Kite for a Purpose (The Golden Age of Kites?)

1 Introduction

My purpose in writing these articles is not primarily the history of kiting but in the development of kites as we know them, i.e. to explain and inform about kites seen in the air today.

There are as usual diagrams, plans and photos. As before capital letters (PELHAM) means a full reference in the bibliography. The layout is:

1. Introduction
2. Needs for kites
3. The fliers
4. Omissions and exceptions

It is sometimes said that the last years of the 19th century and the first years of the 20th century were the 'Golden Age of Kiteflying'. I don't much like the phrase, as it seems to imply that everything since has been in decline. An alternative title could be 'Kites for a Purpose' – all those kitefliers included in this article had a purpose – or two – in mind for their kiteflying.

I have selected five fliers from the period – Eddy, Conyne, Bell, Hargrave and Cody. Once I'd made the selection I knew there was an important omission to be apologised for (see section 4). But each of the five is a name known to western kitefliers, though not everyone is quite as clear as to why they are important. In every case we could expect to see either 'their' kite or a direct descendant at a kite meeting today. A chronology of the key years is set out below. While it would be neat to be able to say 'it all happened in 10 years from 1893' in reality most of it happened in the 13 years 1893 – 1905. I think that the pace of development is remarkable – as a comparison look back to 1989 – 2002. The 4 line Revolution was invented at the start; there have been radical developments in 2 line precision and power kites. The Circoflex was invented in 1994. But compared to the 5 below?

1891 Hargrave invented the cellular kite (or box kite) he had been working on many aspects of flight since 1883.

1894 Hargrave lifted 16ft by 4 box kites in 21 mph wind.

1896 Hargrave boxes adopted by the U.S. Met Office

1898 Eddy filed his patent

1899 The Wright brothers fly their quadline kite.
Hargrave box kites brought to Europe.
Cody started to build kites.

1900 Eddy receive patent – as does Woglam.

1901 Cody applied for patent for his man lifting system

1902 Silas Conyne got his patent.
Bell builds kites and sketched the regular tetrahedron.
Cody man-lifting in U.K. and sets U.K. height records

1903 The Wright brothers first flight.

1905 Bell's first man lifter 'The Frost King'.

1906 George Lawrence photos San Francisco using Conynes.

1908 Cody become the first person to fly in the U.K.

1909 Bell's Cygnet kite.

Before looking at each kiteflier in turn, it's worth considering the question 'why all this activity at this time?' Certainly the five were very different individuals.

- While Eddy and Conyne lived all their life in the U.S.A., Bell was a Scottish/Canadian who made his fortune in the U.S.A., Cody, an American who adopted British nationality and Hargrave an English born Australian.
- While it was important to Cody, Eddy and Conyne that their inventions should be patented, Bell (whose wealth cam from the heavily patented telephone) was open with his scientific enquiries and Hargrave would not patent anything as he believed knowledge should be free to all.
- Again two of the five have a wider fame than designing and flying kites – Cody built the first aircraft in England and Bell had the telephone.

Usually a period of rapid invention and development is caused by the availability of new materials, new techniques or new needs. In this case there was little change in materials – kites could/would be made of silk or fine cotton using bamboo or hardwood right through the period. Admittedly the use of piano wire for high altitude flying was introduced in 1887. Compared to the line available it was cheaper, lighter and thinner (line drag is an important factor in high altitude flying).

A relevant new factor at the end of the 19th century was a network of experimenters interested in flight, together with improved communications so that published papers were read and examples of new practice spread quite quickly.

2 Needs for Kites

The reason why these five emerged when they did was that in the last quarter of the 19th century there emerged a series of needs the kite might meet. These were:

2.1 Scientific interest in the upper air, developing into meteorology
2.2 Aerial photography
2.3 Man lifting for military purposes
2.4 Powered human flight

Of course some of these needs were not new e.g. Chinese man lifting 2000 years ago, Ben Franklin and the electrical kite in 1752, Cayley had used kite shapes in his glider of 1804.

There had been other uses for kites before this period (e.g. shipwreck life saving – see a later article) and there have been new needs in the last 100 years. Examples include Sauls' kites used in anti-aircraft barrages in the U.S.A. during the Second World War. Plans for using a barrage of Cody kites were finally abandoned in 1940. Airsea rescue used the Gibson Girl kite to lift the aerial (see The Kiteflier October 2002 for an article concerning the origins of this kite). One use of kites – for traction – which had been highly developed by POCOCK in the 1830's has been revived in the last 15 years for recreational purposes as kite buggying and kite boarding. Now to look at the 'needs' in more detail.

2.1 Exploring the upper air / meteorology

In 1749 Thomas Melvill and Alexander Wilson in Glasgow used a train of up to 6 paper kites 4-7ft high to lift thermometers attached to the line at known intervals. Tassels were used which, when the fuse had been burnt through, both cushioned the fall and made the instruments easier to find. The experiments continued for some time but ceased on Wilson's death before they tried to replicate Ben Franklin's lightning equals electricity experiment. This took place in 1852 using a simple diamond/square kite apparently made from a silk handkerchief using cane reeds not bamboo. Had there been a nearby hill Franklin would probably simply have used a metal spike on the hill to 'trap' the lightning and show that it was another manifestation of electricity. Franklin and the experiment is one of the most common images involving

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a kite. The kite is usually drawn very badly being an arch top or diamond rather than a square. The experiment did lead to a practical gain – the invention of the lightning conductor.

By the early 19th century balloons were more advanced than kites – Montgolfier's hot air balloon dates from 1782 – and could carry great weights. But they had two serious disadvantages:

- Attached to the ground they became uncontrollable in a strong wind
- Non-captive they drifted and would lose their payload

Into the 1880's and matters came to a head in the U.S.A. There was a disastrous and unforeseen blizzard in New York in March 1888 and there was growing evidence that knowledge of wind speeds, pressure and temperature at altitude would help weather forecasting. Also at about this time better lightweight instruments were developed in France – linked to experiments in 1878 by Herve Houngon.

Flying high altitude trains for meteorological purposes was pioneered by the French Trappes Observatory in 1880. However, long trains of kites with tails were particularly difficult to handle. Eddy whose tail-less kites were used made the breakthrough from 1884. By 1896 they had been replaced by Hargrave box kites to be worked on by Marvin and Clayton to become the patented 'Blue Hill Box Kite'. Interestingly Blue Hill Hargraves had the meteorological instruments fitted to the kite not hanging from the kite. By 1898 it was routine for kite trains in the U.S.A. to lift instruments to 8000ft from one of 17 weather stations. While box kites were normally used, in light winds the Lamson Aerocurve (a great kite, see PELHAM p44) was used as the top kite and one reached 11,060ft in 1897.

Not all kite-assisted meteorology was American. France had launched kite trains to over 5000m using kites designed by Pantenier – the firm continued into the 1950's. I know of two British examples. In 1902 William Dimes used Hargrave kites to lift a meteograph and took a series of readings at 200m on the North West Coast of Scotland. In the same year Cody had a contract with the Newcastle Daily Chronicle to lift meteorological equipment which resulted in the U.K. height record being set by the highest of 3 kites in a train which reached 14,000ft on Newcastle Town Moor on 5th September 1902. But by 1918 the aeroplane and new types of balloons had replaced kites.

In my part of the kite world it is very unusual to see a 'true' Hargrave or U.S. meteorological kite. Perhaps the main influence of meteorology on kites, apart from providing the incentive to develop types such as the Eddy (and the Meteo – see 3.2) was the experience that it was practical to fly at high altitude using kites made following precise plans to high standards.

And the absolute height record is still held by the top kite in the train of 8, which reached 31,995ft on 1st August 1919 over Lindenburg, Germany.

2.2 Aerial Photography

The first aerial photographs using a kite were by Archibald in 1887. There was a great development of such photography in France (e.g. Batut whose wonderful first photographs were taken in 1888) which still remains the centre of that aspect of kite flying today.

