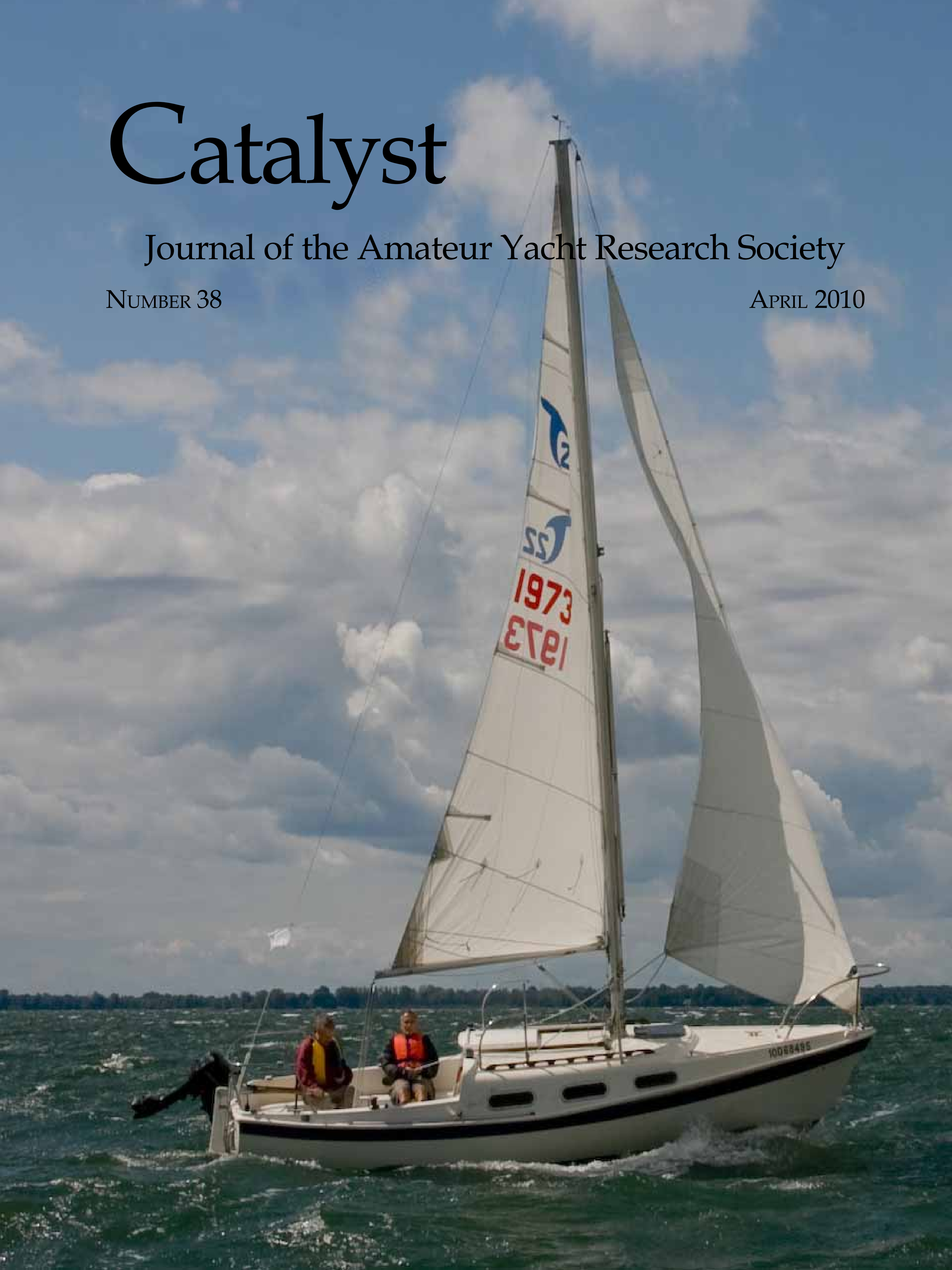
# Catalyst

Journal of the Amateur Yacht Research Society

NUMBER 38 APRIL 2010



With reference to the article by Tim Glover in the January issue of Catalyst I am clearing out my garage etc and I have the following free to a good home. All in good condition

1 number portside hull of a Condor 16 / Hurricane 4.9 K808

Front and rear beams for same

2 rudder assemblies and 2 center boards

Rod Easter
Matfield Kent TN12 7JE
01892722108

*Submitted: Oct 2010*

## How to supply information for publication in Catalyst:

The Best way to send us information:- an electronic (ascii) text file (created in Notepad, or Word, with no formatting at all, we format in Catalyst styles). Images (logically named please!) picture files (.jpg, gif, or .tif). If you are sending line drawings, then please send them in the format in which they were created, or if scanned as .tif (never as JPEGs because it blurs all the lines)

Any scanned image should be scanned at a resolution of at least 300 ppi at the final size and assume most pictures in Catalyst are 100 by 150mm (6 by 4 inches). A digital photograph should be the file that was created by the camera. A file from a mobile phone camera may be useful. Leave them in colour, and save them as example *clear_and_complete_title.jpg* with just a bit of compression. If you are sending a CD, then you can be more generous with the file sizes (less compression), than if emailing, and you can then use *.tif LZW-compressed or uncompressed format.

For complex mathematical expressions send us hardcopy or scan of text with any mathematical characters handwritten (we can typeset them), but add copious notes in a different colour to make sure that we understand. WE can also process MS Equation and its derivatives. Include notes or instructions (or anything else you want us to note) in the text file, preferably in angle brackets such as <new heading>, or <greek rho>, or <refers to *image_of_jib_set_badly.jpg*>.

