then it began to sparkle with electric currents in green and red. Slowly, as it changed shape in the breeze, it became engorged with colours, cyan flushing into emerald, pink into red. It was beautiful, but better still were the reactions from the crowd.

"It's a mushroom, man. A shroom!" said a young man whose lip-piercing knocked against his teeth as he spoke. "It looks like a Welsh bedspread," murmured an old lady. "It's an elephant," said a small girl. "It's like a map of America, with all the votes lighting up in different colours," from another voice. "It's like my daughter's brain when she has her scans," from another.



Is it a jellyfish? Is it a brain? Nope, it's an art installation entitled 'Sky Ear' SHADE ARTIST

And it was all these things, and it was sky coral and it was moon fruit. And for a short while, the crowd was held in a rapture of cloud-reading, one of the oldest forms of augury. There was also the excitement of being able to "phone the cloud". Numbers for the receptors in the cloud were distributed, and mobiles brandished. I tried calling but the cloud put me through to its answer service. When it did connect, I heard gentle, rushing hums and whimpers. These, according to the artist, are "the distant electromagnetic sounds of the sky, called 'whistlers' and 'spherics'. They're the audible equivalent of the Aurora Borealis."

Watching sound and hearing light is hard work, and I headed homeward with the crowd. But the "Sky Ear" continued to resonate. Even on the Docklands Light Railway, people were still calling the cloud. "Listen," said one. "It's the sound of the stars." "Oh really," said a man who hadn't been there. "And can you call the stars collect?" We tried to describe what we'd seen. Then we realised that there are some things you spoil when you explain, and an electromagnetic cloud is one of them.

Hermione Eyre

TRISTRAM SHANDIES ALL ROUND

Fun with wine glasses

Zembla sounds exotic. Perhaps it's an African creature with an interesting hide. Or some kind of elven foodstuff. Alas for any starving elves it's an international literary magazine that's just celebrated its first birthday. Described by *Time Out* in a moment of winning ambiguity as being "unlike any other magazine currently in existence," *Zembla* mixes style and substance while following the motto "Fun With Words". The list of contributing editors is as long as your arm and features Tilda Swinton, Brian Eno and Manolo Blahnik. The *Zembla* reader can enjoy articles that include what magazines they should be reading in between issues of *Zembla* (with five issues a year there's time to fill), why American literature is rubbish and "crap book" reviews that list the faults of so-called classics.

At a party to celebrate its first year of existence, the editor and style-mag veteran Dan Crowe held court at friend-of-*Zembla* Paul Smith's west-London emporium. (Sir Paul and *Zembla*'s art director Vince Frost have come together in the form of a T-shirt, soon to be sported by the great and the good of the literary world.) Dan told me about the "Fun With Lists" section of this month's issue. "My wife went into a shop in New York to buy milk and found about 200 types. One said it came from real cows." The list of milk-related products she found can be perused on page 25.

James Flint, *Zembla* designer and columnist, appeared and tried to tempt Dan with a *Tristram Shandy*-inspired column, made of the word "scurrilous" repeated over an entire page, except for a pearl of editorial hidden in the middle.