In the U.S.A. lifting cameras by a train was seen as one of the main early uses for Eddy's kites. Eddy's contemporary Woglam (see 3.1) also took aerial photographs in 1895. However, it was the Conyne which was used by George Lawrence in the most famous aerial photograph – that of 1906 San Francisco after the fire caused by the earthquake. He used a train of Conynes each a short bridle from the main line but stopped from tangling with it by thin bamboo battens. The camera was suspended from the line by a complicated system involving its central position in a triangle of 15ft weighted booms, which he called his 'captive airship' (now there is a name that has caused some confusion). The camera weighed about 49lb – the negative size was 18" by 48". The reward was similarly huge – Lawrence earned about the equivalent of $300k at today's prices for the shot.

I don't think that photography has had much of an influence on kites seen today except that it acted as a spur to Eddy and Conyne.

But even in 1942 Domina Jalbert (inventor of the soft kite) lifted his daughter on a trapeze slung beneath a train of French Signal kites because he wanted the publicity from her photographs appearing in the local paper (Kitelines Summer 1977).

There are still circumstances in which kite photography has advantages over helicopters etc – for example when an unobtrusive 'friendly' arrangement is required and resources do not run to satellites. Such a photograph is the one taken by French photographer of the Hindu Kumba Mela Festival in India in 1991 (Drachen Foundation Journal Summer 2001). And at larger kite festivals nowadays quite often someone is 'trying a new rig'.

2.3 Manlifting for Military Purposes

There are very old stories of Chinese armies raising soldiers for observation, as well as daring rescues and Japanese robbers. As PELHAM points out, these are all examples of man carrying kites (where the man was fastened to the kite itself) rather than man lifting, where the man was suspended from the line. The only man carrying that I know of in this period was by Bell's large tetrahedral kites (see 3.3). Interestingly Japanese fliers have recently concluded that man carrying on a flat kite is very difficult to do – presumably because of the effects on the airflow and the centre of gravity of the kite.

Of course kites had been used to lift friends of the kiteflier before this period – e.g. Pocock's daughter Martha was lifted '100 yards' in 1825 – this is the first reliable record of a kite lift in the U.K.

However, by the last decade of the 19th century the need for observers (soldiers in the sky) had become more pressing. It had always been true that high vantage points enabled you to see further and that the development of trenches meant that observers were needed to map the enemy's positions. The big change had been gunnery (both on land and at sea) where there was now the ability to send a shell accurately for several miles but no way from the ground to spot where it had landed, particularly how close to a given target. The British army had not covered itself with glory in the Boer War (1899 – 1902), but the artillery had been good and observation from balloons had worked. But balloons were heavy to transport, time consuming to set up and unsuitable in anything above a light wind. Incidentally, my reaction to the idea of soldiers hanging in a basket was the danger of being shot by the enemy. However, the material used in British balloons was virtually self-sealing and experiments (reported in WOGLAM) showed how difficult it was to hit a small target in the sky.

While the British Army had experimented with earlier systems, e.g. Baden-Powell's Levitor Kite (see 3.5), the most

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reliable system devised was that patented by Cody in 1901. The French Army used Conynes, also Cody look alikes by Sacconey. Russia had a system – so did Belgium but more on this in 3.5.

I'm curious why I have never come across an American Military lifting system.

Obviously by 1918 aircraft had developed so that kite observation became obsolete, but recreating the kites and the systems has provided much fun.

2.4 Powered Human Flight

By the last part of the 19th century it was becoming clear what would be the arrangement for sustained man carrying flight, viz.:

- A structure producing lift
- An engine to provide motive power
- A method of using power to move the airframe i.e. a propeller
- A pilot to control and direct the whole thing

The earlier, arm-flapping, birdmen had been shown to be getting nowhere – one obvious problem is that of George Faux (JENKINS p92) who, each time he plummeted to earth from the roof of his house, said "I'm a really good flyer but I cannot alight very well". There was one successful gliding birdman – Otto Lilienthal, who made many glides from 1881 but was killed in 1896. Quite possibly had he lived and been able to attach an engine he would have won the race.

But in general the most successful advances came from the use of kites. Back in 1804 Sir George Cayley's first successful glider has used kites. A large kite was the main airframe with a smaller one reversed and attached to the tail end of the main kite by a piece of wire, to enable the correct tail angle to be achieved.

The most significant contribution – which directly influenced the winning of the race – was the development of the box kite by Hargrave. The Wright brothers adopted this structure and flew a four-line dirigible box kite to discover whether their wing warping method would work. It did and although a design dead-end, was used on the first flight in 1903.

It could be said that there were two groups competing to be the first to fly, the birdmen and the drivers. The drivers saw flying as designing a machine, which was essentially stable and steerable like a car, plus being able to rise and fall. The birdmen sought a machine which, while not necessarily stable by itself, could be stabilised by the actions of the pilot who – it became clear – would need the ability to tilt as a major part of aircraft control.

Hargrave never flew primarily because he didn't have an engine or a propeller. Bell sought and achieved great stability in his kites but his engine couldn't drive the kite he tested and he used a different approach to the airframe in his 1909 successful flight. He was a 'driver'.

I find it interesting that the Wright brothers business was bicycles – by themselves unstable but achieving stability by the movement and controls of the rider.

It is worth noting that the prime kiteflier/flyer, Cody, was a horseman, again an activity where balance is vital – even though horses naturally tilt but don't bank when turning. He was a 'birdman'.

3 The Fliers

3.1 Eddy

Photo 1: Eddy Kite

William Abner Eddy was born in 1850 and became an accountant, journalist, amateur scientist and kiteflier. As a boy he had tried to launch a lantern attached to a kites tail. Later he became interested in lifting meteorological equipment using a train of hexagons. This is a design notorious for the length of tail required. Eddy, who had settled in New Jersey, claimed that although he had heard of the Malay, he developed his own kite independently prior to seeing Malays for sale at the 1893 Chicago Worlds Trade Fair. Essentially the Malay is a small paper kite (diagram 1) with the crosspiece bowed. Eddy's modifications were:

- To move the crossing point up the spine
- In one version to have the crosspiece set at 45 to the rear of the spine. When flexed this resulted in the end of the cross spar being not only bowed but swept back. This is a very similar effect to the bow on an 'Indian Fighter'.

The third feature of the Eddy compared to other diamond shaped kites of the period was to have a loose fitting skin or cover. So the kite in flight (see photo 1) had curved airfoils each side of the keel and a 'bow' i.e. a ridge running across the cover which was formed by the cross spar.

For us the major feature of the Eddy is its lack of tail. This was seen as a very remarkable feature at the time and spectators jeered Eddy for his incompetence in not having one fitted.

Eddy waited until 1898 to apply for a patent, he had to wait an unusually long time – 20 months (average at the time 10 months) – before it was granted in 1900.

The question 'what was new about Eddy's kite?' become more complicated when it is realised that well before 1898 Gilbert Totten Woglam was designing a very similar kite in New York – just across the water from New Jersey. I do not know if they knew each other but it does seem a remarkable coincidence. Woglam received his patent five weeks after Eddy after having to wait for 4½ years. Woglam's Parakite (the name was meant to show that his kite was beyond a 'boy kite') went even further than Eddy to ensure a slack cover by having an open box pleat on each side of the nose of the spine (see photo 2). Woglam was informed and clearly knew of the Hargrave box kite and Japanese and Javanese flat kites. He used trains of Woglams to lift an American flag to 1000ft and to take photographs in 1895. There is an interesting discussion of all this in MAXWELL EDEN p 149. Woglam was a great character, e.g. he had 100 parakites each 'rated' for suitable wind strength and each with a name.

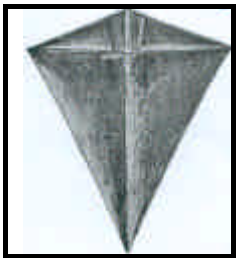

Photo 2: Woglam Parakite

There is a tendency to call kites Eddy's in America that would be called Malays in Europe. But there is real confusion because at least four types have been called Eddy (diagram 1).