Otherwise: — If you write in longhand, and sketch or include photographic prints, and trust to snail mail (a copy, never the original) then all can and will be dealt with in due course. If you have trouble understanding anything in this section, email to ask.

As examples, the polar diagram p16 of *Catalyst 28* was re-created from a second generation photocopy, photos of shunting in the Champion article in *Catalyst 27* (pp 19-21) were screen grabs from a video supplied on DVD. The rest of the images in that article were scanned from photographs, and the text was OCRed (Optical Character Recognition software) or keyboarded.

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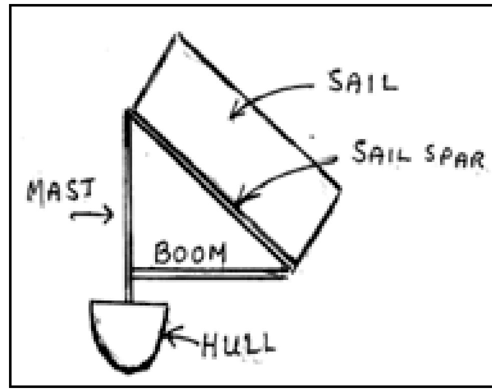
- by email: catalyst@ayrs.org,
- by fax: +44 (8700) 526657, or
- by post: Catalyst, BCM AYRS, London, WCIN 3XX

## Features



## Regulars

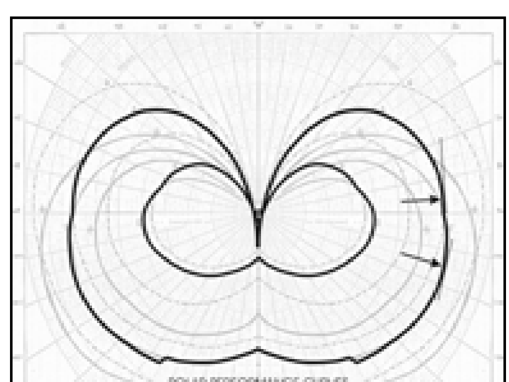





*Cover Photo:*

*Tanzer 22 No. 1973, "Le Must" Jon Austin captain Photo by Heather Deeks Dorval, Quebec.*

*See article on page 15.*



# Catalyst

Journal of the
Amateur Yacht Research Society

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Sheila Fishwick

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Electronics—Simon Fishwick
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Contributions are welcome from all. Email them to **Catalyst@ayrs.org**, or send (at your 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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# Meet the Committee – Part 1

Every Annual General Meeting, there is an election for Officers and Committee Members of AYRS. The Officers (Chairman, Vice-Chairman, Secretary, Treasurer and Editor) serve two-year terms, the ordinary Committee members for two- or three-years. (The rule book says one third have to stand for re-election each year.) There is no limit to the number of terms an individual may serve. In practice most of the Committee have been there for some years, and if you were to say that the Committee desperately needs new blood, then we would not gainsay you.

However very few people turn up to the AGM each January, so only a few know the Committee, so it's probably appropriate to publish a short introduction to each. So we shall start with:

## Graeme Ward – Chairman

Graeme was newly elected to the Chair this year, following the retirement of Fred Ball, but he has been a member of the Committee since the 1970s. Secretary until 1998, he became Vice-Chairman in 2006, and Chairman in 2010. He is an engineer, and currently works for a tool hire company in Croydon, UK, although he hopes to retire later this year. (He said that last year too!) He has a particular interest in the more unusual developments in matters marine and has a library from which he can extract details of obscure Victorian inventions at the drop of a hat. He has been a WSSRC (World Speed Sailing Records Committee) Observer for a number of years, and had a particular interest in measuring sailboard stiffness by observing the acoustic resonances when you hit them with a small hammer.

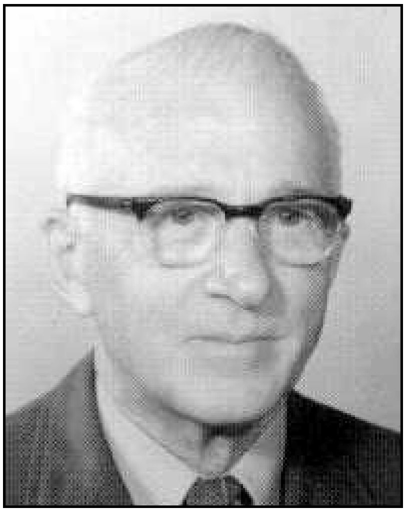
## Sheila Fishwick – Vice-Chairman & Honorary Secretary

Sheila is an artist, botanist and garden designer who became involved with the AYRS' management when her husband (Simon) took her along to a London Boat Show; she was so appalled by the lack of impact of the AYRS' stand that she was promptly tasked with the design of the next year's one, something which she has done ever since. She was co-opted onto the AYRS Committee in 1997 when Simon (then Newsletter Editor) went off to work in Belgium, and the Committee felt they needed some way of keeping him under control. She became Secretary in 1998 and Vice-Chairman (as well) this year.

For those not familiar with British company law, the Secretary is the person responsible for company administration and keeping the records. Sheila should not be confused with the typist! She (with Simon) handles all the sales and distribution of Catalyst and other publications, keeps the membership records and as noted above, manages AYRS' presence at the London Boat Show.

The next Part will introduce the Treasurer (Slade Penoyre), and Editor, (Simon Fishwick).

# Bernard Smith : Sailing's Real Rocket Scientist



Bernard Smith, inventor of the "aero-hydrofoil", and a former Technical Director of the US Naval Weapons Laboratory, died 12th February 2010, aged 99.

