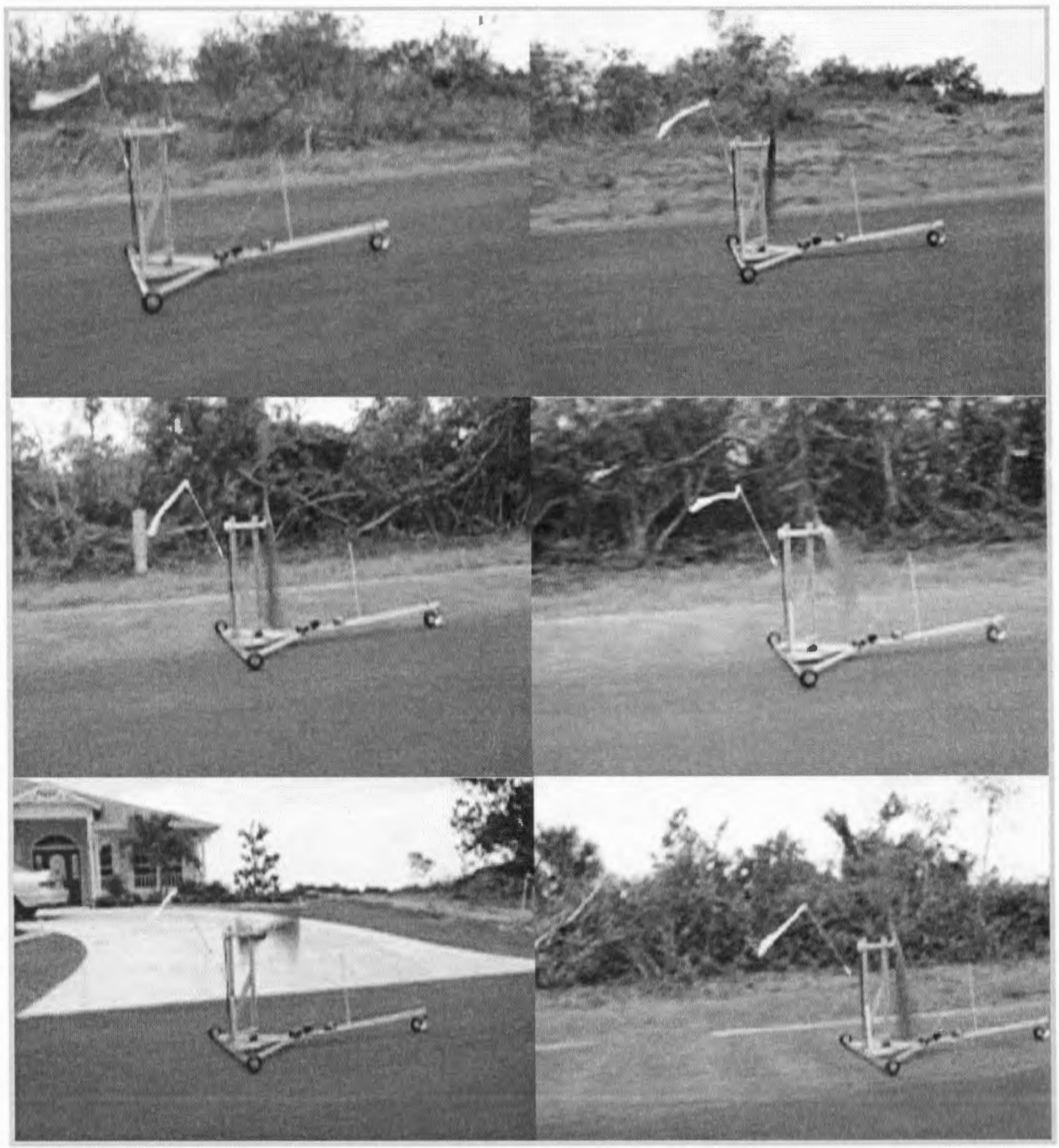
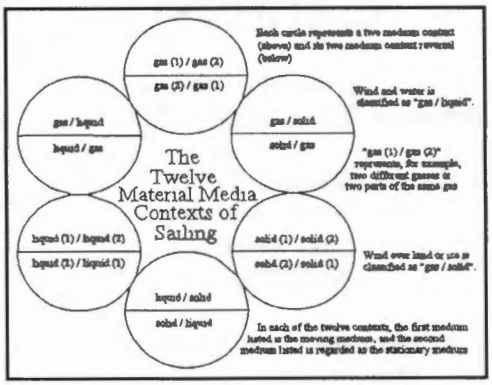
Catalyst

Journal of the Amateur Yacht Research Society

Number 26 October 2006/January 2007

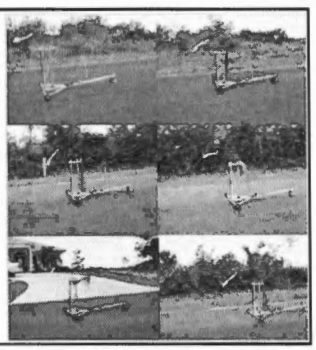


Features



Regulars

Cover shows six frames from Jack Goodman's Video of DDFTTW



Catalyst

Journal of the
Amateur Yacht Research Society

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Contributions are welcome from all. Email them to **Catalyst@ayrs.org**, or send (at your own risk) disks or typed copy with illustrations to the Society's office. AYRS can take no responsibility for loss or damage in the mail.

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Catalyst

Apologies again for lateness, but since this issue is October 2006/January 2007, I've caught up. This issue contains essentially all the material we have to publish.

DDFTTW

Since *Catalyst* 25 of July 2006, the response to the movie of Jack Goodman's vehicle appearing to go DDFTTW was so great that the bandwidth of the AYRS website was exceeded, (more than 1000 downloads in a month) and the movie is now placed on YouTube at:—

http://www.youtube.com/watch?v=aJpdWHFqHm0

(that last character is a zero)

or search *YouTube* under keywords sailing and DDFTTW.

Plainly there is interest in this topic greater than the total membership of AYRS! There has been a lively discussion on the AYRS yahoo group, accessible via a link on the AYRS website. Does the movie illustrate DDFTTW? Some think yes, others no. Discussion is welcome. I have aligned references to 'Dead Downwind Faster Than The Wind' to the consistent acronym 'DDFTTW' within *Catalyst* from this issue.

Administration

Please note the email address ayrs@fishwick.demon.co.uk is no longer useable. Please use email addresses shown to the left on this page. To further avoid confusion I shall consistently adopt the name Percy (rather than Peter) within AYRS.

Plea

Keep writing! Discourse! All feedback is useful. Write up that project you've been keeping to yourself all these years!

Percy Westwood, Catalyst Editor

From Roy Mills

I must admit to very little interest in sailing DDFTTW, because it will not happen in my cat. However, I did have a go at reading and trying to understand Mr Sharp's letters. Should that be Dr Sharp BTW? I can see that the Bauer Air propelled vehicle, if performing as stated, is indeed going DDFTTW. I can also see that the Bauer vehicle on the conveyor belt, when performing as stated, is doing the same thing. With the best will in the world I have not been able to see that the Demonstration Bauer String yacht is doing that.

The string yacht is experiencing no wind at all, the propeller is simply mechanically driven and moves in the direction of its own force, which happens to be in the same direction as one of the strings providing both lift and torque to the device. I think that the device as drawn is sailing dead upwind, and like anything going to windward it generates an apparent wind from ahead. If there was no propeller and no back stop, the device would move from right to left, which would generate an apparent wind from left to right in the direction of and at the same speed as (ignoring any slippage) string B. I can get that far. Putting a backstop on prevents the device from moving from right to left and prevents the development of that apparent wind from left to right at the same speed as string B. Putting the propeller on drives the device from left to right, like string B is moving. If it moves, is it necessarily moving faster than string B. Probably relative to something or other, such as String A, which is also String B, but not relative to some external fixed point, such as the backstop or an interested observer. Can it drive itself from left to right at a greater speed than String B is moving from left to right, as noticed by an observer? To a water sailor does it really matter?

What I cannot get around to seeing is that the string yacht is sailing down wind, it is in fact driving itself upwind, like any power boat can do. I suppose my problem comes from these varying points of view relating to various media. I submit that a system not getting its force from the wind is not, in the real world, sailing dead down that wind faster than it. So I can go along with the Bauer Wind powered yacht and the Bauer conveyor belt yacht, but not the string yacht. In my view the latter is simply a mechanically powered device which can move upwind into the wind it is creating itself. I can see how the Windwinder could work, but I confess to a lack of interest in the project. However I did greatly enjoy the kite-powered carriage article, and it does have real world application, as Dave Culp would agree.