1. Kite with No 4 plan, slack covered and with cross spar bowed to 10% of the span and tilted back 45°.
2. A similar kite but with the cross spar set to bow at 90° (the original patent).

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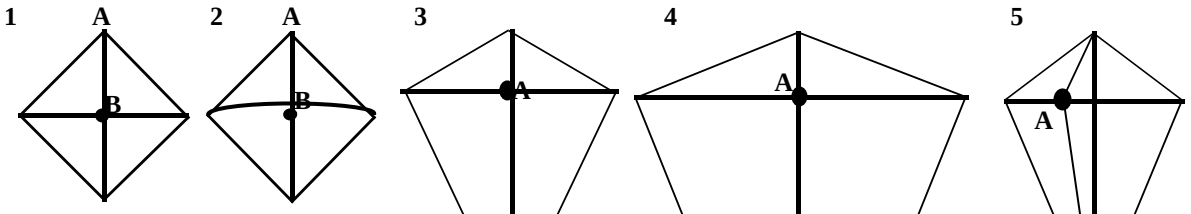


1. Basic Malay: Bamboo Frame; Paper Cover. Bridled at A and B. Spar flexes to give stability

2. Another Malay: Bamboo Frame; Paper Cover. Bridled at A and B. Curved spar when flexed gives an Indian Fighter effect.

3. Malay in Pelham: Dowel and Ripstop; Proportions—Length 1.00, Span 1.30 A is .3 from the top. Flown bowed.

4. W A Eddy's kite: Length 75, Span 70. A is 17% from top. Wood spars, cross spar reinforced. Skin cut 10% oversized to allow shaping.

5. Diamond Kite: Has a fin—bridle point A. Tight ripstop cover. May have built in dihedral. Cross spar may be as high as in an Eddy. Tail required. More tail with low aspect ratio.

Diagram 1.

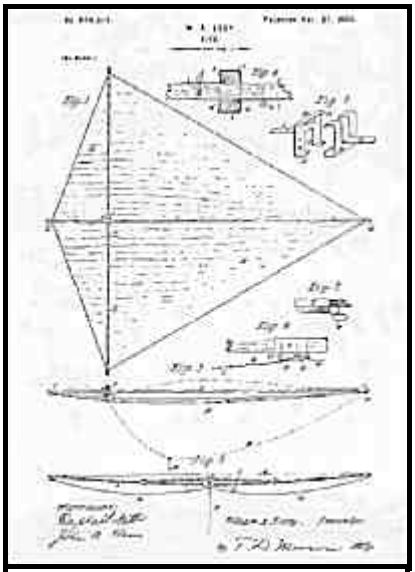
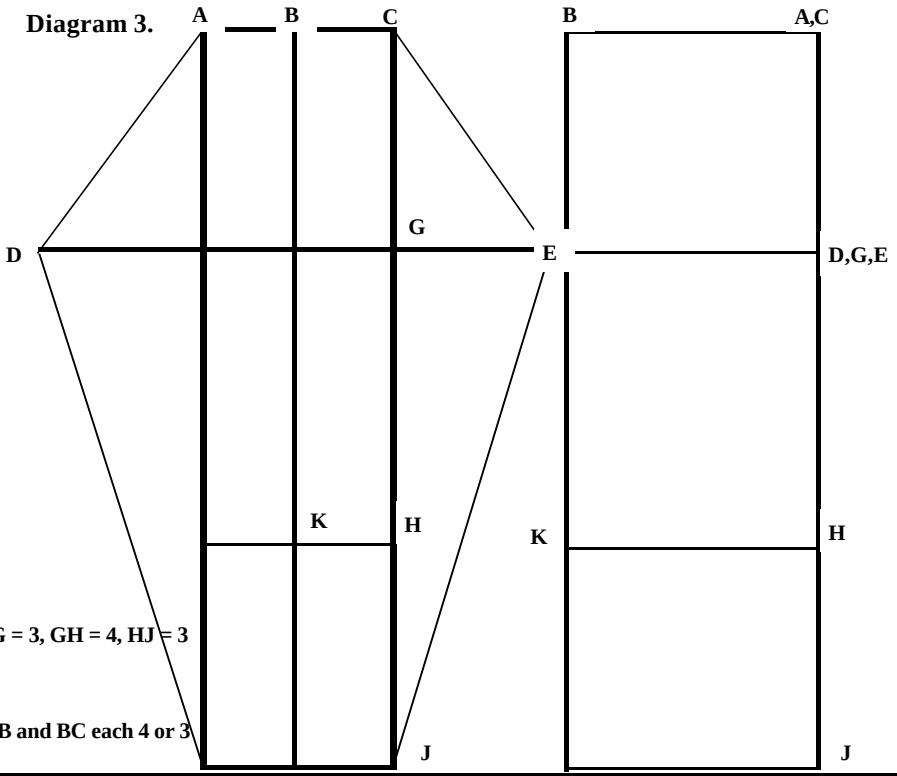


Diagram 2.

Diagram 3.



Conynes dimensions were—where CJ = 10, Then CG = 3, GH = 4, HJ = 3

Where DE = 8 each wing 2.5 and AC = 3

Bridle is B to K. Cell depth (eg ABC) is AC3 then AB and BC each 4 or 3

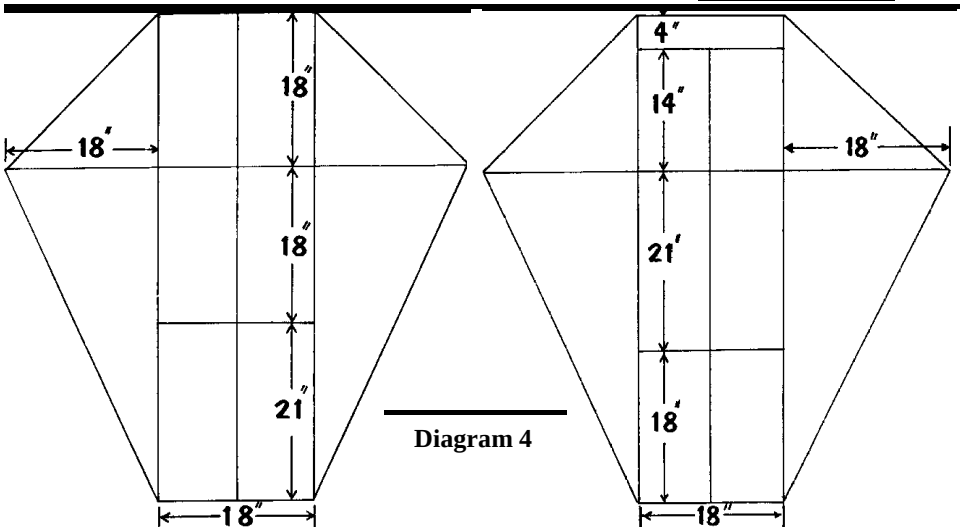


Diagram 4

The left design is from a 1908 publication "The Boy Mechanic". Cotton broad cloth or cambric is recommended cover. The wing spar is set in pockets at the wing tip. Passes in front of the longerons and should be tight enough so that the resulting slight bow causes the spar to be just tangential to the longerons. This takes careful fitting but the results are said to be worth the effort.

The right hand design, by Dan Leigh. It was this kite that led physicist Ray Biehler into his investigation of relative cell proportions. In the left design both cells are actually too large and the better proportions and locations are given here. Dan Leigh states that the best place for attaching the bridle is at the very front edge of each cell.

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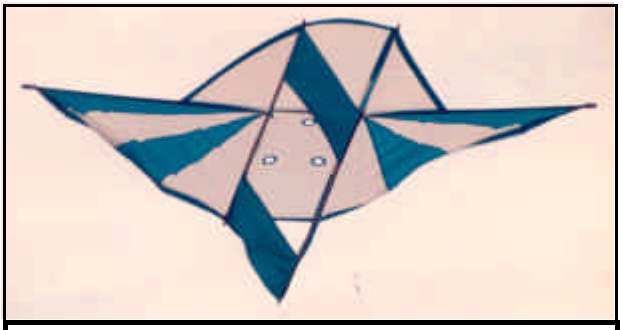

Photo 3: Meteo Kite.