Born and brought up on the Lower East Side of New York, he had little formal education and worked as a blacksmith. He became interested in rockets, and found himself amongst the pioneers of the American Rocket Society, forerunner of the American Institute of Aeronautics and Astronautics. At the age of 34, he went to college in Oregon - the only one that would accept him - and then joined the Naval Ordnance Test Station in China Lake Califormia where he rose to department head and later became Technical Director of the Naval Weapons Laboratory in Dahlgren, Virginia from where he retired in 1973.

In 1963, he published "The 40-knot Sailboat", a simple and easy to read book that outlined Bernard's farsighted concepts for tackling the issues of high speed sailing. Most of Bernard's radical concepts confronted the big issues of sailboat stability head on and were free of the shackles of convention. His book and the craft within (which he described as 'aero-hydrofoils') inspired many designers aiming to unlock their secrets and the potential for power and stability that they promised over conventional craft.

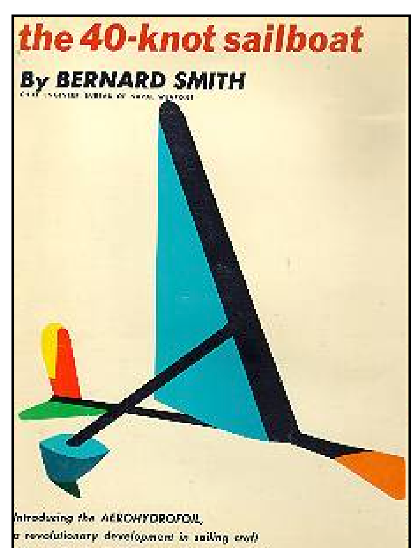
His idea was to use bouyant hydrofoils,two to leeward, one to windward in place of a hull, and to cant the sail so its force was exactly balanced by a downward pull from the windward foil. His work inspired a number of speed-sailing craft, the best known and most successful of which is *Sailrocket*, designed by Malcolm Barnley, and sponsored by Vestas.

On 27th November, 2007 the Vestas Sailrocket team finally broke through 40 knots in a craft based on Smith's ideas. They were delighted to contact Bernard and tell him that his ideas worked. A year later they called him to tell him that his 40 knot concept was in fact a 50 knot concept and at that stage the fastest sailing 'boat' in the world.

The Vestas Sailrocket team are continuing to develop his concepts and believe that one day, he will be acknowledged in the sailing world for the true visionary genius that he was and the originator of a whole new era in high speed sailing.

His inventiveness was not restriced to aero-hydrofoils however. He also extended the idea to stabilising monohulls ("monomarans"), "fliptackers" where the canted sail was swung from one side to the other as the boat tacked, and "sailoons" which used an aerofoilshapedballoon as both sail and aerostatic buoyancy.

His last book - "The Ultimate Sailboat" - was privately published in 2004.



# AYRS - North West UK Area Forum

## Record of Meeting held on the 20th March 2010

The first meeting of the AYRS North West Area Forum was heralded a resounding success by all of the seven members who attended. The meeting, held at the home of Mike Howard, the organiser, started with him delivering a brief welcoming speech. This was followed by Graeme Ward, the new AYRS Chairman, who applauding the initiative taken by Mike and expressed his hope that the meeting would become a regular occurrence and be repeated in other areas of the country. He stated that he intended to take a close look at the postcodes of the current membership and identify "clusters" of members who might be persuaded to develop their own local area forums.

Each of the members, in turn, outlined their interests and activities which had some connection with the aims and ambitions of AYRS. This prompted some lively discussions which included similar and conflicting opinions and personal experiences. This was followed by a short interval during which they enjoyed tea, coffee and cakes! It also allowed time for one-to-one conversations as the individuals got to know one another.

Once the table was cleared, John Morley demonstrated his tethered kite-sail, using two models and a not-to-scale wind, provided by an electric fan! He has developed and improved this system over many years. Once again this prompted many questions, including the use of rectangular sails and reefing systems to produce more boat speed but less lift in high winds. All those present were suitably impressed by John's very thorough analysis and the practicality of his design.

John Alldred then demonstrated his very original horizontal "whaletail" type propulsion system, inspired by watching the underwater speed and agility of a seal. As one member pointed out - "you do not see any fish who use paddles or screws to propel themselves". A general discussion had taken place earlier, on the merits of the Hobie system and Graeme Ward expressed the opinion that this was one area of development worth spending time on.

The meeting finally ended around six o'clock with an action on the organiser to collate members' interests and skills in order to promote a project which was of mutual interest.. A provisional date of the 19th June was set for a second meeting.

Finally, Mike Howard would like to thank all the participants for attending and hopes that this article might inspire members in other areas of the country to do the same.

## Report of the Second Meeting held on Saturday 19th June 2010

Mike Howard welcomed five local members, including a "new recruit", Roy Anderson, who travelled from Settle in Yorkshire to attend. Four other local members sent their apologies. Let's hope they can attend next time around.

The meeting was a lively mix of marine subjects comprising one third theoretical and two thirds practical. John Morley's Tethered Kite Sail project was the subject of the first hour with advice as well as practical help being offered by all those present. The outcome was a proposal to develop a "pint sized" version suitable for Mike Howard's inflatable dinghy and John Shuttleworth's and Brian Shenstone's canoes.

Mike Howard tabled a 1:5 scale plywood model of his simple tortured plywood dinghy, better described as the forward section of a 4 metre long rowing/ sailing skiff. Discussion centred around the members' personal experience of working with inexpensive industrial plywood, rather than marine plywood. One member pointed out the plywood scaling factor which can be found in the Gourgeon Brothers manual.