Roy Mills
rsirf@shaw.ca

From Peter A. Sharp

Thank you for publishing some of my articles that I thought they were long gone into the circular file along with other items I submitted.

Correction: The table on page 11, called 'The 18 Material Media Contexts of Sailing' is entirely wrong and should be crossed out. I apologize to my fellow AYRS members for any confusion my careless error may have caused. The correct graphic is enclosed: 'The 12 Material Media Contexts of Sailing' *[following page, Ed]*. Had I ever been notified that the article was accepted for publication, I would have corrected it over a year ago.

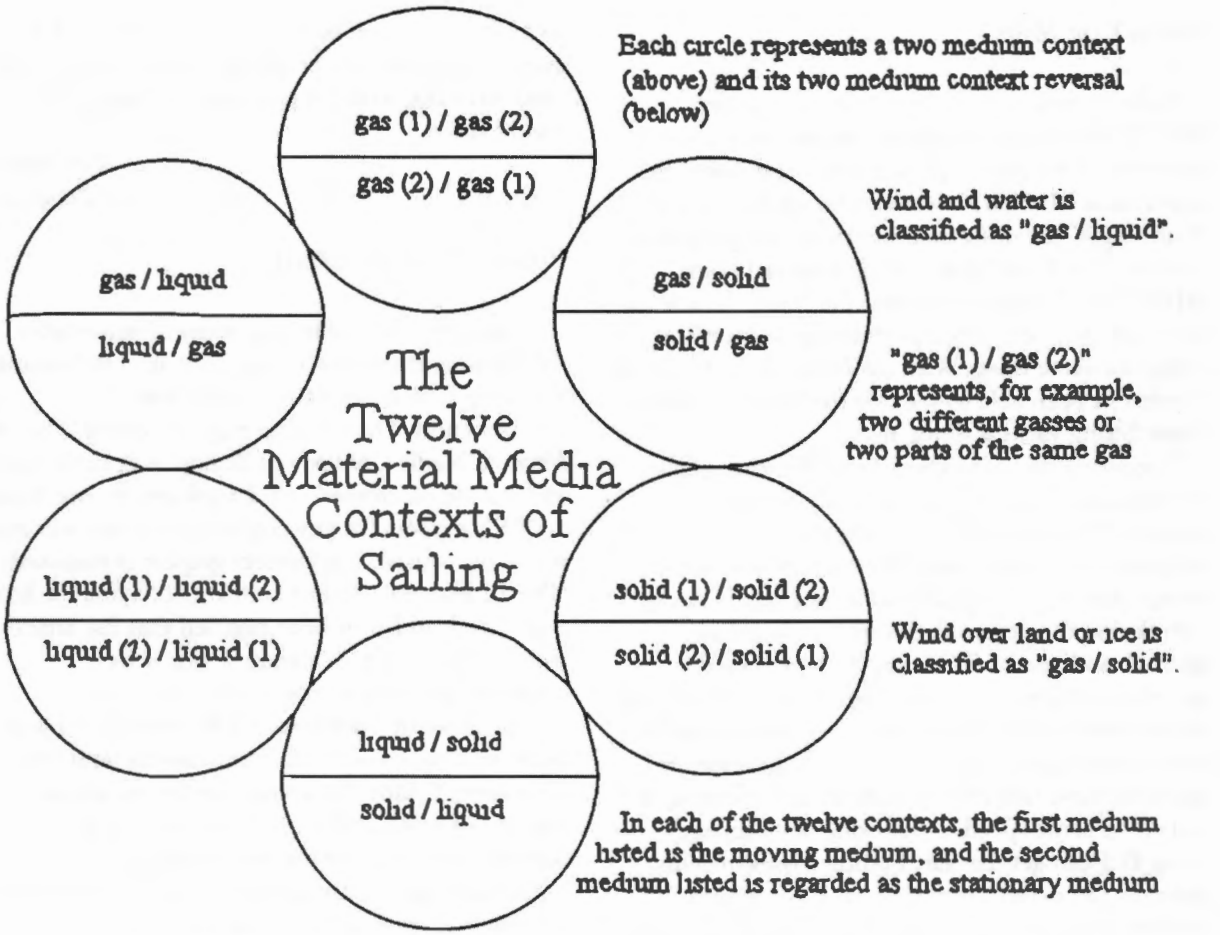
On behalf of my fellow AYRS members, I wish to thank Simon Fishwick, our previous (and now Honorary) Editor of Catalyst for the enormous amount of work and the outstanding job he has done to make *Catalyst* the fine journal it is.

Congratulations and thanks to Jack Goodman for providing us with an excellent film of his ingeniously improved model Bauer vehicle outdoors sailing DDFTTW. See the AYRS site for his indoor and outdoor videos of his model in action. Clearly, the 'purist' belief that it is not possible to sail DDFTTW is conclusively disproved. It is a myth.

I ran across a relevant video by Pim Geurts of The Netherlands showing an indoor model Bauer vehicle on a conveyor belt (actually a small belt sander). The vehicle is crudely built with a wire frame, a simplified power transmission (a winding/unwinding string), and large propeller blades (with no twist or taper) made out of paper! But it works! To find the web site, search Google for Sneller dan de wind met de wind mee or go to the http://www.zeiltheorie.nl/wagentje.html site.

I wish to recommend the Web site of my favorite kinetic sculptor, Bernward Frank from Germany. Notice that his first name is spelled with a "w". Perhaps it stands for wind and water, since those are the sources of energy for his sculptures. He has some fascinating videos and photos. See http://www.kineticart.de or http://test.meindesign.net

Some of his sculptures use model Mill-Prop craft. One sculpture uses a simplified windmill rail yacht.



It is a horizontal cylinder with tapered ends, riding on circular rails, and spun by what looks like a cup anemometer rigidly attached to the cylinder (see his *Wind Zug*). Notice that it can manage to travel in complete circles even though the horizontal axis windmill cannot orient to the wind independently. Yet the windmill still faces in roughly the correct direction when traveling both upwind and downwind. Another sculpture uses a similar vehicle with round water paddles. It rides on circular rails and is powered by water flowing in a circle below the rails (see his *Auf Und Ab, Wasser Zug,* and *Wasser Strabe II*). It sails continuously against the flow of the water. It is Mill Prop Code L/\s, meaning that the Mill medium (capitalized) is a liquid, and the liquid is the moving medium (and therefore listed first). He also shows model windmill land yachts with vertical axis windmills like cup anemometers (see his *Wind Auto* and *Sysiphus*). (The Latin spelling is *Sisyphus,* but he is free to call his sculpture whatever he likes.)

Another tidbit: According to an article in the Science section of the *San Francisco Chronicle,* June 20, 2005, there is growing archeological and linguistic evidence that North America was 'discovered' around 600 AD by explorers sailing from Hawaii. (They came to Hawaii originally from the Marquesas Islands around 200 AD) So perhaps 'Columbus Day' in the US should be changed to 'Hawaii Day' since the Hawaiians 'discovered' the Americas 900 years before Columbus. (Actually, Columbus was lost and was himself discovered by native people in Hispaniola.) By following seasonal trade winds, the Hawaiians apparently landed in Southern California, the home of the Chumash tribe. The Chumash, who were using dugout canoes, then seem to have adopted the Polynesian technique of building deep-sea sailing canoes from planks sewn together with plant fibers and caulked with tar. The Chumash then used the canoes to begin fishing for large, deep-water fish such as marlin. An interesting twist is that the ancient Polynesians made their boats from redwood logs that floated to the islands from the west coast of North America. The original Hawaiians seem to have been conquered and permanently displaced by warlike sailors from Tahiti around 1000 AD. All of these vast ocean voyages

were made without compasses, astrolabes or chronometers. They used star maps made of sticks and they were able to read the complex patterns of wind, waves, clouds, birds, and floating debris. The modern Polynesian Voyaging Society has proved that such voyages from the Marquesas and Tahiti to Hawaii are possible, and they have also sailed their double hulled canoes to the west coast of North America to celebrate their ancient bond with the native peoples of North America. Films of their voyages have been shown on public television. I therefore believe the most skilled sailors of all time are Polynesian.