3. A lightweight kite with No 3 plan. Has a tight cover with a dihedral piece set to give a 'bow'.
4. Kites with No 5 plan. Have a keel and are properly called Diamonds.

Another point of discussion about the Eddy kite is whether he shape of the kite can be given by framing string around the four points. It might help to look at the patent drawing (diagram 2). Whereas children's diamonds often used framing strings with paper covers most modern kites are made to break down and use fabric which can have reinforced edges. Framed Eddys were designed to have the cross spar sprung in with a dihedral curve.

Eddy experimented with kites with a kite shaped hole in the cover at the crossing point. A hole of perhaps 5% of the area helps in stronger winds.

Finally there is an interesting book (25 Kites That Fly by L.L. Hunt) reprinted in 1971 but published in 1929. 'Eddy, Woglam, Kirby and others in the United States either independently discovered or perfected the Malay kite until its performance is little short of marvellous. It is said that Eddy made his cross stick longer than the spine, Woglam held invariably to the depth of the bow being 10% of the length of the spine and Kirby made spine and cross equal with a greater bow calling his kites 'bird kites' from their proportions being like those of a bird' (p37). Rather confusing and who was Kirby?

Eddy was an active flier using his kites to lift flags, lanterns and cameras.

Given that there are questions about Eddy's patent and given that the Blue Hill Observatory only used his kites less than two years how important a kiteflier is he nowadays? What is his legacy? He established that with proper design and accurate construction it was practicable to make a buoyant tailless flat kite. That insight led to other flat kites.

MAXWELL EDEN argues (p140) that Eddy's still dominate the skies. But wherever I have flown in America (admittedly only in seven states) delta kites rule. In the U.K. anything approximating to a pure Eddy is rare and certainly less frequent than deltas, boxes or even Codys.

3.2 Silas J Conyne

Of the five kitefliers included in this article Conyne is the one about whom I know least. An article about him and his kites (Kitelines Spring 1985) has no personal details, says he 'remains a mystery' and was considered 'strange' by other members of his family, some of whom, embarrassed by his kite flying, would deny kinship.

He seems to have lived in Chicago when the Conyne kite (diagram 3) we know was patented in 1902. Conyne called it 'an aeroplane designed to be held captive and to be used with aerial advertising apparatus'. He claimed for the new kite durability, ease of assembly, lifting power, lightweight and 'a pleasing appearance when in the air' – and for the first 100 years it has delivered.

Looking at diagram 3 we can see that essentially the Conyne is a diamond split down the middle and rejoined by two triangular cells. But two key design points are:

- That the cells are separated by a gap (Conyne had another patent in 1911 for what was apparently a 'Conyne' but with a full length triangular tunnel keel).
- That the shape of the cells depends on the wind pressure from the wings i.e. the cells are not braced in any way other than the leading edge keel spar.

While diagram 3 gives the original proportions, diagram 4 shows a 1908 version and what has been claimed to be the optimal cell sizes.

Measurements taken from an original 'Conyne Aeroplane No 3' have the kite 60½" high (cell 18", gap 24") and 53¾" wide with 18" wings and 18" centre gap. His bridling was a two leg 10% and 70% from the top of the leading spar, meeting to form a right angle with the cross spar. Conyne kites are easy to make, the only construction detail to note is that Silas J specified that the cross spar went behind the bottom edge of the top cell (often sleeved there nowadays) but in front of the wings to allow each wing to adopt a smooth curve. There are some Conynes today (possibly going back to PELHAM) which have the spars behind. And, just a thought, why not make a slack covered Eddy with the cross spar in front, though you would lose the 'bow'.

The Conyne kite was successful, e.g. it was called (stamped on the kite) the 'Best Kite in the World' having won Gold, Silver and Bronze at the St Louis World Fair in 1904. A train of Conynes won a man lifting competition in France in 1905. Maillot, a noted kiteflier who lifted weights, switched to Conyne kites – sometimes called French Military kites. The French also used a 3 celled version of a Conyne as a Signal Kite (see diagram 5). A high angle, hard puller.

What is Silas J Conyne's legacy to kitefliers? Firstly the Conyne is a relatively simple kite to make, any reasonable size works, it will fly in anything except a light wind and 'has a pleasing appearance in the air'. Secondly in the U.K. we have Brookite, our oldest kite manufacturer, who must have been making Conynes for 80 years and it is still easy to find their cotton cloth Conynes – which do need a fair blow. Top of their range has been the Master Kite – a double Conyne (wing, triangular cells, full height panel, triangular cells, wing) -–PELHAM mentions one with detachable panels for high winds.

Thirdly we have kites which incorporate the Conyne masterstroke of the unsupported triangular cell (a braced triangular cell would make Bell its ancestor).

The main developers of the Conyne idea have been the French designers Pantenier, involved with the meteorological station at Trappes near Paris, who designed the Meteo as a kite for lifting instruments (see photo 3 and an unnamed kite photo 4. Both kites bought to Blackheath in 1983).

Another variation, rarely seen by me, is the Plano (diagram 6). Take a fairly large Plano and attach 2 or 3 sets of Conyne cells across the width and inside the height of the flat surfaces and you have a Wasseige (diagram 7 and Photo 5). I've seen a photo of a 1992 German version, which was 6 cells

