Soft Kites—George Webster

Section 1

The first article I wrote about kites dealt with Deltas, which were identified as "one of the kites which have come to us from 1948/63, that amazingly fertile period for kites in America." The others are sled kites (my second article) and now soft kites (or inflatable kites). I left soft kites until last largely because I know least about them and don't fly them all that often. I've never made one and know far less about the practical problems of making and flying large soft kites—even though I spend several weekends a year near to some of the leading designers, fliers and their kites.

"Soft Kites" as a kite type are different to deal with, compared to say Deltas, as we are considering a relatively small number of designs mostly by an international group of highly talented designers/makers, rather than by adventurous club fliers.

So after a look at some definitions, section 2 is a chronology and section 3 examines design features. Thanks to Gill and Jon (and Tara for typing) for dealing with old-fashioned paper. Photos are all by G. Webster except: KSGB Numbers 8, 10, 15, 17 and 29, Mark Bowlas numbers 13, 14, 21, 22 and 24

Note

This is nearly the end of the series of articles. For the next issue I hope to have a short article on "Bits and Bobs" together with a note on how they all fit into a book. Every comment and criticism so far has been valuable.

Section 1

The fundamental soft kite is a parafoil (photo 1) in which there are no spars and the upper and lower surfaces of the skin of the kite are connected by risers. There is a gap along the leading edge through which wind enters and by pressure inflates and holds the kite's designed shape. The shape flies i.e. produces lift greater than weight plus drag. Such kites have been called descriptively "ram-air". The principles of ram-air inflation, not necessarily from the leading edge, and the kite's flying surfaces being held in position by internal fabric risers (or later by cords) are common to nearly all soft kites.

There have been some kites which do not use ram-air for inflation. Of most practical importance has been the Kytoon developed over 60 years ago by Domina Jalbert and used for many years for lifting loads such as timber in isolated sites. Jalbert developed it as a response to the bending of the spars of large kites which affected their performance. The Kytoon is a snub-nosed gas-inflated balloon with two horizontal and two vertical planes at the rear. The horizontals provide additional lift which helps to reduce a tethered balloon's tendency to be blown down in anything above a medium wind. The vertical fins give directional stability (see Pelham, p87). It is worth nothing that in 1909 the airship "Baby" which was designed and constructed at Farnborough has horizontal fins and a single vertical fin. Overall it was a broadly similar shape although the fins were proportionately smaller. It used hydrogen to inflate bag and fins—unlike the Kytoon's single skinned fin. The aim was to provide directional stability (P.B. Walker "Early Aircraft at Farnborough Vol. 1" Macdonalds 1971). It was a recognisable ancestor to Second World War Barrage Balloons.

At least two toy kites have been marketed which used inflation by mouth to produce the flying shape (a fat Eddy). One, the Stewkie Glida—kite is lost in the mists of the 70's, the other the American Puffer kite (with an ingenious straw and simple valve inflation system) was still being made in '97 (Photo 2).

The absence of spars is not by itself the mark of a soft kite. Back in 1948 Francis Rogallo patented his flexible kite (see Pelham p83 and my article on Deltas) where the bridles determined the curve of the wing (i.e. no spars but no inflation). First sold by the Rogallos in 1949, the original design was produced commercially as a toy for many years from '54—I just can't find a photo of my 80's red mylar version.

Rogallo in his '48 patent application foresaw that a stiffened keel or spars might be needed in a large kite—he mentioned that they might be inflatable. So Rogallo could argue (see article in American Kite Fall '88) that the key invention was the idea of the flexible wing and in that sense Jalbert's inflated wing section followed Rogallo's invention. Hopefully Tal Streeter's new book will help on this.

Ram-air tubes to replace the spars in the sled design were produced—Ed Gravel's Bullet of '73 is a forerunner. I have memories of monstrous Eddys being produced for record—breaking purposes in the USA which used pre-inflated (i.e. not ram-air) spars. But most see Rogallo's role

Soft Kites—George Webster


Photo 1.