Peter A Sharp
sharpencil@sbcglobal.net

From Fred Ball

I am a sceptic about DDFTTW, so my heart dropped when *Catalyst* 25 arrived, however, I read about Jack Goodman's efforts and downloaded the video and watched it. I was almost convinced, so I had to read the rest of *Catalyst* and think about what was happening.

I base my belief in the impossibility of DDFTTW on the physical law of conservation of energy; which states that you cannot get out more energy than you put in. So if our vehicle is being blown (propeller, spinnaker, or device 'X') downwind, the energy in the system as it nears wind speed is equal to Mass × Velocity; unless the mass is reduced it cannot go faster.

This energy will also be related to drag of the vehicle and the force extracted from the wind: the apparent wind has fallen to near zero so we cannot get more energy from that and trying to extract energy from the medium over which the vehicle is moving can only increase drag and therefore slow the vehicle.

It was with relief that as I read Peter Sharp's articles I found that his experiments confirm that unless the propulsive force is at an angle to the vehicle's direction of travel there is no force developed (*Catalyst* 25 page 16 last paragraph) when the double land yacht is moving as fast as the top plane.

I feel really mean (because he has gone out there and done it and I'm just an armchair critic) in suggesting that Jack Goodman should repeat his experiment, using a radio-controlled electric-powered pace vehicle (with wind direction indicator) alongside his experimental machine as I suspect that the reverse-flying flag is when the propeller acts as a fan on the overrun of a gust.

I believe that the belt and string experiments take energy from the moving belt/string and not the vehicle; maybe the vehicle should be launched down a ramp and allowed to roll along a smooth level floor, as in—for example—a gymnasium.

I do accept that a windmill-driven boat can go directly to windward and does so because the apparent wind increases with speed to windward and can provide acceleration until increasing drag prevents more acceleration; if one thinks about what would happen if the vehicle was launched moving over the ground in a calm there would be no difference between speed over ground and apparent wind speed so although the propeller would revolve it would not receive extra energy and inevitably slow due to the affect of drag.

Fred Ball
frederick.ball@tesco.net

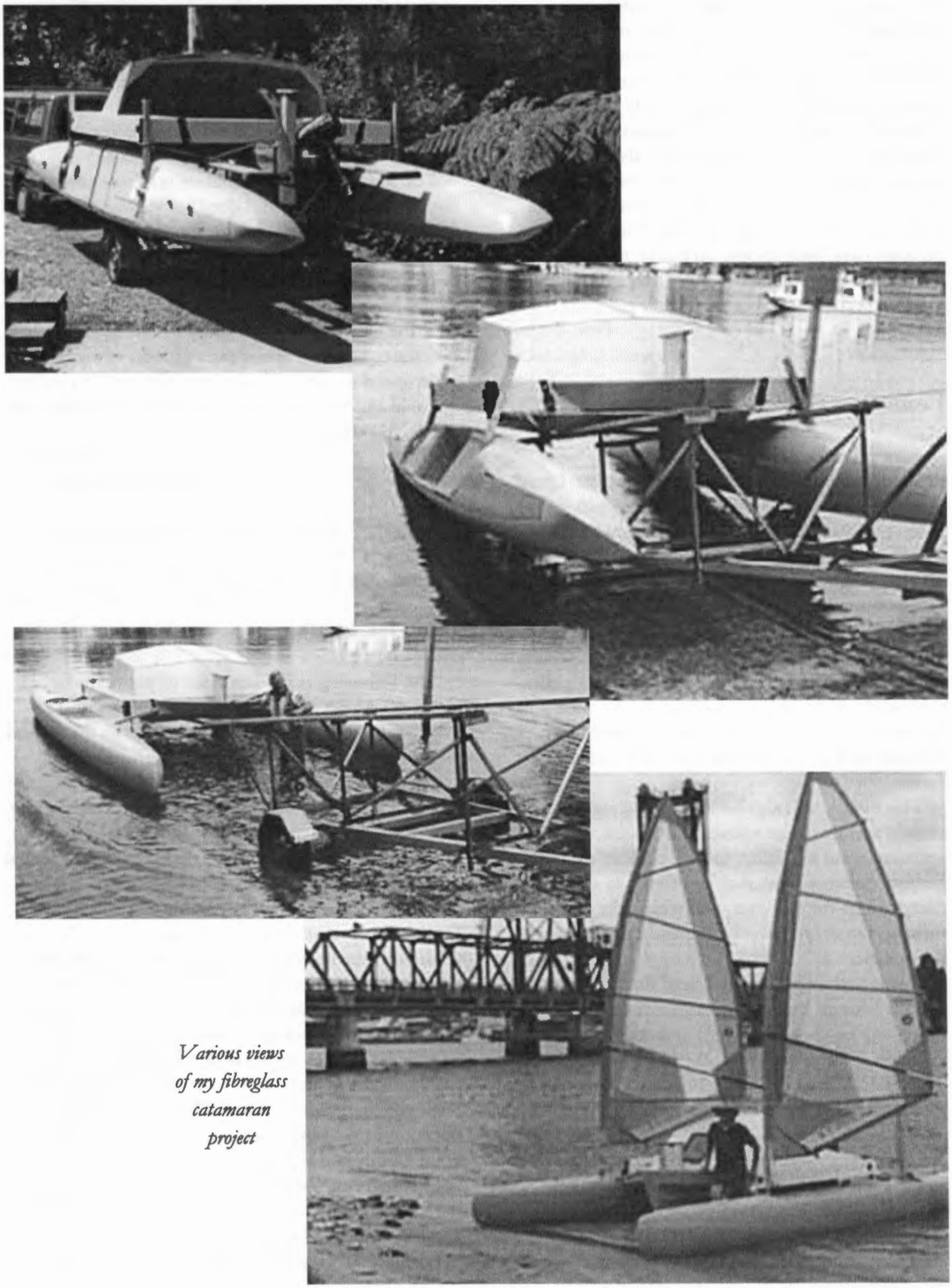
[Fred's] PS. Having watched the video several more times I feel I may need to move from the armchair and build my own version of the vehicle.

From Ian Smith

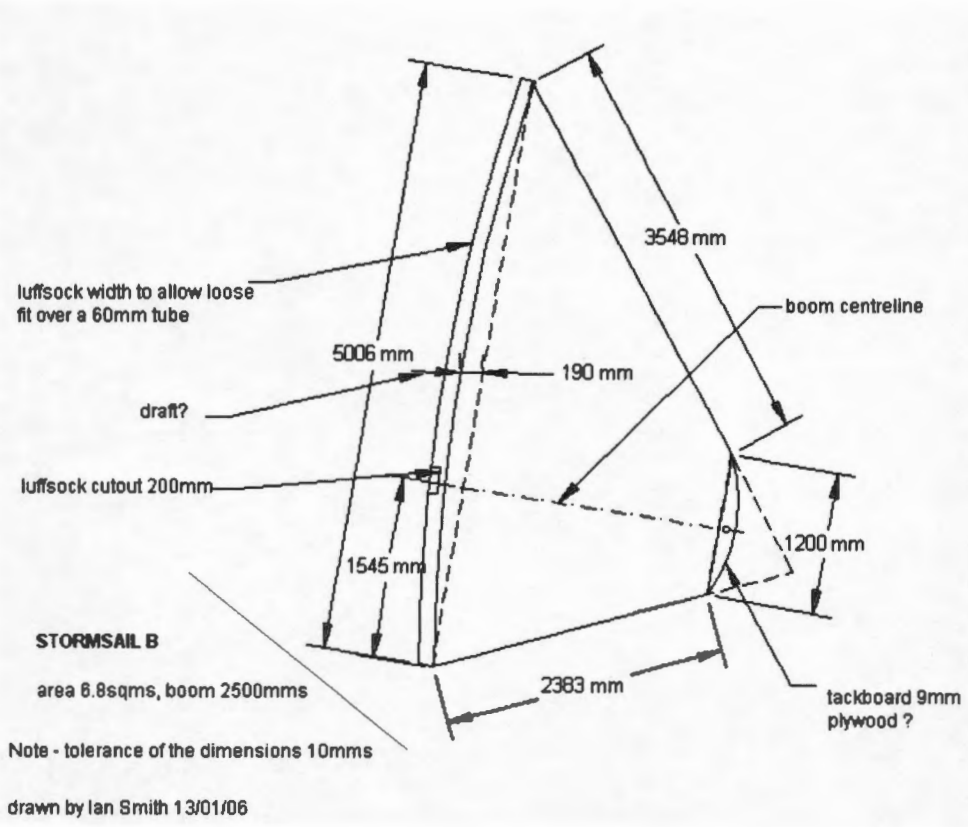
The following is my response to your emails about no AYRS news — following Nico Boon's inquiry about 'no news'. I did send this to the Yahoo web address but I think its more appropriate for your consideration.