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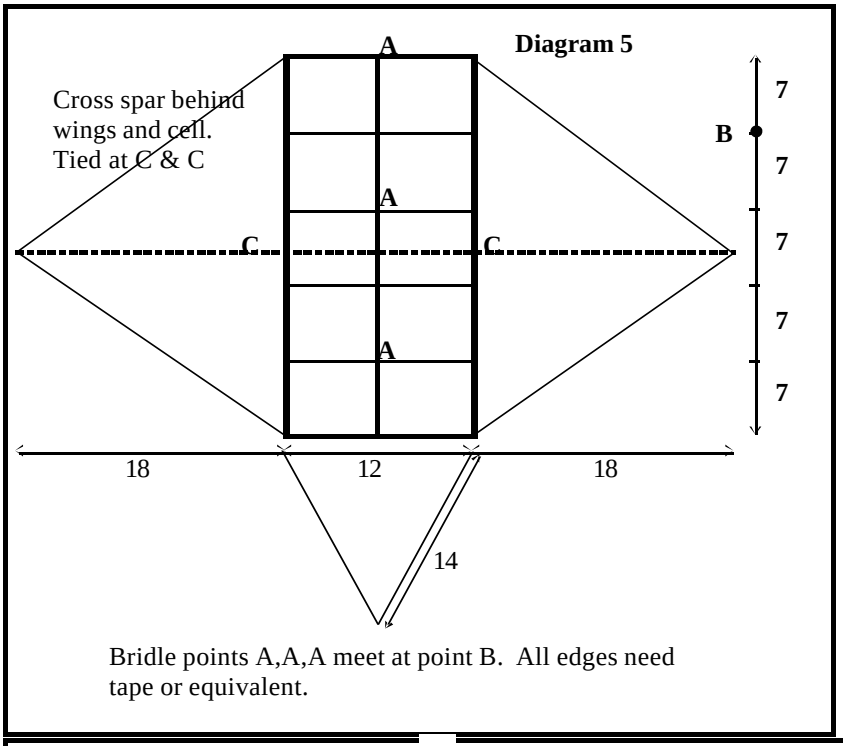
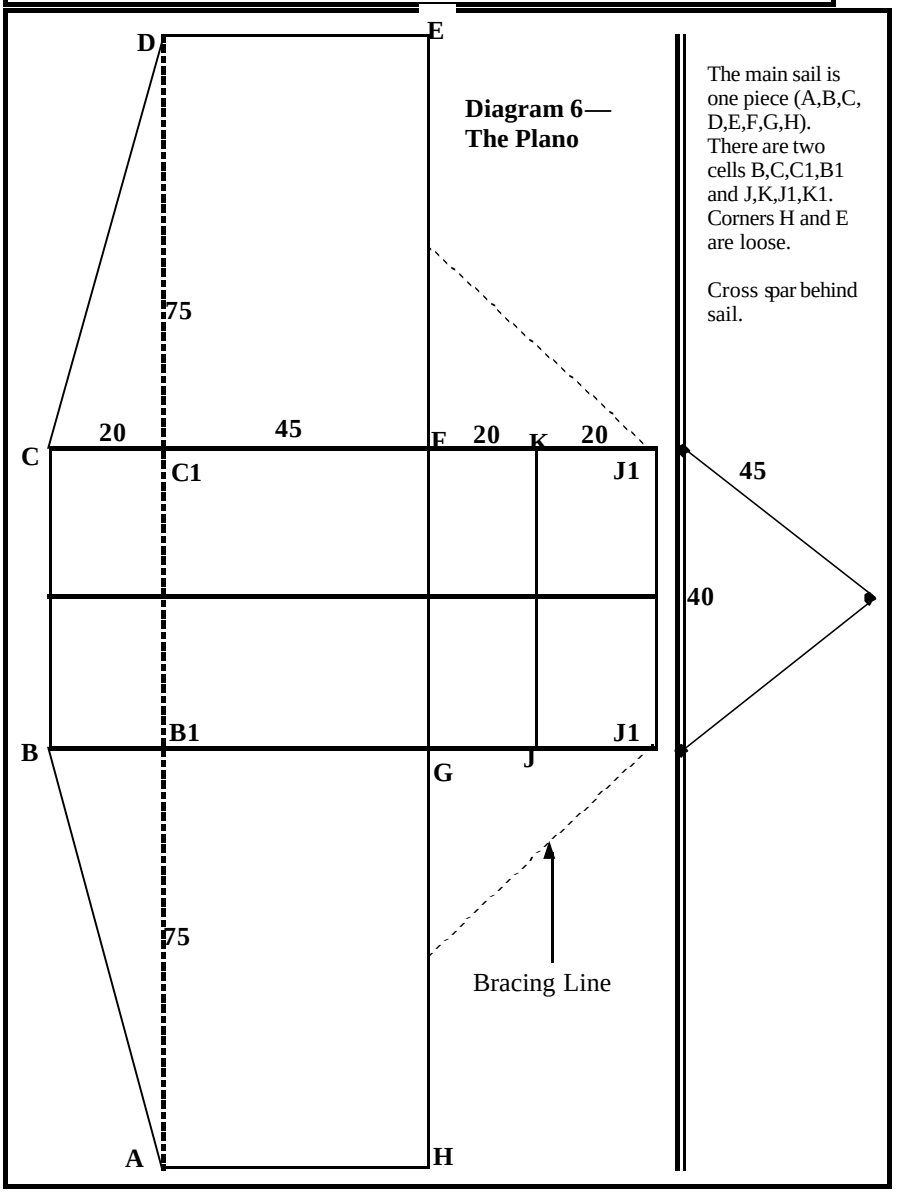


Bridle points A,A,A meet at point B. All edges need tape or equivalent.



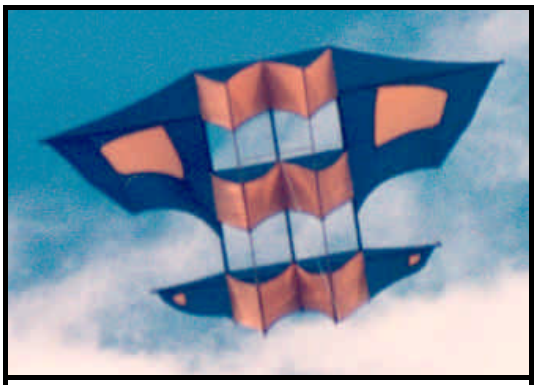


Photo 4: Unnamed French Kite

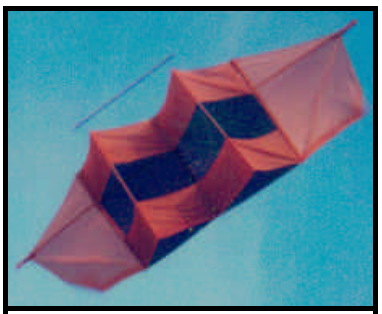


Photo 5: Wasseige

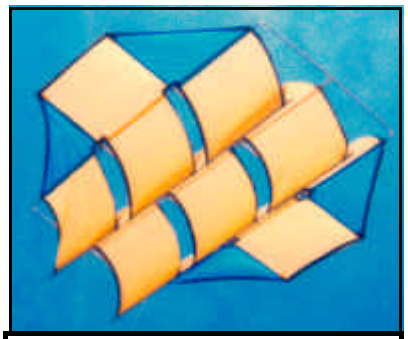


Photo 6: Thorburn Stub Wing Conyne

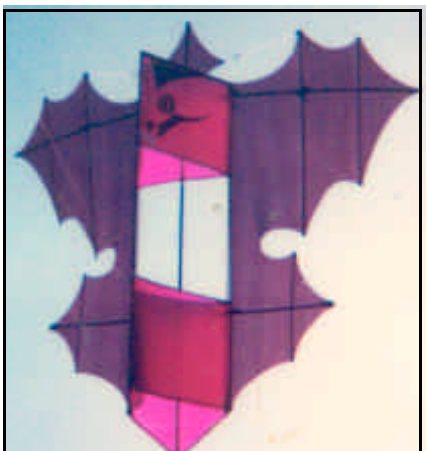


Photo 7: Vampyre

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wide and had an overall width of 7m. Wasseige need a 'trapeze' style bridle, i.e. a spar which is held horizontally to ensure tha the cells are held open. Some bow-induced dihedral also helps. Again easy to make, they are impressive fliers, largely because they are so 'un-modern' – the unsupported square corners of the sail flap happily and there is the rippling of the Conyne cells. 'Like a washing line in the breeze' Mark said.

Conyne cells have been used in several ways combined with Delta wings. THORBURN used Conyne cells for the stacked delta and the well-known Dunton delta/Conyne sprinter has a single full-length Conyne keel. Thorburn, of course, couldn't resist sticking Conyne cells in various combinations sometimes including stub wings (photo 6). An old Conyne variant is the Vampyre (photo 7) now made by Raindrop Kites which combines Conyne cells with Cody Wings.

3.3 Alexander Graham Bell

A Scottish Canadian, whose family had been interested in hearing and teaching, he started as a teacher of the deaf. This led to his understanding of sound, hearing and thus the telephone. Born in 1847 he went to Canada in 1870, worked in the U.S.A. and by the age of 29 was rich. He spent the rest of his life following his scientific interests – for many years from a house with laboratories attached in Nova Scotia. His interest in kites was as a way into flight. In later life he encouraged the development of aircraft and developed hydrofoils. In 1919 his hydrofoil reached 71 mph and for 12 years was the fastest boat in the world. He also tried to breed sheep with more nipples in order to increase flock size.

Photo 8: Andre Cassagne Clock Kite

A large, bearded, expansive, patriarchal figure he was well respected and popular – after all he set up a local industry making 10" sided red silk triangles. His very able wife, who was profoundly deaf, was independently wealthy. One of the most romantic photos in all kite literature is that of Mrs Bell standing in the middle of a 2m, tetrahedral frame leaning forward to kiss the plus-foured AGB (see D H Eber "Genius at Work" 1991).

We know much about Bell's working methods as he kept meticulous and detailed diaries and was one of the first researchers to use the camera as a method of record (but was never interested in aerial photography). As a result there are great kite photos in Eber's book.

Bell was very good at putting together a team – like Cody but unlike Hargrave who worked essentially alone.