Photo 2

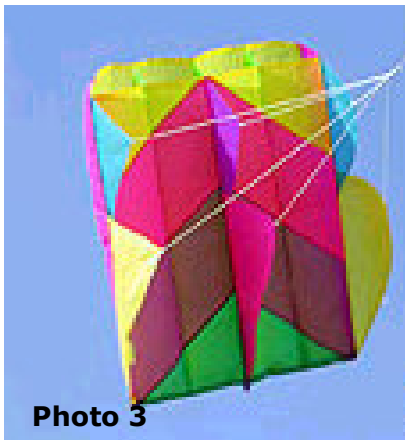


Photo 3


Photo 4

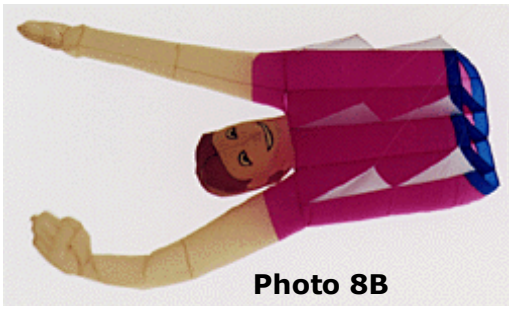


Photo 8B


Photo 8A

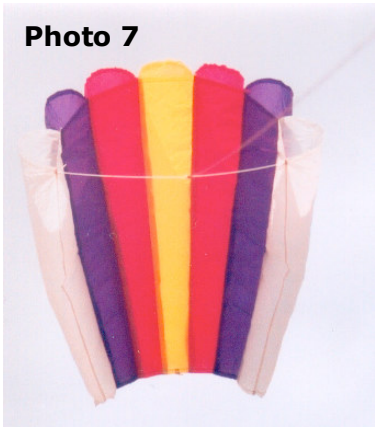


Photo 7

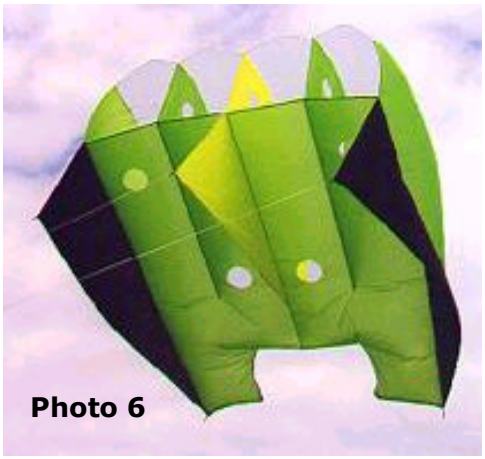


Photo 6

Photo 5


Photo 7A


Photo 10


Photo 9

Soft Kites—George Webster

as being the direct producer of the hang glider and being important in the development of the Delta—all using the single skin canopy. Jalbert is the father of ram-air parachutes and the modern soft kite. Photo 3 shows the first commercial "toy" kite, the J-7.5 of the '70's.

Designers have used ram-air combined with spears to great effect. Undoubtedly the leader in this type of kite has been Martin Lester. His shark of '83 is still a wonderful wriggling creation when correctly sparred (photo 4 is an artistic shot). The bird kite article shows his goose. I managed to get a pre '88 space shuttle at a recent auction (photo 5). Few other designers/ craft men seem to have used this combination although in recent years there have been "toy" kites using air to give a 3D body to aircraft and birds.

One last look round before we get down to the chronology—have soft kites existed before or elsewhere? Interestingly one of the candidates for the earliest European kites (see article "An Outline History of Kites in the West") was a windsock. I doubt whether it was designed with lift in mind but perhaps the stubby dragon wings helped. Incidentally it is suggested that they had fire in their mouths, which, with smoke, frightened the enemy. Apart from the problem of fireproofing, flames might have been very spectacular as presumably air (and therefore flames) flowed in and out of the mouth with changed in wind conditions. I don't know of oriental designs which used wind pressure to form a 3D shape – while whistles, hummers and mechanical devices are of course common.