From my experience with internet groups starting around 10 years ago, starting with Newsgroups such as rec.boats. building, I found that the great potential of internet as a means to meet and talk to like-minded people–has just not been realized. During this period I received at least 50 emails relating to my Project Windrigger web-publication, but these contacts resulted in only one on-going contact. Apart from answering the questions in the e-mails, I would include a photo of where I sail–hoping for similar response as my love of seashores and harbours is part of my interest in sailing–but no response. I admit that much of the replies to my question to rec.boats.building, were useless–lacking in credibility and typical of that from armchair yachtsmen. But I still believe there are sailors around the world from whom I would appreciate hearing about projects and answers to my quesions.

So the following is a further effort to get the AYRS news working for me:



Various views of my fibreglass catamaran project



sails around Australia which are either old or no longer competitive–but I was not able to locate them. I am sure an internet group like AYRS news would have been useful for this task.

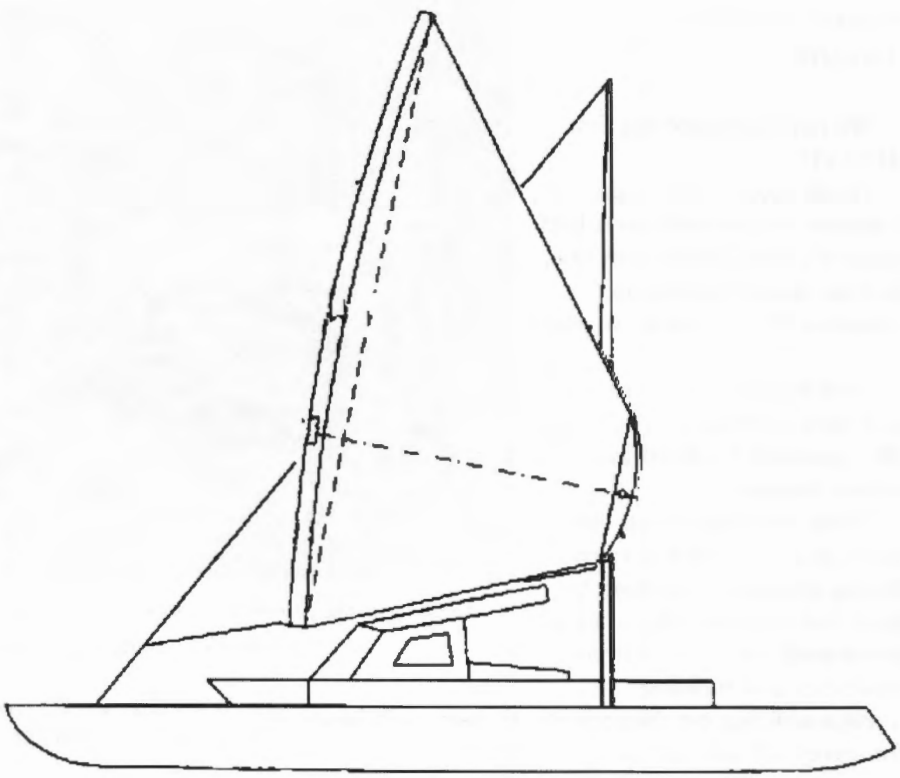
Improved asthetics? In the lower drawing the sail obscured by the stormsail is a biplane rig with sails set forward of their masts to enable furling around their fore-stays–waiting to trial it.

Ian Smith
smithie@sci.net.au
[see where Ian sails on the next page, Ed]

How about first of all getting AYRS members to list their interests and projects on the AYRS news–progressively such one a week, for example as in the following:

The photos *[previous page]* cover some aspects of my fibreglass catamaran project.

I am presently waiting delivery of two new sails to the design shown in the top drawing on this page, to enable furling the sails around their masts and so simplifying rigging (the fully-battened sails shown in the photo have to be rigged onshore). Prior to this order to a sailmaker, I tried to acquire sails used on exisiting sailing skiffs which had sailtrack-luffs (allowing rigging on-board). There must be many such suitable



Where I sail – 300 km north of the site of the 1998 SydneyHobart race storm – Ian Smith

From Christopher Laughton

We have delivered the first ROCAT!

David drove down from Cheshire last weekend to collect 'catalyst', ROCAT number one, and has already tried it on Coniston Water—so far so good.

And ROCAT numbers two and three will ship to Vancouver (BC), and Sao Paulo (Brazil), within the week.

These first three boats have taken an age to make because, having developed the boat, we have had to spend a lot of time developing the manufacturing processes, and building innumerable jigs etc. Henceforth, though, each batch (of three) will take less time.

'Looking at this picture, it seems very strange that I didn't get swamped — but I didn't.' [courtesy: www.rocat.co.uk]

With best wishes from Christopher and co at ROCAT +44 (0)1736 366560 www.rocat.co.uk

Christopher Laughton
CL@rocat.co.uk

From Theo Schmidt

I was thrilled by Catalyst 25! A Peter Sharp compendium, Roger's review of *The Aeropleustic Art,* and Wipke Iwerson's imaginative technical work of art! And the link to Jack Goodman's video finally offering modern evidence of DDFTTW, on land anyway.

On the AYRS mailing list there was much discussion about this, but not all people are able to download such large files. A newcomer on the list, Luc Armant, also offered a link to his fantastic book and video, both having to do with his extensive research with kites and hapas, which he calls *ailes d'eau.* This superbly illustrated PDF-book and edited video, both in French, are rather large files and not easily downloaded. We discussed the possibility of translation to English, but this would be rather expensive and there were no *amateur* or *reduced rate* offers.

I'd be happy to send all the mentioned files and also the 'Zeppy' videos and some solar and human-powered boat stuff to interested members on a CDrom. Anybody who wants one, please send me a few £, Euros or $5 in an envelope or via Paypal sus2006@bluewin.ch in order to cover the cost of postage and copying.

Theo Schmidt
Ortbühlweg 44, CH-3612 Steffisburg, Switzerland

From G. Kutzgar

I am writing to add to the data given by Ken Upton and William Groombridge in the April 2005 issue of Catalyst regarding The Wave Rocker. Readers may remember their concept was a 'wagon' on the deck of a boat being pitched by the waves. The rocking motion was to be translated into useful power by attaching the ends of a hydraulic cylinder between the wagon and the boat, causing the back and forth motion of the wagon to provide pressure to turn a generator. I apologize for not getting this to you sooner when it might have saved someone a lot of time. I procrastinated writing it for a few months, then Katrina got me and I am only now able to pass on my experiences.

Back in the sixties we had a fishing camp in a place called 'End of the World' because the next land was South America. We were on a bayou whose waters were protected by a high rock breakwater which stopped waves whose fetch was hundreds of miles. I had the idea to obtain power for the camp from those waves by building a 'raft' made of concentric rings of floats. The power was to come from hydraulic cylinders being moved by a small mast on each float changing their spacing as the flex angles between the outer floats and the next ring inward changed. I was going to place the smaller floats in the outermost ring where the power of smaller waves could be extracted first. Each ring was to be composed of ever larger floats, with the largest floats in the inner ring. I built two floats connected by a cylinder to test the idea.

The floats were made of four inch diameter schedule 20 PVC (the thin stuff) with the connecting structures for articulation made from one inch and 3/4 inch schedule 40 PVC, which made good bearings because the sizes nested nicely. This material worked well because of the many tees, elbows and other shapes available. The floats were rectangles three feet wide and five feet long, which length was derived from our estimates of the pitch of the waves. We used a double-acting hydraulic cylinder from a derelict Bob-Cat with two one-way valves to trap the hydraulic pressure in an old Freon 22 tank formerly used by air conditioning people. We had to make new floats with a tee section at the cylinder end to get more flotation for the cylinder's weight.

We had a surprising amount of trouble keeping the floats properly oriented. There was no way to anchor the rig that would leave the front float free to rise. Perhaps the Upton/Groombridge rig would fare better if the boat were not anchored.