Brian Shenstone showed a lovely model of a traditional Canadian Canoe, which he was using to develop a sailing rig, in particular a drop in device housing two independent leeboards. Again, lots of practical advice was forthcoming from other members.

Tea, coffee and home made banana loaf and carrot cake came next (you really are spoiling us Colette!). During this time lots of "one to one" discussions took place. Mike Howard advised John Alldred on potential stitch and glue catamaran dinghies which he had located on the internet. John Shuttleworth discussed canoe sailing rigs with Brian Shenstone and John Morley attempted to convince Roy Anderson that his Tethered Kite Sail Rig really does work!

Following on from the break, John Shuttleworth reviewed his weekend visit to the Beale Park Boat Show and promised a full presentation at the next meeting of his Scottish canoe "voyage" with two colleagues, including a brush with the law when they ventured too close to the nuclear submarine base at Faslane! The final hour centred around boat building materials and boat building books. A separate list is enclosed for member's retention.

Finally, Mike Howard would like to thank everyone who attended for making the second local meeting even more interesting than the first one.

## List of References from Second AYRS North West Local Group Meeting

### Supplier of 3 metre long plywood sheets complying with BS 1088:

Jordan Timber Ltd
Pocket Nook Lane
Lowton
Warrington
Cheshire
WA3 1AB
Tel: 01942 683060

### Manufacturer of Fix All (crystal) SM Polymer Adhesive:

Soudal UK Ltd
Unit P, Riverside Industrial Estate
Tamworth
B76 3RW
Tel: 01827 261092

### Supplier of Sailing Canoes

Solway Dory
2 The Avenue
Grange over Sands
Cumbria
LA11 6AP
Tel: 01539 535588

### Books:

Stitch and Glue Boatbuilding
The latest authority on stitch and glue boatbuilding, very practical approach, contains 11 plans for kayaks, a skiff and a rowing shell.
Author: Chris Kulczycki
Publisher: The McGraw Hill Company (www.internationalmarine.com)
ISBN: 978-0-07-144093-6

Ultrasimple Boatbuilding
Contains the plans for 17 plywood boats anyone can build.
Author: Gavin Atkin
Publisher: The McGraw Hill Company (www.internationalmarine.com)
ISBN: 978-0-07-147792-5-6

Design and Build your own Junk Rig
Simple step by step instructions
Author: Derek Van Loan
Publisher: Paradise Cay Publications Inc
ISBN: 0-939837-70-6

Boat Plans on t'Internet
www.duckworksbbs.com/plans - lots of plans for every conceivable type of boat
- Gavin Atkin - amateur designer who has produced lots of simple boats
- Michael Storer - lots of exciting boats including the sailraid41
- Geodesic AiroLITE (www.gaboats.com) - very light boats

Small Craft Electronic Magazine (free)
www.duckworksmagazine.com

# Development of the Morley Tethered Kite Sail System

## Application to the AYRS Howard Fund

Michael Howard

Dr. J.M. Morley has been developing his Tethered Kite Sail System for more than twenty years. The design and the details have been developed by technical analysis and by building scale models, which have been tested on an open beach. The AYRS membership have been made very aware of the ongoing development of Dr. Morley's tethered kite sail system because several articles have appeared in the Society's publications over a number of years [Refs 1 & 2].

Dr. Morley is a non-sailor and as a result has never had the opportunity to test out his theories to full scale. In spite of the publicity that his Tethered Kite Sail System has received from the AYRS over the years, Mr. Morley has never had any previous offers of help or assistance from the AYRS membership or from the local sailing fraternity.

An Application is being made here to the AYRS Howard Fund for the sum of £3000. This sum, together with some personal funding from both the Applicant and Dr. Morley will be spent on a continuous basis over the length of the Project. Neither the Applicant nor Dr. Morley have the necessary financial resources to carry out this project without outside support.

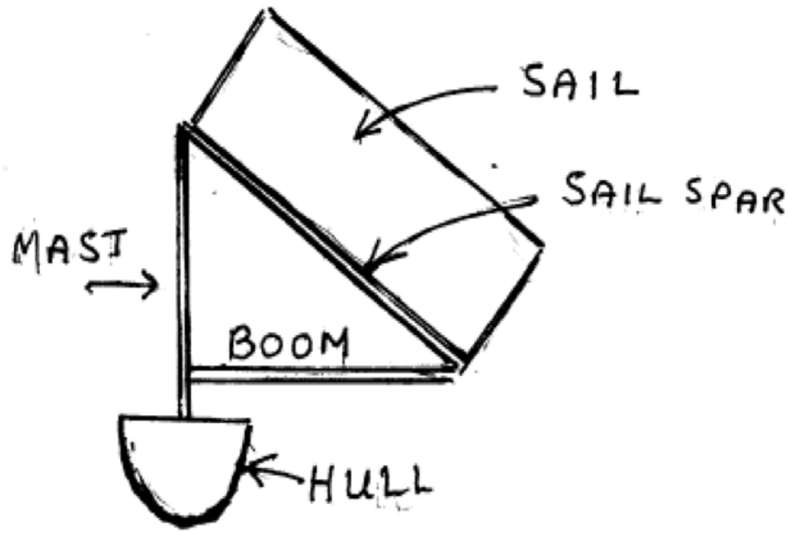
The principal aim of the Project is to build a full-scale version of the Morley Tethered Kite Sail System and mount it on a suitable medium sized two-man sailing dinghy. The modified dinghy will then be sailed in company with a conventionally rigged dinghy of the same class and the relative performance monitored and recorded. The results will be presented for publication in Catalyst.