Section 2—Chronology

1930's—Domina Jalbert develops the Kytoon
1948—Francis Rogallo patents the "flexible kite"
1951—Rogallo writes in Ford Times—"If we could combine the shape of the supersonic airplane with the unbreakable structure of the parachute, we would have a fine kite indeed!"
1964—Jalbert looks at his Beechcraft plane wing and decides to produce a soft cambered airfoil. He starts by removing the gas tank cover and measuring his plane's wing chord.
1974—Steve Sutton, a parachutist, having seen trials of the Jalbert parafoil in 1965, patents his Flowform parachute, which in 1979 becomes the Sutton Flowform kite. He claims to have been influenced by realising that a drogue is more effective with a hole at the downwind end. The Flowform (photo 6) with its distinctive cut away trailing edge is still used at kite festivals as a lifter. It uses a thicker section chord than a typical parafoil with a much larger front edge intake linked with air exiting along the trailing edge. There are also holes both between risers (shared with some parafoil designs) and on the upper and lower skins to allow air movement in response to local changes in pressure. Claimed to be better in fluctuating winds it has the practical advantage of requiring fewer bridles.
1978—Richard Lewis produces the flexible pocket kite.
1981—Jalbert takes unsuccessful action against the Sutton Flowform on the grounds that it infringes his patent.
1981—The Ferrari Ram (photo 7) is advertised in the UK. Still being made, it uses ram-air to stiffen a series of tubes—the bridling makes it clear that this a type of sled.
1981—Scheveningen –a Dutch team flies the world's largest kite (50 ft, 550m^2) - photo 7a shows it at Scheveningen.
1983—Martin Lester's Shark created, it is his signature kite and is still part of his logo.
1987—Peter Lynn, a New Zealand designer hitherto best known for his Tri-D box kites, takes up kite sailing using a steerable parafoil parachute given to him by the American John Walters.
1988—Martin Lester's "Legs" kite. The origins of the kite are Martin's response to the advert on the back page of The Kiteflier, published by the Kite Society of Great Britain, Jan '88 (illustration right, see also www.aeolian.co.uk). While Martin's own legs were widely seen at the time, no such kite existed. This, his first totally soft kite was produced later in the year. Looking at the advert it is obvious that a soft kite was not envisaged and one wonders about the significance of the bridling. This remains, to my knowledge (photo 8A and 8B show legs and top half), the only kite developed as a response to a joke. Subsequently the "Chorus line" appeared (photo 9)

Soft Kites—George Webster

1989—The German designer Peter Rieleit designs the Superfly (photo 10). Flown on two lines for basic control rather than stunting, this is for me, among the very first "radically different from a parafoil" designs, having six legs and shaped bi-plane wings. Peter's other designs of the period included a large, curiously doomed looking, bird and an asymmetrical banana (so is a real banana). See his article in Kitelines Winter/Spring '96 and book (in German) "Lenk drachen" Otto Maier 1993.
1990's—Peter Lynn has developed the first practical kite powered buggy (but remember George Pocock) and designs the Peel kite to provide traction.

This marks the point at which soft kite design splits to follow two fundamentally different paths. We will follow the largely single line kites designed for appearance or their aesthetic qualities. But sometimes old forms were used e.g. Tal Streeter's artwork "The Flying Red Line" is a Doug Hagaman built 700 sq.ft. Red ripstop parafoil with a 5 mile long 1 ft wide tail, which I understand has flown to 1 mile (see T.Streeter "The Philosopher's Kite" 2002 p48).

The other development path, of course, is that of 2 or 4 line kites designed for traction. While Peter moved to buggies as being easier for testing traction kites than boats, power kiting in the last 10 yrs has made spectacular advances in the water—kite surfing which emphasises different kite qualities compared to buggying e.g. ability to relaunch from water.
1988—Peter produced the first of his single line soft kites—the Manta Ray. (photo 11 shows him launching it at Dieppe).
1990—Jim Rowlands has great success at the Dieppe Kite Festival with his whale (photo 12 – the example shown is 60ft—Roly built by the Avon Kite fliers). His frog is a further step away from the parafoil (photo 13 shows a group). Both are still in production, together with new designs such as Humpty Dumpty and the Clown.
1992—The highest soft kites—to my knowledge -are used for scientific purposes flying at 11,400 ft above Christmas Island in the Pacific (Kitelines Spring/Summer '92). Interestingly, recent world altitude attempts have not used soft kites.
1992—A good year for new designs. Peter Lynn's Octopus is a very popular design, widely seen and widely copied (photo 14). Two one-off designs; Wolfgang Schimmelpfenning's Jake the Snake and Jürgen Ebbinghaus's The Frog.
1995—Peter Lynn's Trilobite (photo 15) - based on the Palaeozoic Arthropod. Developed in size to hold the largest kite record.
1996—Martin Lester's top half (see photo 8)
1998– Marco Casadio's Mermaid (photo 16). The first glamorous face, plus other attributes which would probably mean it couldn't be flown in the southern USA.
2001—Peter Lynn's Kitty kite (photo 17 and 18). Two photos of this remarkable kite. Look at the back view and explain how that generates lift.
2003—Peter Lynn's flag kite (photo 19 and 20) - The world record sized version will be launched in Kuwait in Feb '05; here is a smaller Union Flag from '03. "Toy" versions are now made.