There was a delay in the action as each wave came in, causing the floats to bury into the wave. We increased the floatation by attaching 30 gallon drums to the floats. These buried less, but the delay was still there. That delay put the whole thing out of synch and we only got three pounds of pressure after 15 minutes. I expect the Upton/Groombridge wagon would have an even greater delay. We pondered using pneumatic cylinders, but the work being done would be the same, and we expected the same delay. We decided there are better ways to get power out of moving water and gave up on the idea.

G. Kutzgar
New Orleans

From William Groombridge

Sea-grass removal in the Mediterranean

Posidonia is a most important sea-habitat, defined by EU directive 92/43/EEC Annex 1 (Natura 2000) Code 1120 priority habitat. *'Natural habitat types of community interest whose conservation requires the designation of special areas of conservation'.*

During the past thirty years, numerous scientific studies have shown the great importance of the role it plays within the marine coastal environment of the Mediterranean Sea. *Posidonia* is not a sea-weed or algae, it is a real *phanerogam* which means it reproduces sexually (mates openly and unashamedly! Great !).

It has the basic structure of a plant, like flowers (found on the beach as sea olives and that brown tape-like leaves and fussy fibre balls), a root system, rhizomes and leaves. It needs clear and clean water in which to live, it photosynthesizes, and produces about 15 litres of O_2 every 24 hours! No wonder it feels so good to walk on the beach nearby!

The *posidonia* meadows provide habitation for more than 400 types of plants and 1000 types of animals making it the most important marine habitat in the Mediterranean.

The meadows are critical to ensure the stability of sandy shores and seabeds as they prevent land erosion. Waves and currents are dampened by the *posidonia* matter and suspended sediment is trapped and accumulates within the elaborate rhizome structure, forming submerged breakwaters that dissipate wave-energy and act as a automatic food dispenser for young fish.

Now think, who in their right mind would go into a local wood or forest, sweep up all the leaves, nuts, seed, fungus, flowers, twigs, worms, beetles, little other things on the ground that are all part of the system etc so the birds and other animals that live there would have nothing to eat or hide from their predators. Then spend a fortune to collect it and truck it away and dump it where it does not belong. So the leaves cannot rot down to feed the very trees they came from.

This is what your blue flag loonies insist the local councils do to our beaches to get this blue flag. Part of your taxes pays for this madness that will destroy your families future, work, climate and your investment here.

What to do?

But it is no good protesting unless you have a better solution to give a positive answer.

Yes! do clean the beaches by moving the *posidonia* to the waters edge, where it belongs.

Make it into orderly heaps along the edge with gaps about every 25 meters (like a famous chocolate bar, from where they hide all the black money). The gaps of just wide enough for the tractors and the public have access to the sea. Then clean the sand behind with the normal equipment that is used at night and very early in the morning ready for people to enjoy the clean beach during the day .

Do not remove the *posidonia* trucking it inland to dumping sites. So the salt that is washed of into our ground waters does more damage to our ecosystems when it rains.

A huge amount of money and energy, could and would be saved. Some of this could be spent on making jobs for people to remove the manmade litter and other debris that is washed to the shore and entangle in the *posidonia* natural sea defence to save your beach and economy.

This could lead to restoring the local inshore fishing and caring for the interests of tourists and locals in a more intelligent way. The public in general could soon be re-educated and informed on how Mother Nature designed her systems to keep them fed and well and what this wonderful plant plays in their life.

The rest of the money that is saved could be better spent on other community services, or even better, rebuilding the sea. By making eco reef gardens in the bald patches caused by the ignorance and greed of these recent times.

The FEE is just one of the major culprits in this destruction, and probably the most easy to control, as we the public hold the purse strings. Some of the others are the IC engine industry, and the companies that supply the present fuel to make them work on land and sea. Other culprits are local councils etc that do not heed and enforce the EC and UNEP laws.

All this is well-researched by many organisations such as Greenpeace and WWF. Many small charities and organisations are fighting and doing things in their own way to save something of our world.

These as a collective will sort out the culprits, as time marches on. The ones that are already in the net just need to be shown a better way to do it and if they refuse to learn, then the simple solution is to eradicate these foolish parasites.

The *posidonia* meadows provide habitation for more than 400 plants and 1000 animals making it the most important marine habitat in the Mediterranean. Its very presence guarantees a healthy and clean marine environment and our future.

William Groombridge

'Blue Flag' History

The Blue Flag was born in France in 1985 where the first French coastal municipalities were awarded the Blue Flag on the basis of criteria covering sewage treatment and bathing water quality.

1987 was the 'European Year of the Environment' and the European Commission was responsible for developing the European Community activities of that year. The Foundation for Environmental Education in Europe (FEEE) presented the concept of the Blue Flag to the Commission, and it was agreed to launch the Blue Flag Campaign as one of several 'European Year of the Environment' activities in the Community.

The French concept of the Blue Flag was developed on European level to include other areas of environmental management, such as waste management and coastal planning and protection. Besides beaches, marinas also became eligible for the Blue Flag.

In 1987, 244 beaches and 208 marinas from 10 countries were awarded the Blue Flag.

Since then the FEEE has become the FEE and has moved to the UK as the company Tax laws are different.

Latest news is that they are enlisting North African counties into their blue flag madness.

Biplane Hagedoorn Craft

Roger Glencross

I do not need to explain Hagedoorn's dream of a manned windpowered seaplane working on the principle of the sailing yacht but with a very minimal 'hull', called a *hapa*, in the water. The hapa is now ready. Thanks to Fred Ball we have a large, stable, efficient, predictable low-speed hapa which produces sufficient sideforce at low speed to meet the requirements of the slow-flying manned paraglider. The hapa has been christened 'harlequin'. So now the manned paraglider must be got ready and here I have met a problem.

Failure to build a light 30 ft leading edge spar

For the last three summers I have been building a frame to take the 30 ft wingspan of my paraglider. This summer (2006) I finished building the frame for one wing of sufficient strength to fully withstand the forces on it (I think).

Unfortunately it proved to be too heavy, so I put it aside without building the frame for the other wing. This frame is only needed when the wind is insufficient to inflate the ram-air canopy, e.g. before takeoff, in a lull etc.

On inflation the air alone supplies sufficient rigidity to the wing to render the frame redundant. Inflatable kites are unsuitable for this experiment because they are too small when bowed, too dynamic and too inefficient due to their thickness.

Advantages of a biplane

The advantage of a biplane is that it can be built lighter than a monoplane of the same wing area, since it is more compact. The two wings can be braced against each other. It thus directly addresses the main problem that I face, viz the long wing span of the monoplane paraglider.

Disadvantages of a biplane

The disadvantages are:—

(1) The loss of lift caused by the interference effect of one wing by the other. This is particularly bad if the wing is unstaggered and the gap is small. Unfortunately this gap cannot be made large due to weight and structural considerations.

(2) Potentially double the induced drag, due to having four wingtips instead of two, mitigated in part by the beneficial effect on the top wing of ground effect received from the bottom wing.

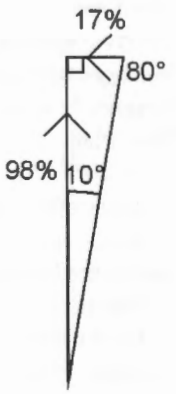
Figures of lift for the monoplane

I know the figures for the monoplane and we will see if it is possible to get comparable performance out of a biplane of similar total wing area. The elliptical kite's lift figures at 10 mph are:—

Man+Kite+Frame = 150+10+10 or 170 lbs, then

$$170 \text{ lbs} = C_L \times \frac{0.0024}{2} \times 224 \text{ ft}^2 \times (14.67 \text{ ft/sec})^2$$

thus $C_L = 2.9$



We know the kite can fly at 10 mph carrying a man weighing 150lbs. But the kite will fly banked in order to produce a horizontal as well as vertical force. Assuming a 10° angle of bank, 98% of the resultant force is vertical (cos 10° = 0.9848), and 17% of the resultant force is horizontal angle of (cos 80° = 0.1736), so the vertical component of the resultant lift force of the kite is (98% x 170) = 167lbs.