The Applicant, who is a retired Design Engineer and a member of the Royal Institution of Naval Architects, began his sailing career in his early teens. He has both technical and practical skills and has designed and built a couple of small dinghies. The Applicant believes he has the necessary experience to bring the Project to a successful conclusion.

### History of the Morley Tethered Kite Sail System

There are two constraints limiting the further development of sailing boats. Firstly, the sail power cannot be increased beyond the point at which capsizing occurs. Secondly, the speed of a boat is limited by hull drag, which is approximately proportional to the displacement. Both of these limitations can be overcome by the use of an offset angled sail. This produces a lifting force that balances the heeling force. At the same time, the lifting force reduces the displacement and hence the hull drag.

Control problems are encountered with this simple approach. The system is inherently unstable and difficult to control by manual response. As a consequence, a tethered kite sail design has been produced which provides an automatic response to fluctuations in both wind speed and direction. Experimental models of various sizes, up to about




*The Morley Kite Sail (from Catalyst 33)*

one metre, have been built, with radio control of the sail setting. These models have been tested on Southport beach in the presence of a steady westerly wind (wind blowing from seaward across a clear area of tidal sandbanks/shallow water). The models behaved as predicted.

## Arrangement of the Morley Tethered Kite Sail System

The basic design has been fully described in articles published in Catalyst issues 14 and 33 [Refs 1 & 2[. These articles show a possible arrangement with variable geometry, which can be utilised either as a conventional rig or in the form of a tethered kite sail. The former rig has some advantages when close manoeuvring is required. The kite sail can be set when in open water.

In order to deal with fluctuations in the direction of the apparent wind, the sail assembly is free to rotate about the mast. It appears that this is the first time that this arrangement has been proposed. In order to deal with the fluctuations in the apparent wind speed, means are provided whereby the sail automatically spills wind before the lifting force becomes large enough to lift the boat from the water. The design still relies on a conventional keel and rudder combination for course direction and to combat leeway.

The proposed system, therefore, reduces heel to negligible values, provides for a substantial increase in sail area, reduces hull drag to negligible values and also provides for the rapid transformation to a single sail conventional rig.

## Contribution of this Project to Nautical Science

The successful development of Dr. Morley's Kite Sail System will, in the first place, prove the practical application of his theoretical work. In the long term, it will provide an alternative sail plan to the current conventional small boat sail systems. The benefits of the Morley Tethered Kite Sail System is that it significantly reduces the heeling effects, which in turn, provides a safer, more stable and less tiring environment for the sailor. In addition, the system provides increased boat speed by producing lift, which reduces both the wetted surface area and drag.

## Project Objectives

There are five main objectives:

1. To design and manufacture a full scale Morley Tethered Kite Sail System suitable for a medium sized two-man popular class of sailing/racing dinghy.
2. To install a full scale Morley Tethered Kite Sail System in medium sized two-man popular class of sailing/racing dinghy.
3. To carry out sailing trials with the Morley Tethered Kite Sail System, installed in the chosen dinghy, and develop the techniques for handling the rig.
4. To sail the Morley Tethered Kite Sail System dinghy against a conventionally-rigged dinghy of the same class. To monitor the relative boat speed, angle of incidence, and control issues under a variety of recorded wind and wave conditions.
5. Publish the results of the full scale sailing trials in Catalyst.

## Project Definition

There are a number of steps that need to be taken in order to realise a full scale Morley Tethered Kite Sail System.

The first step will be to carry out all the necessary technical design work to develop a full scale rig. Both the Applicant and Dr. Morley have the technical ability to perform the structural calculations and the Applicant has 2D and 3D CAD software to produce 3D models and working drawings for the components and assemblies.

The procurement of standard fittings and manufactured special elements of the rig will be undertaken by the Applicant, using his knowledge of the marine industry and his contacts with local companies. These contacts include both stainless steel fabricators and machinists as well as textile fabricators.

The next stage will be to purchase a pair of identical medium sized sailing dinghies. The likely candidates for this role are the GP14, Enterprise, Fireball or 420 class dinghies. All of these dinghy classes have been around for a long time and second-hand dinghies, in a fair state of order, are to be found for sale in the yachting press and at local sailing clubs. Depending on the purchase prices, one of the dinghies may be purchased by the Applicant, using his own funds.

One of the pair of dinghies will require modification to enable it to carry the Morley Tethered Kite Sail System. This will involve woodwork as well as possibly composite material modifications, if the dinghy is of glass fibre construction. The Applicant has reasonable woodworking skills, having built two plywood dinghies and is professionally trained in GRP repair techniques.

The assembly and rigging of the Morley Tethered Kite Sail System will require an understanding of the rig and a good deal of nautical knowledge. It is expected that both the Applicant and Dr. Morley will be engaged in this phase of the programme. The Applicant has been sailing, on and off, since he was a teenager and has experience in dinghies, half decked boats and has sailed in yachts up to 15 metres (50 feet) in length.