Section 3—Some factors in the development of soft kites

3.1—Shape

3.1.1 Early ram-air kite development was largely by the use of new airfoil sections (or chord shaping). Some were obtained through knowledge of technical data about their performance, others were clearly "eyeballed".

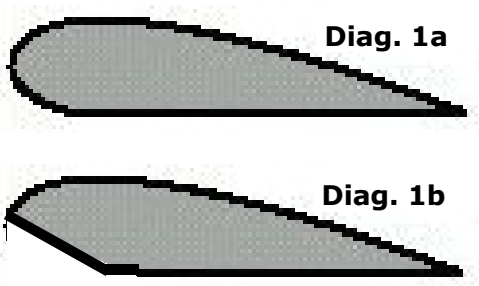


Diagram 1 A) shows "classic" airfoil shape. Often designers (of parafoils) have to use B) due to the use of a leading edge air intake.
This changes a vital part of the airfoil. It can be modified by using gauze which holds the shape but still adds to leading edge turbulence. Another approach is to have air vents in the lower surface, allowing an A) type nosed chord shape. N.B. invert A) and you roughly have the chord shape of the Flexifoil. Not quite as strange as it seems as the "flexi" is only bridled at the leading edge and shapes A) and B) are held to a flying angle by a system of bridles.

3.1.2—Aspect Ratio (defined as span divided by area).

This was also the subject of experimentation together with a range of flat shapes (e.g. pointed trailing edges). Many "ordinary" or club kite fliers who made their own kites and who would happily borrow (say) a delta plan, make some changes and build it, were conscious that ram air originals were legally protected, required excel-

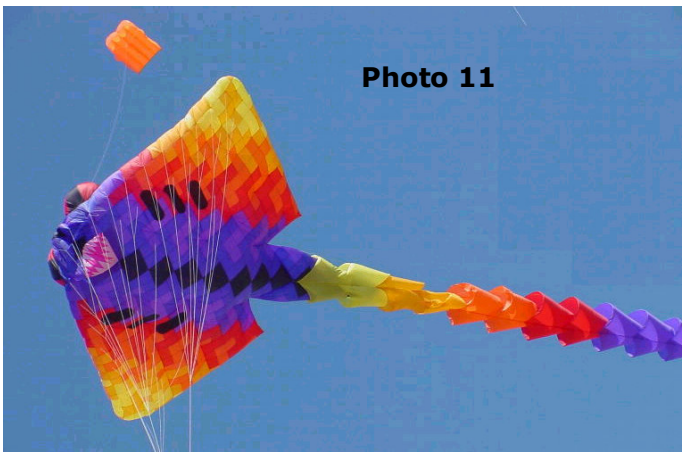


Photo 11


Photo 12


Photo 13


Photo 14


Photo 15


Photo 16


Photo 17


Photo 18

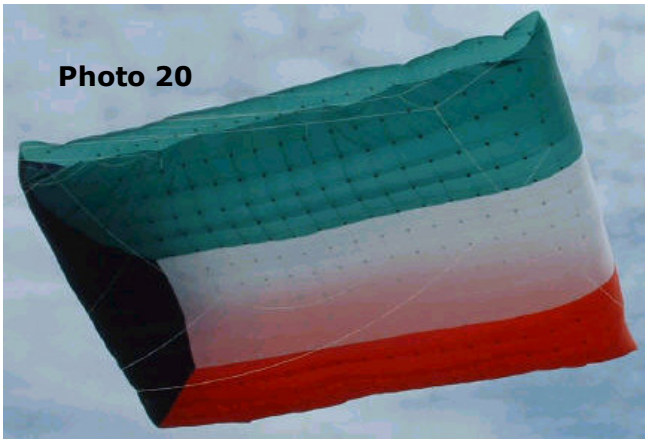


Photo 20


Photo 19

Soft Kites—George Webster

lent sewing skills and very time consuming to make.