So the amount of lift available to lift the weight of a kiteframe at various speeds is as follows:

Airspeed	Airspeed	Total Lift	Net lift (>160)
10 mph	14.670 ft/s	167 lbs	7 lbs
11 mph	16.137 ft/s	202 lbs	42 lbs
12 mph	17.604 ft/s	240 lbs	80 lbs

Lift increases with the square of the velocity over quite a wide range.

Figures of drag for the monoplane

Adequate lift is vital for the machine to work **at all**. Adequately low drag is vital for the machine to work **well**, so is not as important.

But I want to compute the drag as a reality check on the lift figures and because it is interesting anyway, I hope it is not a circular argument, since I use the C_L figure for both calculations.

The most dominant form of drag in a low aspect ratio plane such as this is induced drag, accounting for I estimate (which means, I read somewhere!) 75% of total drag. Induced drag is computed by the formula.

$$C_{DI} = \frac{C_L^2}{\pi \times A}$$ where A = aspect ratio, so

$$C_{DI} = \frac{2.9^2}{\pi \times 4} = 0.67$$

Adding on 1/3rd for other types of drag (0.22) we get total drag coefficient of 0.67 + 0.22 = 0.89

Checking the lift/drag ratio we get

$$\frac{C_L}{C_{DI}} = \frac{2.9}{0.89} = 3.26 \text{ (to 1)}$$

Since the published L/D ratio is 5.5 to 1, since manufacturers exaggerate, since the manufacturers figure is the best obtainable at the most favourable speed, since we are abusing the glider by using it as a kite (a powered plane), I consider my figures to be eminently obtainable.

Figures of lift for the biplane

I have a rectangular sports canopy of 121 square feet, aspect ratio 1.5, span only 13.5 feet, chord 9 feet. Two identical canopies give 242 square feet compared with 224 square feet for the monoplane.

It is not a foot-launched canopy but needs a landrover to launch it, but it is foot-landed.

Assuming C_L is identical to the elliptical canopy (and it is a big assumption), we get lift as follows:-

Lift required is now man+kite1+kite2+frame, or

150 + 10 + 10 + 10 = 180 lbs

and the required velocity is given by

$$180 \text{ lbs} = 2.9 \times \frac{0.0024}{2} \times 242 \times 98\% \times v^2$$

thus, Velocity (required) = 14.62 ft/sec = 10 mph

— but there is a loss of lift due to biplane interference effect. This is computed from the graph in Sherwins 'Manpowered Flight' page 53 which gives a graph of gap/chord ratio over lift correction factor.

The wing gap is 5 feet, being the height of my tetrahedron (central to the wing structure) the wing chord is 9 feet, so gap/chord ratio is 0.55, giving a lift correction factor of 0.74. Therefore we get a revised lift equation of:—

$$180\text{lbs} = 2.9 \times 0.74 \times \frac{0.0024}{2} \times 242 \times v^2$$

thus, Velocity = 17 ft/sec (11.5 mph)

which is acceptable.

Figures of drag for the biplane

The induced drag of a biplane with wings of equal span is computed by the formula

$$C_{DI} = \frac{(1 + K) \times C_L^2}{\pi A}$$

when K (a constant) is drawn from Sherwin's ground effect graph.

(The biplane has twice the induced drag of a monoplane, but lessened by the downwash from the top wing being deflected by the bottom wing. Without it K would simply be 1).

In this case K = 0.80, based on the ratio of wing gap to wing span (5ft to 13½ ft) so:-

$$C_{DI} = \frac{(1 + 0.8) \times (2.9 \times 0.74)^2}{\pi \times 1.5}$$

$C_{DI} = 1.76$

Add 1/3rd for other drag = 0.58

thus, $C_{DT} = 1.76 + 0.58 = 2.34$

$$\text{Lift drag ratio} = \frac{C_L}{C_{DT}} = \frac{2.9 \times 0.74}{2.34}$$

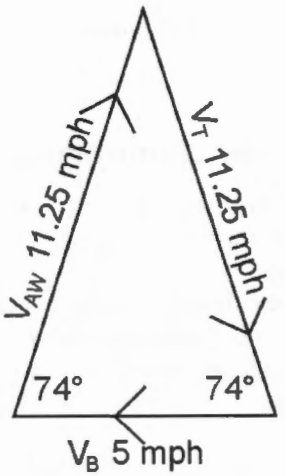
$$= 0.9 \text{ to } 1$$

The triangle of velocities

The machine's L/D ratio being 0.9 gives a drag angle for the biplane of 48° (cotangent 0.9 = 48°). Assuming the hapa has a L/D ratio of 2 to 1, its drag angle is 26° (cotangent 2 = 26°). The beta angle is the sum of these two drag angles, so is 74°. So with a required apparent wind speed of 11.5 mph to take off we get the following triangle of velocities (while **flying,** not sailing):—

I expect that the hapa needs a water speed of 5 mph to generate enough thrust, and the angle of bank of the biplane would only reduce lift by 2%, so I have ignored that.

So we get a required true wind speed of 11¼ mph. This triangle of velocities seems eminently achievable, the formulae seem conservative and the underlying assumptions seem reasonable. These are my figures, and I recommend them to the House!



Conclusion

The biggest doubt that I have is whether I can transport the C_L of the elliptical kite (2.9) to the rectangular kite. In other words, is there a correlation between C_L and aspect ratio? (i.e. the lower the aspect ratio the lower the C_L). Also is there a correlation between the age of manufacture of a canopy and C_L (i.e. do more modern, more sophisticated, more efficient canopies produce a larger C_L than old canopies?) Perhaps I could retune the kitelines to produce a higher angle of attack, and thus a higher C_L? This is what I need your help on. If as I fear my older rectangular canopy has a C_L nearer to 1 than the 2.9 that I have used, then I am finished.

R. E .Glencross

AYRS Notice of 2007 AGM

The 43rd Annual General Meeting of AYRS will be held on Sunday 21st January 2007 at the Village Hall, Thorpe, Surrey, starting at or after 4.00 pm. The AGM is open to all paid-up members and their guests, but only members may vote.

AGENDA

1) Apologies for Absence.

2) Minutes of the 42nd Meeting held on Sunday 22nd January 2006 at the Village Hall, Thorpe, Surrey.

3) Chairman's Report. *See this Catalyst*

4) Treasurer's Report and Accounts *See this Catalyst*

5) Confirmation of President and Vice-Presidents, Election of Officers and Committee Members. *[See below]*

6) To appoint a Reporting Accountant for the year.

7) Any Other Business.

8) Vote of thanks to the helpers of the society.

Previous Minutes: *The draft minutes of the 42nd AGM follow on page 15*

Officers and Committee Elections: Under our rules, the Vice-Chairman (Graeme Ward), Secretary (Sheila Fishwick), Editor (Simon Fishwick) and Committee Members Charles Magnan, and Mark Tingley have completed their current terms of office. They are all willing to serve again. Any other nominations should be submitted, preferably in writing, to the Hon. Secretary, Sheila Fishwick, by or on 15th January 2007.

Reporting Accountant: The Committee propose that Robin Fautley be re-appointed.

Any Other Business: No matters have been submitted for this Item. Any items for formal consideration should be submitted by 15th January 2007.

Sheila Fishwick Hon. Secretary
Fax: 08700 526657; email: hon.sec@ayrs.org

Going for a spin, or sailing the Rotorboat

Fred Ball

Stephen Thorpe very kindly allowed me to take his Rotorboat (*Catalyst* 24 p26) to Weymouth Speedweek, and I have therefore acquired yet another sailing experience

Rotorboat dimensions:— Length 12 ft (3.6 m); beam 4 ft (1.2 m); round bilge, foam sandwich construction, dagger board (adjustable fore and aft), partly-balanced rudder. Rotor 10 ft (3 m) tall; top diameter 6 inches (0.15 m); base diameter 12 inches (0.3 m); surface area 23.5 feet^2 (2.12 m^2); projected area 7.5 feet^2 (0.66 m^2); powered by brushless 12v motor with designed rotor rpm 1600 (Unfortunately the rotor had been damaged and a balance problem kept the useable rpm to 800).

Having been shown by Stephen on the Saturday afternoon how to assemble the rotor I was able to launch on Sunday and go for a sail. The wind was westerly 12 knots, so I was on starboard tack leaving the pontoons at the Portland sailing academy. I had placed the dagger board under the rotor and was pleased with the progress made, there was no real feel through the steering, and no easy way to decide if the course to windward was pinched or full-and-bye except by speed through the water. This I equated to slop through the back of the dagger board slot and direction of travel. When it was time to tack – helm down, turn rotor drive off, let go of tiller to grab rotor and stop it (before reversing direction of drive for port tack), oops! — immediate spin through 180 degrees (it felt like a full 360!) the partially balanced rudder had gone to 90 degrees and the boat had spun about the dagger board/rotor axis. I soon got underway again and then ran back towards the dock, rapidly learning that tacking downwind was needed to maintain speed.