The actual sailing trials will require a number of experienced sailors. For this phase of the programme the Applicant will call on the services of the AYRS North West Local Group. The Group, who recently met for the first time, are keen to get involved in a local project. The Group currently comprises five AYRS members (including the Applicant and Dr. Morley). They all live within a 40 mile radius of the Applicant's home. Within this area there are four venues that will be suitable for the sailing trials:

## Project Costs

There are a lot of variables associated with this project. These include the initial cost of the trials dinghies, the manufacture of a series of unique fittings, and the choice of the sailing venue(s). For best practice, a high and low budget has been drawn up.

| Item No | Item | Lowest Cost | Highest Cost |
|---|---|---|---|
| 01 | Design & working drawings | 0 | 0 |
| 02 | Purchase of a suitable dinghy & road trailer | 500 | 1000 |
| 03 | Purchase of a matching dinghy and road trailer | 500 | 1000 |
| 04 | Metalwork - spars & fittings | 1500 | 2000 |
| 05 | Sails (several different shapes/sizes) | 500 | 700 |
| 06 | Adapt trials dinghy to suit new rig | 100 | 200 |
| 07 | Instrumentation (purchase and/or hire) | 500 | 1000 |
| 08 | Lake Fees | 200 | 400 |
| 09 | Transportation | 200 | 400 |
| 10 | Contingency Fund (approximately 15%) | 600 | 1000 |
| | TOTAL PROJECT COSTS | £4600 | £7700 |

These sailing venues are:

1. Scotsman's Flash, a sixty-acre lake formed by mining subsidence, and located near Wigan in Lancashire.
2. Pennington Flash, a lake of similar size, also formed by mining subsidence, located near Leigh in Lancashire.
3. Crosby Marine Lake - a sixty-acre man made lake adjacent to the river Mersey estuary, and close to Liverpool.
4. Southport Marine Lake - another man made lake, about 100 acres in size, adjacent to the Lancashire coast.

In addition, the Applicant owns a holiday home in the Lake District, close to both Lake Windermere and Coniston Water.

## Project Timescale

The Project will commence on receipt of the grant from the Howard Fund. It is envisaged that the Project can be completed within a six month timescale, provided that:

the trials period falls within the sailing season

that that personnel are available for the trials period.

suitable weather conditions allow for continuous time afloat

## Success or Failure?

"If you don't dip your toe in the water you never know how hot or cold it is"

The Applicant is 100% confident that a Morley Kite Sail System can by designed, manufactured and assembled. This confidence comes from a lifetime's employment in the engineering industry, during which time he was responsible for the design and development of a number of unrelated and diverse projects . He also has well developed practical skills, which he used in order to teach artisans, employed overseas, new construction and assembly techniques.

To prove the Morley Kite Sail System is a successful idea is the principal aim of this project. However, scaled up to full size, it may prove to be difficult or impossible to handle. It may not be as close winded as a conventional sail. It may not increase boat speed. However, even if the Morley Kite Sail System fails to live up to its inventor's claims - the project will have been a success - it will have proved a point.

It is noted that a similar, but not identical, Swing Sail Rig was developed by David Duncan (reference 3). He was awarded the AYRS John Hogg Prize in 2001 for his efforts (reference 4). Although the rig appeared to offer some advantages, no comparative results have been published in Catalyst.

## References


1. Catalyst 14 - Self-stabilising, variable geometry Kite Sail System by Dr. J.G. Morley
2. Catalyst 33 - A Captive Kite Sail Design by Dr. J.G. Morley
3. Catalyst 07 - Introducing the Swing Sail Rig by David Duncan
4. Catalyst 07 - AYRS - John Hogg Prize 2001 - Report of the Judges


# Comment by the AYRS Committee

This application was received in March 2010. Because of the long delay in publishing the April Catalyst, we have we decided we could not wait for comment from the members but have approved this application. We have suggested (but have not required) that if the team were to select Wayfarer dinghies then the results might be comparable with David Duncan's rig trials. It might also be possible to sail the rig against Wayfarer dinghies at the forthcoming Broad Horizons meeting (May 2011).

Despite that we have made a decision, we welcome comments, especially those that will improve the Project.

# Innovation in rating sail areas

## Version 2009

Nico Boon

Since 1982 the Texel and similar multihull rating systems have used the aspect ratio to calculate the rated area of mainsail and foresail. The method is based on a formula developed in that year in California. In recent years more rectangular mainsails with square tops have show themselves to be more efficient than the triangular mainsails. But the aspect ratio of these 'modern' sails is relatively lower than for more triangular sails, which puts a lower efficiency factor in the formula. This is not correct.

That fact has been the main reason for the study of new ways to determine the efficiency of a sail. These studies have been done all over the world. In Australia a new system already was introduced in 2008, in the OMR (Offshore Multihull Rule) for around 170 multihulls of the Multihull Yacht Club of Queensland, (MYCQ). In 2008 new formulae were tested in Holland, introduced in 2009; for open cats these will be introduced in 2010.

### Efficiency formula

The new efficiency formula for the mainsail is based on the ratio **sail area divided by $e^2$**, where **e** is the greatest width of the mainsail. Generally this will be the length of the foot of the main. This formula is a combination of two ratios:

The measure of rectangularity of the main, that is the ratio of the actual sail area of the main divided by the rectangle **p** times **e** (where **p** is the height of the mainsail, i.e. the length of the luff). In formula form, this measure is: (msam_ex_mast) / (**p*e**).

This ratio is multiplied by the second one, the ratio (**p/e**). For the higher and narrower a mainsail, the higher will be its efficiency.

The product of both results is:

### Rating Formulae for Mainsails and Foresails

Experimentally a new formula has been developed to find the right efficiency percentages or factors. The formula being introduced in Holland is:

$$\text{Efficiency\_Factor} = 0.67 \times \left(\frac{\text{msam}}{e^2}\right)^{0.3}$$

This formula gives results that hardly differ from those of the slightly different Australian OMR formula. The MYCQ (Multihull Yacht Club Queensland) uses the measured dimension **lpm**, not **e**, where **lpm** is the perpendicular on the hypotenuse in the right angle triangle formed by top, tack and clew. As **lpm** always is shorter than **e**, the factor they need is 0.65, a bit lower than the Dutch one.