Magazines had plans—this was pre-internet—and makers then got involved in the other obvious variables as follows.

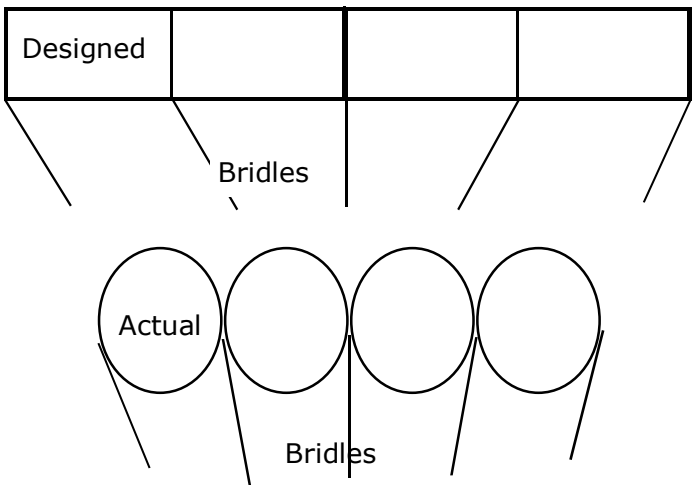
3.1.3—Location of air intake. Jalbert had foreseen that this was not necessarily at the leading edge.

3.1.4—Use of gauze covered intakes and fitting simple "flaps" to provide valves (pioneered by Robert Ingraham as early as 1970).

3.1.5—Size of intake. Some early ram air derivatives e.g. soft sharks, which looked closely related to drogues, had over-large intakes. For most purposes $1ft^2$ intake will serve a $15ft^3$ kite. I remember Martin Lester explaining that the size of the mouth on his semi-soft shark, was as small as possible but had to allow a hand to be inserted to assemble the spars.

3.1.6—Frequency of ribs. Given that fabric ribs were required there was a trade off with more ribs adding weight and building complexity but fewer ribs allowing distortion of the flying surfaces between them (diagram 2).

Diag 2. Front Elevation of 4 celled ram air.



3.1.7—The use of holes in ribs to allow air flow between cells to balance pressure and in particular to cope with wind changes.

3.1.8—The size and nature of fins and the number of bridling points required. Whereas originally fins were used not only for lateral stability but to spread the load on the fabric, techniques such as cording helped to allow fins to be "designed out" of the kite e.g. the flag kite.

3.2—Bridles

Apart from the physical difficulties of bridling a large parafoil there was the problem of identifying stretch. I remember Doug Hagaman, a greatly missed builder of superb parafoils, telling us that he might re-bridle every 2 weeks.

Kitefliers experienced with framed kites knew that it was often possible to sort out flight instability by adding fins, adding a tail or adjusting the bridle. Soft kites however seemed to fly stably for some time before suddenly needing considerable stabilisation i.e. tail. Mares tails and drogues were both used and a form of drogue is now universal with large kites which have to fly stably in reasonable wind conditions.

It became clear that the bridling was often the key e.g. the Peel's bridle is copyrighted. The reason is basically that bridles (sometimes called shrouds in reference to the back to parachutes) do not simply hold the kite in its desired angle to the wind as with, say an Eddy, but determine the shape of the airfoil which is responding to the air flow. Re-bridling to improve flight when all the bridles are tight in the air is a complete job.

3.3—Essentially 3.1 and 3.2 covered the type of development up to the late '80's. Jalbert parafoils were the main type seen, augmented by Sutton Flowforms, marketed as being more stable and with less pull. Dave Green of Burnley's Stratoscoop was the main English variant.