On Monday I was invited ('we'll tow you out NOW') to go for a run down the 500 metre speedsailing course. I had moved the dagger-board aft and stuffed the exposed slot with foam rubber. I put some 'reins' on the tiller to restrict its movement to 45 degrees each way—a much more pleasant set up. The course was closed when we got to the start area, so I was able to have a sail around. The motor fuse dislodged and she came to a halt; Slade Penoyre hung awkwardly from the nurse boat's boarding ladder and was able to reach through the forehatch and reconnect the fuse; it would have been impossible for me to reach round the rotor and in through the hatch.

The course was now open and she steadily plodded along being overtaken by sailboards and other entrants. It was quite fun, so to emphasise the ability to sail where I wanted; I returned and repeated my run, twice, and then returned to base. I was given a speed of 4.6 knots.

Later in the week we tried to demonstrate how the rotation accelerated the wind on the side where the surface was moving in the wind direction and slowed it on the opposite side, by blowing soap bubbles towards it; several attempts were needed to record this on video.

On the last day I sailed her in and around the pontoons to allow video footage of close-quarter manoeuvring, she certainly short tacks very easily.

Sailing observations:—

- difficult to assess angle to apparent wind.
- if left rotating through the eye of the wind, there is a marked heeling action.
- need to tack downwind.
- large visual blind-spot dead ahead.

What use is it to the yachtsperson? Not obvious but:—

- enables a solar-powered boat to take advantage of wind power.
- enables lightweight control of a 'sailing' boat – possible perfect sailing balance and no need for a rudder by having two rotors (ketch or schooner, or one in each hull of a catamaran)

2006 AYRS AGM — Draft Minutes

The 42nd Annual General Meeting of AYRS was convened at the Village Hall, Thorpe, Surrey, UK at about 16.00 hrs on 22nd January 2006.

1. Those Present & Apologies for Absence

Present were the following Officers and Committee members: Michael Ellison (Chairman of Committee) Fred Ball (Vice Chairman), Sheila Fishwick (Hon. Secretary), Simon Fishwick (Hon Editor), Slade Penoyre (Treasurer), Graeme Ward, C R Magnan, Mark Tingley, and 10 other members of the Society.

Apologies for absence were received from Dave Culp, and Kim Fisher.

2. Minutes of the 41st Meeting held on Saturday 23rd January 2005. The minutes of the 41st AGM were approved. There were no comments, and the Chairman signed a copy.

Last year, the Committee were asked to examine the use of credit cards for payments to the Society. The cost (including terminal rental) was found to be about £500 a year, and probably more than we would take. The Society already accepts PayPal across the Internet.

3. Chairman's Report – The Chairman's Report, which had previously been published in the January *Catalyst,* is summarised as follows.

While survival is necessary it is the quality of our activity and what we achieve which is important. Far too many people have never heard of AYRS.

The annual plea remains the same but is now more urgent: we need help with publishing, and people to run local and regional meetings. Could you do anything?

AYRS has had a stand from the very first London boat show at Earls Court. The publicity has been considered vital to our survival but now the cost is rising and perhaps the money could be better spent in other ways.

There is a vast amount that could be done in the future, we could squander our resources on a hundred worthwhile projects and achieve nothing. We could save our reserves and silently vanish into the unknown. Hopefully we can continue to publish and encourage people with ideas to put pen to paper, saw to wood and resin to fibreglass.

There were no questions or matters arising from this Report, and it was accepted, *nem con.*

4. Treasurer's Report and Accounts – The Accounts and the Treasurer's Report had also been previously published. In summary, the Treasurer reported as follows.

The Society's reserves remain in a more-or-less satisfactory position. At the end of 2004, the assets, including a nominal £1,013 of publication and other stock, amounted to 85% of the current year's expenditure.

From the Income and Expenditure account, last year the Society made a surplus of £2,154. This is not a large amount, however it should not be allowed to grow *(see below).*

In detail, comparing 2004-5 against 2003-4, income is down, and expenditure is well down.

Last year, we said we would review both the subscription rate in US Dollars, and the Retired members rate, with a view to increase. As the Dollar exchange rate appears to have stabilised, and the costs contained, our current proposal is that the concessionary rate for retired members be increased to £12.50, 20 euro and, provisionally, $20, but only from October 2006. We will review this again later in 2006.

In response to questions it was noted that Boat Show income has not this year been analysed into subscriptions etc, but was about 4% up on 2003-4.

Adoption of the Accounts was proposed by Roger Glencross, seconded by Jasper Graham-Jones, and carried *nem con.*

5. Confirmation of President and Vice-Presidents, Election of Officers and Committee Members – By universal acclamation of those present HRH Prince Philip, Duke of Edinburgh, was confirmed as President of the Amateur Yacht Research Society. The Vice-President, Dick Newick, was similarly confirmed.

The Chairman, Michael Ellison, having announced his wish to retire, the Vice-Chairman, Fred Ball, was elected into his position. Graeme Ward was elected Vice-Chairman (prop: Fred Ball, 2nd: Slieve McGalliard), and the Treasurer, Slade Penoyre, was re-elected. Committee members Dave Culp and Robert Downhill had completed their current terms of office, and were willing to stand again, and the Committee proposed also the election of Peter Westwood. The election was proposed by Michael Ellison and carried *nem con.*

6. To appoint a Reporting Accountant for the year

The Committee proposed that Robin Fautley be re-appointed. This was carried unanimously.

7. Any Other Business

No other business had been formally notified.

8. Vote of thanks to the helpers of the society

This was proposed by Fred Ball and carried unanimously.

The meeting closed at about 16.45.

AYRS Weymouth Meeting – October 2006

reported by Simon Fishwick

The Wednesday evening during Weymouth Speedweek is given over to an AYRS meeting held in the Royal Dorset Yacht Club. By tradition, a number of speakers are invited to talk about their involvement with speed sailing, or their new boats, for a maximum of five minutes each (carefully timed!) This is a brief summary of each of the talks.

Slade Penoyre

Slade has been working on wind power. Not great windmills, 50 m high, requiring lots of careful and individual engineering; but small ones that can be made in thousands, and deployed as needed. In fact he envisages that they be mounted on 40 ft/13 m long catamarans and each produce about 15 kW.

Twenty thousand of those deployed 15-20 km offshore in the North Sea would produce more than twice the UK's immediate energy needs, with the excess used to generate hydrogen from the seawater.

At present the idea has progressed as far as model trials. After some onshore tests of the basic idea, a catamaran has been constructed and is deployed in the Bristol Channel – a notorious stretch of water where the nearest land to windward is the American coast. If it can survive and work there, it can do it anywhere.

The craft is at anchor, being tended by students from the United World College of the Atlantic – an international sixth-form (16-18 years old) college that has been there since 1963, and a place not new to experimental small craft developments as it was responsible not only for the invention of the Rigid Inflatable Boat (RIB) in 1964, but also for the 8 years of work that led to the Atlantic 21 inshore lifeboat deployed by the UK's RNLI and the Netherlands KNRM.

Slade has agreed to write a fuller article on this work for *Catalyst*.

Jonothan Barton

Jonothan is working on a catamaran design with a double-skin sail stretched between two masts. The idea is that the sail surfaces self-shape under wind pressures to make a sail that is more efficient and effective than a single skin one.

So far he has made a number of models that are proving that the reduced pressure on the lee surface is not enough on its own to produce the shape he wants and that further refinement is needed.

James Grant

James is the skipper of the Volvo Extreme 40 "*Basilica*" that was competing at Speedweek.

He explained that the Volvo Extreme 40 was designed for inshore racing. It carries 100 m² of sail, 75 m² in the mainsail, 25 m² in the jib – and has a 70 m² spinnaker. It will easily sail at twice the true windspeed in moderate conditions.

At the moment they are still heavily involved in the development phase of their programme, and had come to Speedweek to learn what the boat could do in stronger wind conditions.

Chiefly they had learned that the boat needed a T-foil aft to hold down the stern, and they were unable to put more power on as the bows lacked buoyancy and buried.