Bell's interest in kites was as a step towards achieving manned flight and he started with Hargrave's two-celled box kite. This he called 'the high water mark of progress in the 19th century' in his article that appeared in National Geographic magazine of June 1903. Bell thought about the shape of box kites (see diagram 8), recognising that the bracing needed for a rectangular kite involved spars required to stiffen the shape and not support the actual flying surfaces (he doesn't seem to have considered wire bracing). The two penalties were weight and wind resistance. This led him to triangular sections where the spar does both functions. He followed up with hexagonal box kites – seen as six triangles with common sides. Incidentally he considered other box shapes including the circular kite still sometimes seen (photo 8). But he was concerned with the 'problem' that such a triangular cross section still had rectangular sides, which would require support. On 25th August 1902 he came across the regular tetrahedron, tried to sketch it and complained in the notebook "can't draw it". I'm not going to try. One description of a regular tetrahedron is that it is a triangular based pyramid, i.e. has four identical sides. Perhaps the easiest way to visualise it is to use Bell's own approach, viz.: there was an old puzzle asking someone to make four triangles using 6 matches. The solution is to make a triangle of matches and then sit a tripod of matches aligned onto the triangle. This is potentially an extremely strong structure; cover any two surfaces and you have the basis for a kite (photo 9).

Photo 9: Professor Waldorf Tetrahedral Kite

About this time Bell had also reasoned that an efficient flying machine might well comprise many small units rather than one large one. There was at least one respected scholar at the time arguing that a frame large enough to support a person would be too heavy to fly (see Bell's National Geographic Magazine article).

Bell's cottage industry of making 10" red silk triangles and then joining them to make tetrahedrals got into full swing as he realised that very large kites were possible and that rock steady kites could come from a range shapes made of tetrahedrons. By 1907, having flown his first man lifter the Frost King in 1905, all that he appeared to need was a suitable engine to drive, what were now becoming, enormous kites. The Frost King had 1300 cells but the high point for kite fliers was the 1909 Cygnet with 3393 cells.

Bell left kitefliers a three-part legacy:

1. The idea of making large kites by using standardised small components. One of the best exponents of this is Andre Cassagne with his Bell inspired circular kites (photo 8). Also Peter Dolphin with his Sun and Moon circular kites.
2. The use of triangular sections in box kites – but I have not seen one of his hexagonal box kites for years.
3. The tetrahedral kite. Rock steady, majestic if on a large scale, the most solidly three dimensional of all box kites, tetras tend to be made and flown by specialists (photo 9).

There are two reasons for this; assembled they take a great deal of room and assembly tends to be extremely long-winded. Various systems have been used. One of the funniest half-hours of my life was with my son trying to use the instructions to assemble a Professor Waldorf tetra. Sorry Peter. And this was on a carpet with no wind except gales of laughter.

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3.4 Lawrence Hargrave

Born in Greenwich in 1850, emigrating to New South Wales at 15, his father was a judge and Solicitor General of N.S.W. He successfully avoided exams which would have enabled him to become a lawyer, spending 5 years as an apprentice engineer and 5 years serving expeditions to New Guinea (I used to educate lawyers and this seems a fair swap). This was a highly dangerous business, on the first trip in 1872 the ship was wrecked off the Queensland coast. Hargrave survived by some cool thinking and some luck, the captain and part of the crew were killed on landing by native Australians. From 1878 – 1883 he was Assistant Observer at Sydney Observatory. In 1883 his father gave him an income of £1,000 per year. Married and with family he then used this to devote almost 30 years to aeronautical research.

Probable reasons for his failing to achieve powered flight

- He was very much a 'one man band'.
- That although he kept good records and believed strongly that scientific advance should be shared and not restricted by patents, there is an impression that although he was in touch with workers elsewhere, others seemed to be able to make more of his results than he could of theirs.
- He tried to develop a suitable aero engine, but although he got some way towards a rotating radial engine he never had an effective power source.
- He persisted with a system of flappers rather like flails and known as 'trochoidal motion' as being the best way to move an aircraft rather than the propeller.

Hargrave experimented with a wide range of shapes for kites (see PELHAM p36 also W.HUDSON SHAW) but by 1894 he had settled on his cellular kite and had been lifted to 16ft by 4 of them at Stanwell Park Beach. There was an attempt to repeat this dizzying feat at the centenary festival.

Hargrave was probably helped by an article by the American Langley asserting that lifting surfaces could be stacked one above the other and so long as there was a suitable gap there would be no adverse effect on lift (see also C HART).

The 'walls' of the box provided stability and Hargrave really determined for all his box kites the best arrangement for stability – which was to have two lifter cells separated by one or a set of longerons or centre spars. By 1897 his kites were being used for weather research in the U.S.A. and became widely known in the U.K. In Europe Santos-Dumont's aeroplane of 1906 was an arrangement of Hargrave boxes.

A feature of Hargrave's work was the appreciation that a curved airfoil (e.g. the cross section of an aircraft's wing) gives more lift than a flat surface. Not new, this had been experienced by the glider Lilienthal in 1874. To my knowledge, apart from some of his 'boxes' only the Lamson Aerocurve kite was built with a pre-formed airfoil shape.

Is Hargrave's legacy that he is the ancestor of all the box kites we see? With one exception I think so. The exception is the family of externally braced kites such as facets or snowflakes (and I'll consider these in a later article). Those who point out that the Chinese have long had three-dimensional kites with the shape rigidly pre-formed sometimes dispute Hargrave's claim. Good examples are lantern kites, pagodas etc – I've seen a photo of a kite in the shape of a rectangular aquarium where the fish move during flight. But to me they are not 'true' box kites because their shape is determined by the object or creature being represented rather than a form used for its flying properties, which has no natural basis.

With such an enormous family of box kites all I can do is pick some particularly interesting designs or applications.

1. Codys or other military man lifting systems are dealt with in 3.5 below.
2. The Pomocerf was a Russian box kite from the early 20th century. The photo (photo 10) is a modern lightweight version.
3. Harry Saul in the 1930's developed a kite originally for advertising purposes, which was really a Hargrave with part of the space between the longerons infilled (photo 11). He later produced a viable barrage system whereby every aircraft would be deterred by the lines.
4. The Gibson Girl box kite (photo 12), designed in WW2 to be flown from a dinghy lifting an aerial is many peoples idea of a box kite. Sized 36" long by 27" it is a simple 2-celled box in yellow silk with an aluminium frame. Still to be seen, see The Kiteflier October 2002 for an article discussing its origins.
5. A popular box kite of the 1980's was the stub wing box (photo 13) sometimes called the Keyhole Box and marketed in the U.S.A. as the Cloud Seeker. Flown square to the wind I have a version which has the bridles so arranged that in a high wind the kite can be flown 'sideways', i.e. with the narrow side to the wind.
6. An unusual Hargrave variant is the single celled Mark Cottrell Swept Wing Box (photo 14).

There are, of course, dozens of descendants from Hargrave's cellular kite (never box kite) to be seen – even merely mentioning the names makes obvious omissions. Rhomboid or Diamond boxes (photo 15), the Morgans Optic Box (photo 16). And, of course, the fliers called by Ron Moulton the 'Cotton Club', who make replicas of historic European kites such as the Gomes, the Grund etc.

3.5 S F Cody

He was born Samuel Franklin Cowdery in Iowa in 1867. A cowboy at 14, then a failed Yukon gold prospector he came to Europe in 1890. Although some contemporaries were sure he was illiterate he wrote 'The Klondike Nugget' in 1898. This was one of the most successful melodramas of the period and he toured with the show in which his partner and her sons also appeared. That is a summary of Cody's life up to the point at which he started to make kites. For more read G JENKINS – there is some great stuff, e.g. he used to make a living backing himself on a horse in a race against a French cyclist.

We know that in 1899 he was designing kites – being much influenced by the Hargrave box kites which were bought to the U.K. that year. He first developed the Cody Compound (photo 17 – yes this one needs a drogue). I have seen a single celled variant.