There had, of course, been attempts to use the ram-air principle in more "interesting" shapes. I remember an American hammerhead shark which was a fish body attached behind a Flexifoil head. Martin Lester's legs of '88 and indeed his top half of '96 looked at closely, are ramfoil shapes with legs or head and arms attached.

However, the Manta Ray of '88 is, to me, the first produced for sale soft kite which really visually concealed its parafoil origins. Jim Rowland's frog was another example of new commercial shapes which owed little to the parafoil –except the all-important notion that a 3D shape could be inflated by wind speed enough to fly. Complex bridling could be designed to allow stability and at least these new shapes often provided enough

Soft Kites—George Webster

depth to achieve sideward stability. About this time asymmetrical (left/right) shapes were produced—I remember a Grand piano –but development has settles down to symmetry.

3.4—Size

From 1978 there have been small pocket kites on the market using ram-air effects to give unsparred kites; often sleds, sometimes foils. A market is hikers/walkers— "climb the peak and fly your kite off it". There was an attempt at one time to claim that such kites would be useful in an emergency, Day-Glo orange, but mobile phones and GPS availability stopped that. Initially many club fliers were attracted by larger kites and for a period amateur kite wrestling was a feature of festivals.

However, the major implication of soft kite development was that extremely large kites were now possible and they were easily transportable as no cumbersome spars were involved. As a result 10m+ kites have become common in the last decade. Essentially this is possible because multiple bridles spread the load over the material. Simply put, a 4 celled, 5 walled ramfoil is bridled from each wall and can increase size by extra walls with no increase of bridle pull on the material.

Size did bring problems with the material used. Before the widespread availability of ripstop makers used fabrics designed for other purposes. For sparred kites lack of stretch is often very important and ripstop is treated in such a way that porosity and stretch are reduced but a cost of weakened fabric. Material with some stretch is desirable for large soft kites, partly because designs involve curves and because strength is helpful when a large kite hits the ground at speed.

Peter Lynn discusses the problem (see bibliography) and has moved to, as far as possible, specifying the material which meets his needs, given that even he is a modest buyer by the standards of his Chinese and now Korean producers.

Other things that Peter discusses are:

- Using cord rather than fabric ribs to give the wing cross section.
- Most importantly, adapting techniques used by makers of sails and balloons to use spectra line stitched to the fabric to reinforce points of stress and to spread load diagonally across the weave of the fabric. This is a cheaper and, more importantly, lighter solution to a problem which would otherwise demand a stronger, heavier fabric.

3.5—The current situation

The development of very large soft kites has transformed many kite festivals in recent years. There is great popular appreciation of large, invariably colourful and often ingenious designs which being 3D are visible from all angles. However, size has created safety issues for single line kites—obviously the issues are still greater for those involved in kite traction. Although there are no spars, big soft kites can easily knock over a spectator and being caught and lifted by a bridle line has led to death in the USA. Large kites need space and have pushed at the limits of some kite venues. Designers and fliers have responded by using header (or Pilot) kites (photo 21). These are relatively small ram-air kites which are used to stabilise the flight of the main kite and may help wind intake in unsettled or low wind conditions, for example by holding up the top surface of the air intake.

Section 4—Conclusion

As usual as I get nearer the end of one of these articles I start to think more of the short comings and omissions. In this case I'm very aware of the Eurocentric selection of the kites mentioned. I'm even more aware of creative kite makers who have been omitted. So here is a set of photos of great kites not otherwise mentioned.

4.1—A remarkable designer/maker over the last decade is Rolf Zimmerman of Germany. The sea seems to be his theme and the lobster his signature kite (photo 22). I prefer his soft star fish – appearing in a group photo but also in a solo shot (photo 23). There is a temporary inflation problem but such a look. While many of his seahorses are drogues, at least one has flown. Also shown is a break from tradition and a recent success—the Blue Owl (photo 24).

4.2—I don't know the name of Team Vulandra's designer. Here a shot of the 15m spacecraft, the centre piece of one of their displays, showing the steps down which a little green man (allegedly) comes to earth (photo 25)

4.3—Wolfgang Schimmelpfennig Basking Shark (photo 26) but the sucker fish (or remora) are a wonderful asymmetrical touch.