The efficiency of foresails is calculated with a comparable formula. Based on the ratio **msag/ $lpg^2$**, where **lpg** is the perpendicular from luff to tack. **lpg** is also used to calculate the basic triangle area of jib or genoa. A new formula had to be sought, as crews have the opinion that big overlapping genoas are penalised with too high an efficiency under the old formula.

The formula now being introduced here is:

$$\text{Efficiency\_Factor} = 0.72 \times \left(\frac{\text{msag}}{\text{lpg}^2}\right)^{0.3}$$

Same power as the one used for the mainsail. The MYCQ uses the same factor and ratio also but their power of 0.298, as for the mainsail.

It does not make sense for us to copy their power value of 0.298.

The rated areas have to be calculated as illustrated below..

rsam = efficiency factor × msam_ex_mast + area mast (if a swivelling mast)

rsag = efficiency factor × msag.

For a staysail the rated area is calculated with the same formula as the one for jib or genoa.

## Free flying sails (sails, not connected to a forestay), Spinnakers and screachers

If smg / sf > 0.75 then the sail is treated as a spinnaker, and

rsas = 0.07 × (msas-rsag).

If smg/sf <= 0.75 the sail is called a screacher. Then:

rsascr = (0.82 –smgscr/sfscr) × (msascr-rsag).

This gliding scale formula was suggested by members of the rating committee of the Norwegian Multihull Association. But in Holland a reduction of rsag is included in the formula, comparable to the one of the Australians in the OMR. The factor 0.07 to rate spinnakers may be found to be too low now, because of the rsag reduction with the same 7%. After the rsag reduction, rsas on average is about 6% of msas, because spinnakers are relatively much larger sails than jibs.

The midgirth length of modern screachers often is not more than around 0.50 of the foot length. That is about the same ratio as with jibs and genoas. As screachers generally are smaller than spinnakers, the influence of deducting rsag is such that on average rsascr is lowered from a maximum of (0.82 – 0.50), by the formula, 32%, to about 20% of msascr.

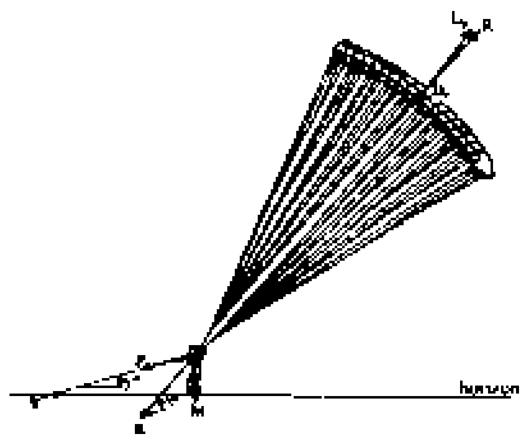
For open cats rsas = 0.15 × msas, combined with a variable reduction of a part of rsag.

The development of rating systems never ends!

*Under the Texel rating system, the Rated Sail Area (RSA) is the sum of the rated sail areas of the mainsail (RSAm), the jib or genoa (RSAg), any staysail (RSAst), spinnaker (RSAs) and screacher (RSAscr). These are related to the Measured Sail Areas (MSA) of their respective sails by the use of an efficiency factor. In the case of free-flying sails (spinnaker, screacher) only the extra sail areas they provide over that of the normal jib/genoa is important. There appears to be an inbuilt assumption that when these sails are flown the upwind sails are furled. For more information, see the Catamaran en Trimaran Club Nederland website, http://www.ctcnederland.nl/Pagina.php?parentpaginaid=7&paginaid=45 and the Texel rating site http://www.texelrating.org*

*Start of the Ronde on Texel. When you are dealing with these sorts of numbers, you need a reliable rating formula!*

# Why doesn't AYRS offer a Hagedoorn Centenary Prize?



Roger Glencross

2012 is the centenary of Professor Johan Gregorius Hagedoorn's birth. For those who have not heard of him, Prof Hagedoorn was the first (in or before 1975 [1]) to expound the idea of "Ultimate Sailing" – travelling over water suspended by a "kite" with the minimum of contact with the water. I should like to propose that AYRS use some of its monies to offer a prize to the first person to succeed in demonstrating in practice the Hagedoorn idea. As I am at present working on this project, I must declare an interest and not take part in the competition myself.

The reason for the slow progress in achieving the Hagedoorn dream is the small number of people working on it. Progress will be made when large numbers of unrelated teams put their minds to it. By approaching the problem from different angles the chances of success are increased. Einstein defined insanity as "doing the same thing over and over again and expecting a different result". Having been at it for forty-four years, I am stuck in a rut. Anyway, the winning craft may require athleticism, and therefore youth.

My Hagedoorn experiments have not absorbed much money, but time is money and a grant to a young inventor would enable him to take time off work and give the project the attention it deserves. Also, the hire of a heated workshop would enable him to work throughout the year. If I came into some money, I could not see any way of ploughing funds directly into the craft. I do not wish to use expensive exotic materials. It is much better to build prototype out of crude materials (within reason) because many changes are made and to do otherwise would be a waste of money. Sophistication can come later after the basic concept craft has flown. Nor would I employ a professional model builder. It is a cardinal rule of inventing that you should build your own models. It helps the thought process. Also, I have grave doubts as to the usefulness of models in an aerodynamic setting, because they work at different Reynold numbers as compared with full size. They can give false results, both positive and negative.

I would not employ a test pilot. It is much more embarrassing when you injure or kill a colleague than if it happens to yourself. Besides you would be handing all the fun over to him/her!