But it is for the Cody War Kite or 'Bat' (photo 18) for which he is best known to kitefliers. Several versions of the Bat exist and, apart from the patent papers (diagram 10) no authoritative contemporary plans exist. In general high wind versions had deeper centre cells (and thus more dihedral); even standard kites seem to have had extended wings. Where possible Cody flew them with the top knot not always seen today and used a drag panel (he called it the 'save all') to stop the pilot kite flying at too high an angle.

Kite design was to take the Hargrave box and to realise that using one set of diagonal braces which were extended beyond the cell gave him dihedral wings and attachment points which enabled him to tighten the fabric on the whole kite. The distinctive 'scalloped' edges were designed to give taut edges

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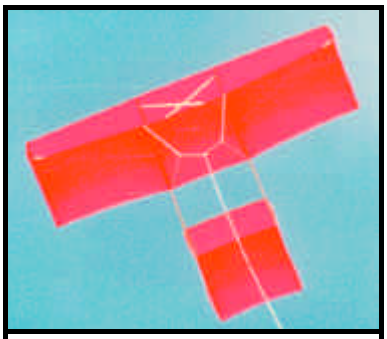

Photo 10: Pomocerf Kite

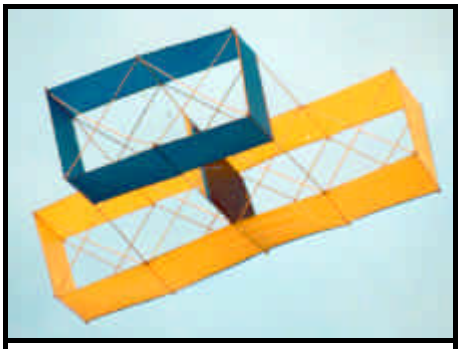

Photo 11: Sauls Barrage Kite

Photo 12: Gibson Girl Box Kite

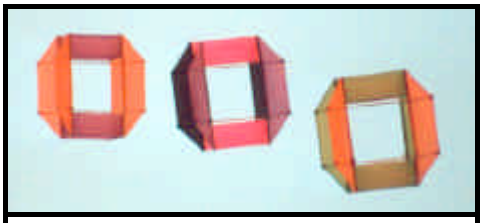

Photo 13: Stub Wing Box

Photo 14: Mark Cotterell Swept Wing Box Kite

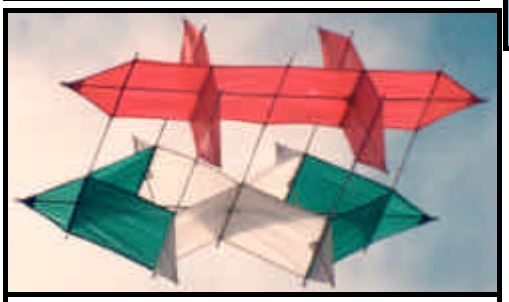

Photo 17: Cody Compound Kite

Photo 16: Morgan Optic Box

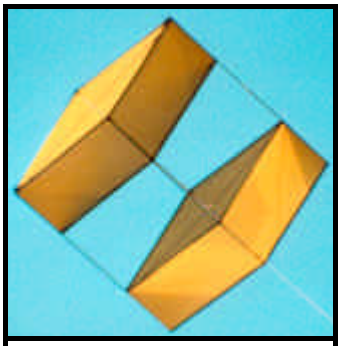

Photo 15: Rhomboid Box Kite

unachievable with his fabric with a straight edge – he wanted as little flap as possible.

Cody's place in history rests on three achievements. Firstly on 16th October 1908 he became the first person to fly in the U.K. Conscious that he was an American he applied to become a British subject with the final part of the process – taking the oath – made in public on Doncaster Racecourse in 1909. He was attending an early Air Festival at which there had been no aircraft flying due to the weather and the crowd was restive. This crowd pleaser reminds me of kite festivals where there is no wind but a famous kite flier is in attendance – what can we do?

Secondly he designed the control surfaces and was the engineer on the only successful flight of Britains first airship in 1907.

Thirdly, and this is back to kites, he designed the most successful man lifting system. As was mentioned in 2.3 there was a real military need to lift observers and the Baden-Powell Levitor kite system of 1895 was clearly dangerous. Levitor kites resemble rokkakus, relying on all spars flexing to give dihedral, before a train was developed a single kite 36ft high was used. Cody patented his system in 1901 (diagram 10) which, although this was not accepted by the Navy and not as widely used by the Army as he had hoped, did allow him to work at Farnborough from 1905 and contribute to flight in Britain.

The man lifting system used Bat kites in three roles:

1. The pilot kite – 14ft span.
2. The (usually four) lifter kites – 17ft span.
3. The carrier kite, 20ft span from which was attached the observer's basket which hung on the line.

Having established the pilot kite in the air the lifters were sent up the line to their predetermined points. This was achieved by having four cones up the line of increasing size. A lifter was attached to the line by a ring, the size of which meant that the first kite would slide over the lower three cones before being jammed by the fourth, the second kite would lodge on the third cone and so on. Only when the whole rig was flying and a load of 1 ton was recorded on the wire would the carrier kite be launched – its progress being controlled by lines from the basket which the observer would use to control the flying angle and thus the lift. From 1902 Cody's system made many man lifts. In 1905 Sapper Moreton was lifted to 2600ft, but the record was Lt Burke-Smith at 3340ft on 17th July 1905.

Of all the kitefliers Cody was the one who pushed furthest ahead with manned flight – this is not to deny the basic work by Hargrave. After making the first flight Cody developed a monoplane, but it was his original design of biplane (it was big at 52ft span and weighing 1 ton) which in 1912 won the trials to be the aeroplane adopted by the British Army. Having been mocked for his cautious approach he become immensely popular by 1912 and when, on 7th August 1913 he was killed trying out his new 'hydroplane' he was the first civilian to be given a military burial at Farnborough and estimates of the crowd vary from 50,000 to 100,000.

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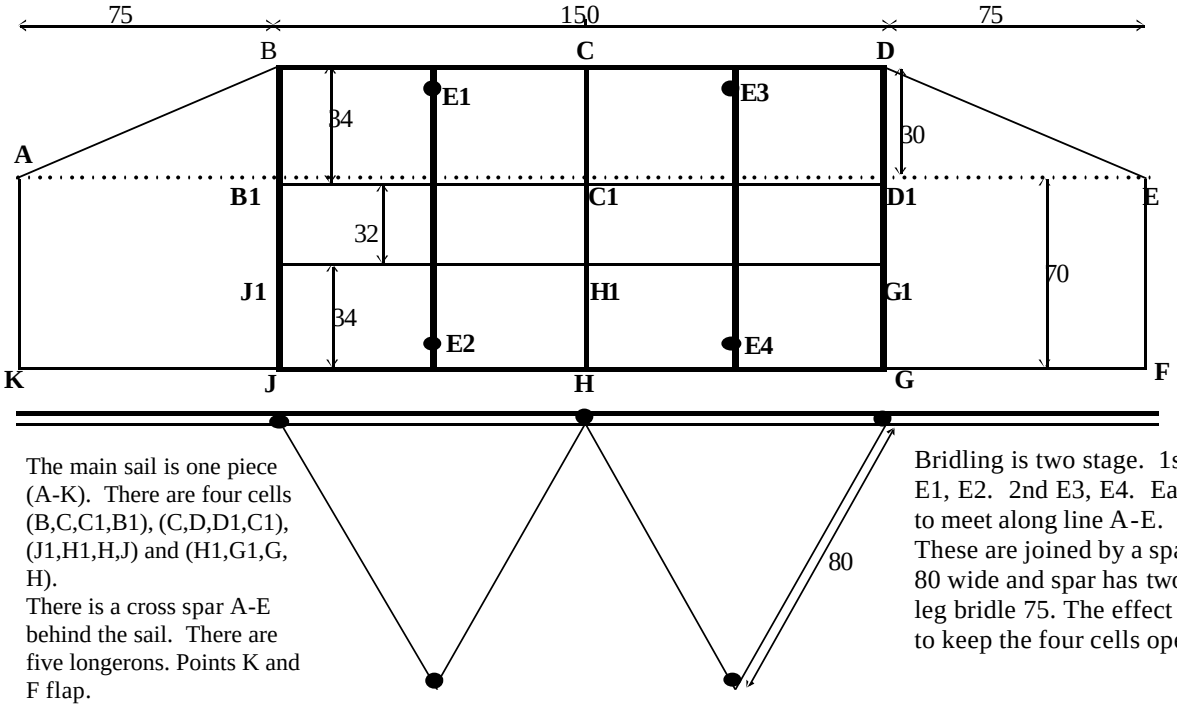
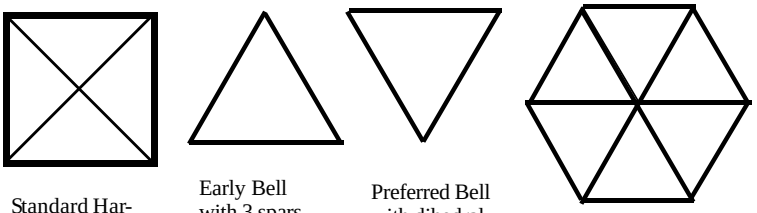
Diagram 7. The Wasseige