Soft Kites—George Webster

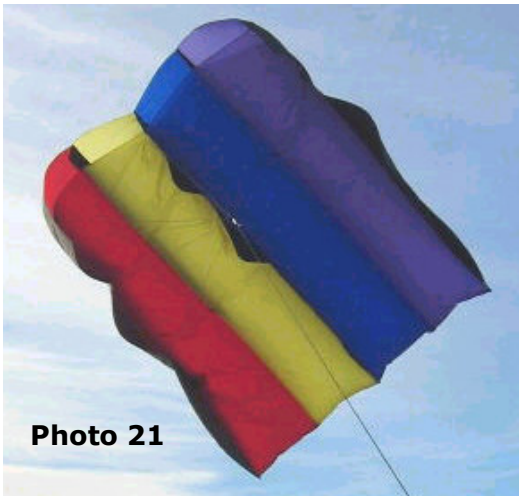


Photo 21

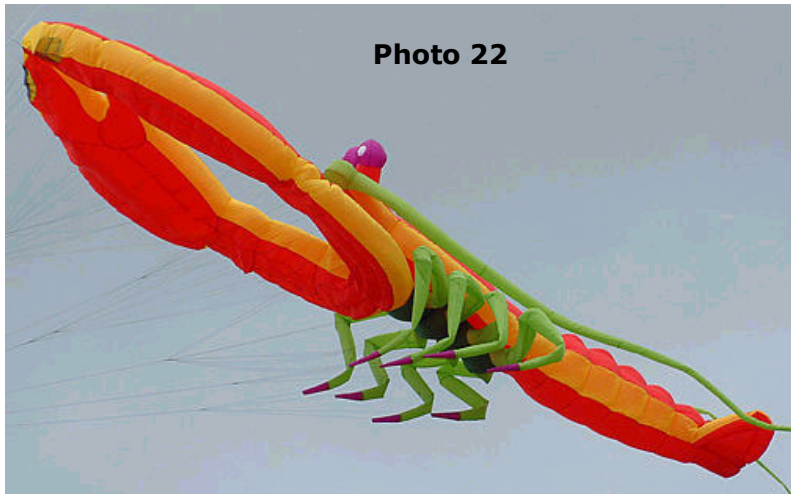


Photo 22


Photo 23


Photo 24


Photo 27


Photo 25


Photo 28


Photo 26


Photo 29

Soft Kites—George Webster

4.4 –The hand appeared at Bristol '03 (photo 27)

4.5—I've mislaid the name of the designer of Bertie Bassett—which was best kite at Weymouth '03 (photo 28)

4.6—Dave Hill's thunderbird kite keeps the English tradition of semi soft kites flying (photo 29)

So many types of artist/designer have been attached to the development of soft kites since the J-7-5 (six bridles on such a small kite!) - while some such as Tal Streeter have primarily been interested in efficiency and lifting ability, many have been 3D designers. Here I think of Peter Lynn who combines invention with the most profound technical knowledge operating today. Then we have Martin Lester, in some senses nearer to the "pure" designer who is fascinated by the 3D shape of the kite. But how do you respond to someone who produces one of the best designs of recent years (Zimmerman's Blue Owl—It's wings shake) from a toy bought at Cleethorpes? And none of this is meant to downsize essentially 2D designs of those such as Stretch Tucker, who have applied great designs to foils.

Bibliography

Much of soft kite development has been too recent to be included in the sort of book published recently—check the internet.

Pelham and Maxwell Eden—both have plans of a Rogallo Flexikite and a Jalbert Parafoil. Pelham has the better brief history.

Jim Rowlands— His best book "Kites and Windsocks" Batsford 1992 has the widest range of soft kite plans and building instructions. "Flying Modern Kites" Dryad '88 also has plans.

Peter Lynn—Currently writes for Drachen magazine. Three important articles were The Kiteflier Oct '90 (Current Trends), the July '96 (Cording and No-Rib Construction) and Kitelines Summer '90 (Future and Power Kiting at the start).

Plans may be found:

M.Cottrell—"The Kitestore Book of Kites" - Ramfoils

Stretch Tucker—(Famous for excellent parafoils) - Kitelines Winter '91/2

Martin Lester—The Top Half – Kitelines Fall/Winter '96

Fred Broadhead—"Fredform". Kiteflier Jan '02

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