Tony Morris

Tony asked 'What is a legitimate sailing craft?'

His thesis is that windsurfers like Björn Dunkerbeck can readily sail a 2 to 2.5 times the true windspeed on a reach. If they sailed a deeper course then they would move at a lesser fraction of the windspeed, but could handle stronger winds, and maybe would go faster. Sailing high needs and efficient craft, sailing lower less so.

He postulated that the record would eventually fall to a downwind sled with a parachute that could perhaps do only 75% of the windspeed straight downwind, but given a fast enough windspeed could perhaps do 75 knots. At the end of the speed-run, the

parachute would be jettisoned and allowed to blow away in the hurricane, whilst rescue craft attempt to recover the sled and its pilot.

Although his tongue was firmly in his cheek during this presentation, the thought he raised is one that does bear thinking about, perhaps to ensure that it never happens.

Björn Dunkerbeck

Björn himself is concentrating on improving board speed in lighter winds, and on trying to take the Nautical Mile record well over 40 knots. *[In October it stood at 39.97 kts and was held, along with the World 500 m Record, by Finian Maynard. In November, Björn recorded a speed of 41.4 kts at Walvis Bay (subject to WSSRC ratification). SF].*

At these high speeds water drag is much more critical than air drag, and the drag from cutting through waves is a major part. His 'chop-buster' has now been tested and proved effective at up to 40 kt winds, and he is hoping that by sailing a somewhat deeper course than customary (say about 130°) he will be able to sail faster albeit at a lower V_b/V_t ratio.

At these speeds it is important to use the sail to lift the board as much as possible. In answer to a question he said he did not like the idea of using T-foils to lift as they produced too much drag at high speeds (40 – 50 knots).

Bob Spagnoletti

Bob introduced the meeting to the idea of dynamic soaring, whereby a bird (or a glider) can keep itself aloft without power by exploiting the difference in windspeed higher up and lower down especially in the leeside of hills (or waves).

By flying in particular patterns, and by trading-off momentum gained downwind for height gained upwind, birds like albatrosses can cross vast distances without ever needing to flap their wings. Glider pilots, particularly the model aircraft fraternity, are learning to do the same trick. *[This topic has been discussed at some length on the AYRS Yahoogroup on the Internet. See* http://tech.groups.yahoo.com/groups/ayrs/message/205 *et seq. - SF]*

If a glider pilot can reach a speed of over 200 kts simply by exploiting faster or slower wind flows, what could be done in a river? What else could be done using this principle? If a craft can dynamically soar between airflows of different speeds, could it dynamically soar between air and water (using alternately wing and hydrofoil)?

Ideas for thought.

Fred Ball

Fred Ball described to the meeting his experiences sailing Stephen Thorpe's Rotorboat, but since these are written in another article in this edition of *Catalyst*, it will be left there.

George Dadd

George is working on a tri-scaph craft propelled by a kite. The craft geometry skews to allow the kite pull (which is taken to the centre of the crossbeam between the two front hulls) to align with the centre of lateral resistance.

At the moment there are a number of control issues, chiefly to do with the kite.

When asked how he fabricated his curved crossbeam George explained that he used PVC pipe as a mandrel made to curve by running hot air through it. He then cut a spiral around the pipe to aid its removal from inside the beam.

Bob Downhill

Bob talked about his timing system development which is described elsewhere.

Tim Hurst

Tim is developing an alternative method of determining when a speedsailor crosses a (start or finish) line. The sailor (or his craft) carries a small radio transponder, which identifies him with a short transmission every half-second. The "line" is defined by an array of two high-gain aerials connected to receivers. The aerials are slightly out of parallel so that as the sailor passes in front of them the signal strength grows first in one then in the other and then declines. The sailor is on the line when the signal strength in the two receivers is equal. (For those familiar with avionics systems, this is like an

Instrument Landing System, but with the positions of transmitter and receiver interchanged). When on the water, the aerial array is stabilised in yaw by an electronic compass.

This development is still in its early stages, and we hope to have an article for a future edition of *Catalyst.*

Chris Edwards and Richard Varvil

'Daddy Longlegs' is a hydrofoil catamaran with two steerable bow foils and two main foils. It is based permanently at Weymouth because it needs the wide slipway.

In light winds they use only the main foils (as lateral resistance) but once the winds go over 15 knots, the bow foils are put down. They preferred the canard configuration (main foils aft) to an aeroplane (main foils forward) as it is less likely to pitchpole.

Their intention is to produce a boat that is fast in waves. The bow foils are of a super-cavitating section to minimise stall/crashing.

Early problems were that the bow steering linkages were too flexible. They have now been remade to be much stiffer.

Michael Ellison

As well as being on the AYRS Committee, Michael maintains records of multihull accidents for MOCRA.

Following a well-publicised incident off Mexico earlier this year, when an experienced multihull sailor felt constrained to abandon his catamaran when the waves became higher than twice the beam of the boat,

Michael is looking for any evidence that exists of multihulls being capsized *by wave action alone*, i.e. with no sail set. At the moment he does not know of any such incidents, and accordingly has always maintained that it is safe to lie a-hull in multihulls in storms (up to the point at which the windage of the mast and rigging becomes significant). He would like to know if he is wrong. Please write to him with any evidence available, c/o AYRS.

Catalyst Calendar

This is a free listing of events organised by AYRS and others. Please send details of events for possible inclusion by post to Catalyst, BCM AYRS, London WC1N 3XX UK, or email to **Catalyst@ayrs.org**

November 2006

1st **AYRS London Meeting** *Subject to be confirmed.*
1930 for 2000 hrs at the London Corinthian Sailing Club, Upper Mall, London W6 9TA. Location Map: www.linden-house.org Contact: AYRS Secretary, BCM AYRS, London WC1N 3XX email: office@ayrs.org.

December 2006

6th **AYRS London Meeting** *Subject to be confirmed.*
1930 for 2000 hrs at the London Corinthian Sailing Club, Upper Mall, London W6 9TA. Location Map: www.linden-house.org Contact: AYRS Secretary, BCM AYRS, London WC1N 3XX email: office@ayrs.org

January 2007

5th - 14th London International Boat Show
EXCEL Exhibition Centre, London Docklands

21st **All-Day AYRS Meeting (Date to be confirmed)**
0930 -1600 hrs, Thorpe Village Hall, Coldharbourlane, Thorpe, Surrey (off A320 between Staines and Chertsey – follow signs to Thorpe Park, then to the village). Details from Fred Ball, tel: +44 (0) 1344 843690; email frederick.ball@tesco.net

21st **AYRS Annual General Meeting (Date to be confirmed)**
1600 hrs, Thorpe Village Hall (see above). Details from the AYRS Hon Secretary tel: +44 (0) 1727 862 268; email: secretary@ayrs.org

February 2007

7th **AYRS London Meeting.** *Subject to be confirmed.*
1930 for 2000 hrs at the London Corinthian Sailing Club, Upper Mall, London W6 9TA. Location Map: www.linden-house.org Contact: AYRS Secretary, BCM AYRS, London WC1N 3XX email: office@ayrs.org.

March 2007

7th **AYRS London Meeting.** *Subject to be confirmed.*
1930 for 2000 hrs at the London Corinthian Sailing Club, Upper Mall, London W6 9TA. Location Map: www.linden-house.org Contact: AYRS Secretary, BCM AYRS, London WC1N 3XX email: office@ayrs.org.

April 2007

13-15th Broad Horizons (AYRS Sailing Meeting). Barton Turf Adventure Centre, Norfolk UK. Details on the AYRS website www.ayrs.org, or contact: AYRS Secretary, BCM AYRS, London WC1N 3XX email: office@ayrs.org.

May 2007

14-18th Sailing Trials at Weymouth.
Castle Cove, Portland Harbour, Dorset UK. No prizes, but the speed measuring equipment will be there. Contact: Norman Phillips, email: wnormal.phillips@ntlworld.com

October 2007

1-7th **Weymouth Speedsailing.**
Weymouth and Portland National Sailing Academy. Contact: Nick Povey, email: nick.povey@speedsailing.com for details and entry forms

Catalyst — *a person or thing acting as a stimulus in bringing about or hastening a result*

On the Horizon . . .

Tri-foiler project update —

. . .

More sources and resources: review, publications and Internet sites

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Amateur Yacht Research Society
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