The main sail is one piece (A-K). There are four cells (B,C,C1,B1), (C,D,D1,C1), (J1,H1,H,J) and (H1,G1,G, H).
There is a cross spar A-E behind the sail. There are five longerons. Points K and F flap.

Bridling is two stage. 1st - E1, E2. 2nd E3, E4. Each to meet along line A-E. These are joined by a spar 80 wide and spar has two leg bridle 75. The effect is to keep the four cells open.

Diagram 8. Bell and Box Shapes (All views head on).



Standard Hargrave with 6 spars

Early Bell with 3 spars.

Preferred Bell with dihedral effect.

Bell hexagonal box. He would have all edges braced but later boxes used three cross spars and still later just the six spars for the perimeter.

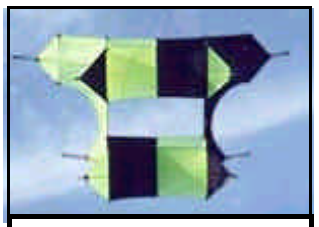
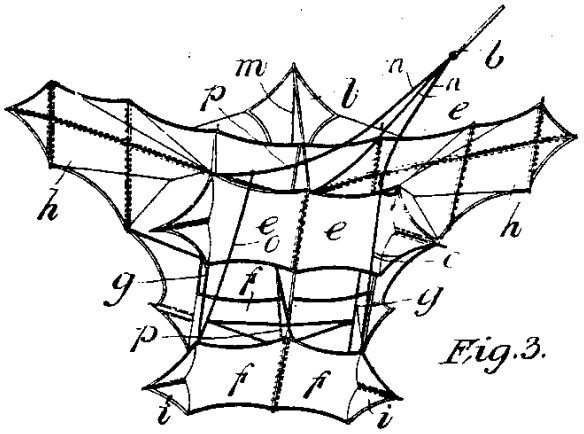


Photo 18. Cody War Kite

Photo 19: George Kite



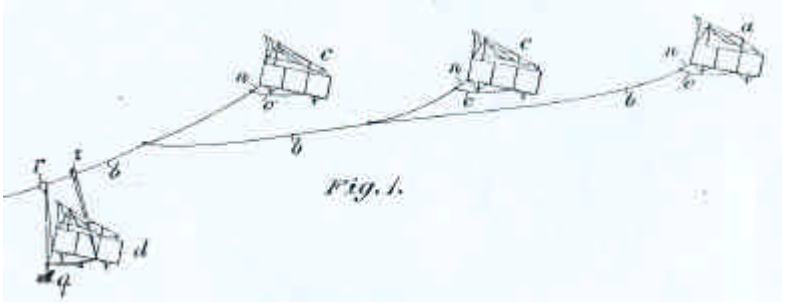


Diagram 10. Cody Patent extracts

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Cody achieved so much because he was a hardworking experimenter who was a good practical 'turn your hand to it' engineer. Physically he was strong with good eyesight and balance – a good pilot. He was universally liked and could set up and inspire a team.

What is his legacy? As mentioned in 2.3 above, there were several contemporary man lifting systems, several of which used Cody type kites. My favourite is the Georges (photo 19), the kite was cruder than some but the name appeals to me – it was the name of the Belgian Army sergeant in charge of their man lifting system 1909/1915 [Kitelines Summer 1983].

Today, I know of two Cody man lifting teams, one German and one Dutch. Both descended from the 1970 revival team of Martin Lester, Nick Morse and David Turner. I can't resist quoting Martin 'Scary! yes! We got up to 300ft, high enough to die. The first 50ft are the worst because if you fall you might live!'. I have not seen a successful launch in England for nearly 20 years. The danger became very clear to those of us at the 'Original Washington' (Tyne and Wear) festival in 1988. A squall hit the train just before the carrier started to lift. Result; the pilot kite broke free and landed miles away, the lifters imploded in the sky and fell. No casualties.

Cody's legacy for the average flier is the Bat kite. Most festivals in England will have a Cody flying if the wind is above gentle. Spectators always respond to that slightly sinister Victorian shape. Kitefliers love them:

Photo 20: Tod Vinken Cody Design

- Some make them in modern materials or as 'repros'. I have read about, but never seen a 'Dyco' – a Cody rebridled to fly tail first.
- There are craft built ones available
- The large commercial kite makers now have Codys in their range. The colours bother me – I feel that you ought not to detract from the dramatic shape by too busy a colour scheme. Cody usually used off white silk.
- There is a 'Slody' or 'Genkody' (Drachen 4/92). A mixture of Coy, Genki and Sled.
- There is even a brilliant piece Cody design by Tod Vinken now on the market (photo 20).

4 Omissions and Exceptions

Of the five fliers:

- Eddy has many links with other flat kites.
- Conyne, we have followed up the derivatives of his triangular cells.
- Bell and Cody both derived their kites from Hargrave (although the tetrahedral doesn't look much like it).

There are two questions.

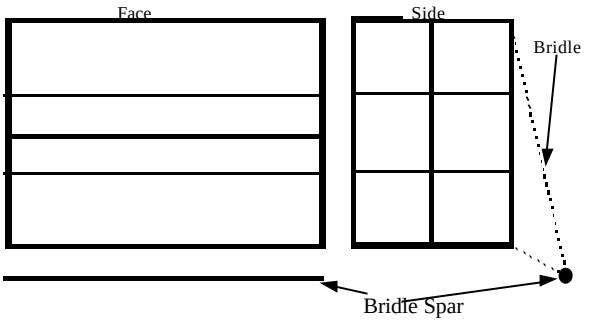
1. Are there other inventors of box kites whose influence can be seen today but have been omitted?
2. Are there box kites, which don't owe their ancestry to one of the five above?

These things are a matter of judgement but I would admit that J LeCornu, the great French designer should be included. He is out largely for the inglorious reason that I know little about him in English texts and I haven't got, or couldn't get, much out of his book. LeCornu's great contribution was the Ladder Kite (diagram 11) and Waffle Kite (photo 21). The kites could be thought of as a single celled version of one of Hargrave's 'waffle' designs (see PELHAM). They fly at a very high angle and one version will fly with a vertical face because the cell surfaces are angled at about 15°. Not often seen but a great sight.

Photo 21: Le Cornu 'Waffle'

My answer to question 2 is that only Facet (or Snowflake) box kites have such a tenuous connection to Hargrave that they deserve a special mention and they will have a place in an 'Odds and Ends' article in due course.

Diagram 11. LeCornu Ladder Kite



Finally, as before I hope you found this interesting and I would be happy to get comments or suggestions, either through The Kiteflier or directly. Next up will be an attempt to classify and look at the development of Flat Kites. Then soft kites loom. Also my thanks to Jon Bloom for the typing and diagram services plus some of the photos.

George Webster

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