The inventor needs a motorised support boat with a qualified driver, and AYRS funds could help here. One of the problems with this project is all the waiting around, sorting out kite lines, waiting for the right winds or tides, so that when the moment arrives the support boat has gone off to assist some other experimental craft which appears to have more going for it. So a dedicated support boat and trained crew is essential.

The rules for the prize grant can be simple. The craft must be wind powered at all times, the pilot must be lofted into the air, the airborne pilot (not some winchman at sea level) must control the equipage, (don't reinvent parascending) it must start from rest (not necessarily on water) and there must be no stored energy other than what can be contained in the tension in the lines. Note there is no mention of a hapa. If the aquaviator can get away with towing a boat in place of a hapa then that is fine. The boat he tows can have a crew on it (but no engine). This crew can work the changes of tack or the craft can be untackable. Ground speed can be as slow as you like and there is no need to measure it. The winner is simply the first person to show daylight under the pilot's undercarriage. There is no minimum or maximum height requirement and ground effect "flights" are acceptable. However, momentary jumps are not treated as flights.
Once airborne the pilot should be able to stay up as long as the wind holds. Manoeuvring down any particular course is not required and he may fly any course he chooses relative to the wind direction, nor need the pilot specify in advance what course he intends to fly. Only third party insurance is required and no Certificate of Airworthiness, safety certificate, controllability, or proof of fitness for purpose is required. AYRS deny all liability….etc. etc.

So here are three areas where AYRS can help financially. First, it can offer a prize for the first successful Hagedoorn craft. This puts all the risk on the punter who may invest years of effort and fail to win. Second, AYRS can offer support boat facilities. This means the punter only gets help once he has built and launched his craft. Third, AYRS can provide the cost of heated building facilities and living costs. In this case AYRS takes all the risk, since the punter may fail to produce anything.
This risk can be lessened if payments are made by instalments and the punter produces a clear plan and time schedule and sticks to it. Lack of progress can lead to termination of payments. Unfortunately, invention is full of serendipity. You never know what is round the next corner.

Would the AYRS committee consider the above, please?

Roger Glencross

## Further reading

[1] Hagedoorn, *Ultimate Sailing*, Scientific American, March 1975.

[2] *Ultimate Sailing*, AYRS Publication #114, 1994.

[3] *Manned Kiting*, Dan Poynter

*Roger's testbed taking off (unmanned!)*

# Comment

by Simon Fishwick

To an outsider (such as myself) it is difficult to see what there is left to develop before achieving "Ultimate Sailing". After all, parascenders regularly achieve flight behind powerboats, why not behind an unpowered boat? As far as the kite is concerned, it is merely a matter of airspeed developing a force – either to lift or to lift and drive. However it seems it's not quite as simple as that.

In the first place is a small matter of safety, and of control. Parascenders are normally towed up, either by a truck or a boat, and their altitude is entirely dependent on the speed of tow. They have no (airborne) control over it. If they want to maintain a steady altitude, then the tow has to speed up or slow down as the windspeed varies. (Typically, parascending is done, I understand, straight into a wind of no more than 15 knots so that if the parascender is released or detaches the tow they land at a reasonably low ground speed to avoid injury.) An ultimate sailor needs to be able to control their own altitude.

The second problem is at the other end of the towline – the boat, or hapa or whatever. Although Roger suggests that a crewed boat may be used, I do not myself see much difference between that and parascending. Given a sufficiently intrepid aquaviator, prepared to fly in, say, a 30 knot wind, a suitable drogue should allow him to fly downwind at a few knots ground/waterspeed for as long as the wind was blowing hard enough. With a crew-steered boat, a similar technique should allow sailing on a broad reach as well. The man on the kite would merely be ballast (or payload).

For it to be regarded as true sailing, I think the aquaviator needs to be able to exercise some direct control over his craft, to be able to alter his course, to wear, or to shunt, to sail on a reach and maybe even to make progress to windward (the essence of all basic sailing qualifications) and return to their starting point. If they cannot do that then they are merely drifting at the mercy of the wind. The difficulty I see is that despite the work of Paul Ashford, Didier Costes, Robert Biegler, Theo Schmidt, Fred Ball, and Roger himself (to name but a few) there seems to be no fully-successful hapa or hapa-boat design out there that would work on either tack (or shunt) and could be controlled merely by moving the kite around the sky; they all seem to need some kind of steering or trim adjustment when they change tack or shunt. That could need a second pair of hands. (Maybe we should be thinking about tandem parascenders).

As an engineer, I look for numbers when thinking about solutions to problems, and as far as ultimate sailing is concerned I don't know any. It was relatively easy to find the maximum safe windspeed for parascending, but difficult to find what *minimum* airspeed is needed to get a parascender to rise. Nor does it seem to be easy to find out what control a parascender can have. They do conduct spot-landing competitions (tow up, release, land on a target) so some parascenders must have some kind of directional control, even if the commercial "off-the-beach" operators dare not permit it. Neither does it seem to be easy to find how much towline tension a parascender exerts (which is a measure of its lift/drag ratio and hence of aerodynamic efficiency), and which would give me an idea of how much force a hapa needs to resist. For that matter – can parascenders waterstart? I know they can launch from a run and from towboat decks, but can they actually take off from deep water (given enough wind)? The ability to do that would I know save Roger a lot of effort he is putting into developing a launch platform.

So though it may seem that the problems are essentially solved by parascenders, the remaining problems are unique to ultimate sailing, and are still looking for solutions. Any ideas?

# Sailing a Faster Course

## Hypotheses from a study of polar performance curves

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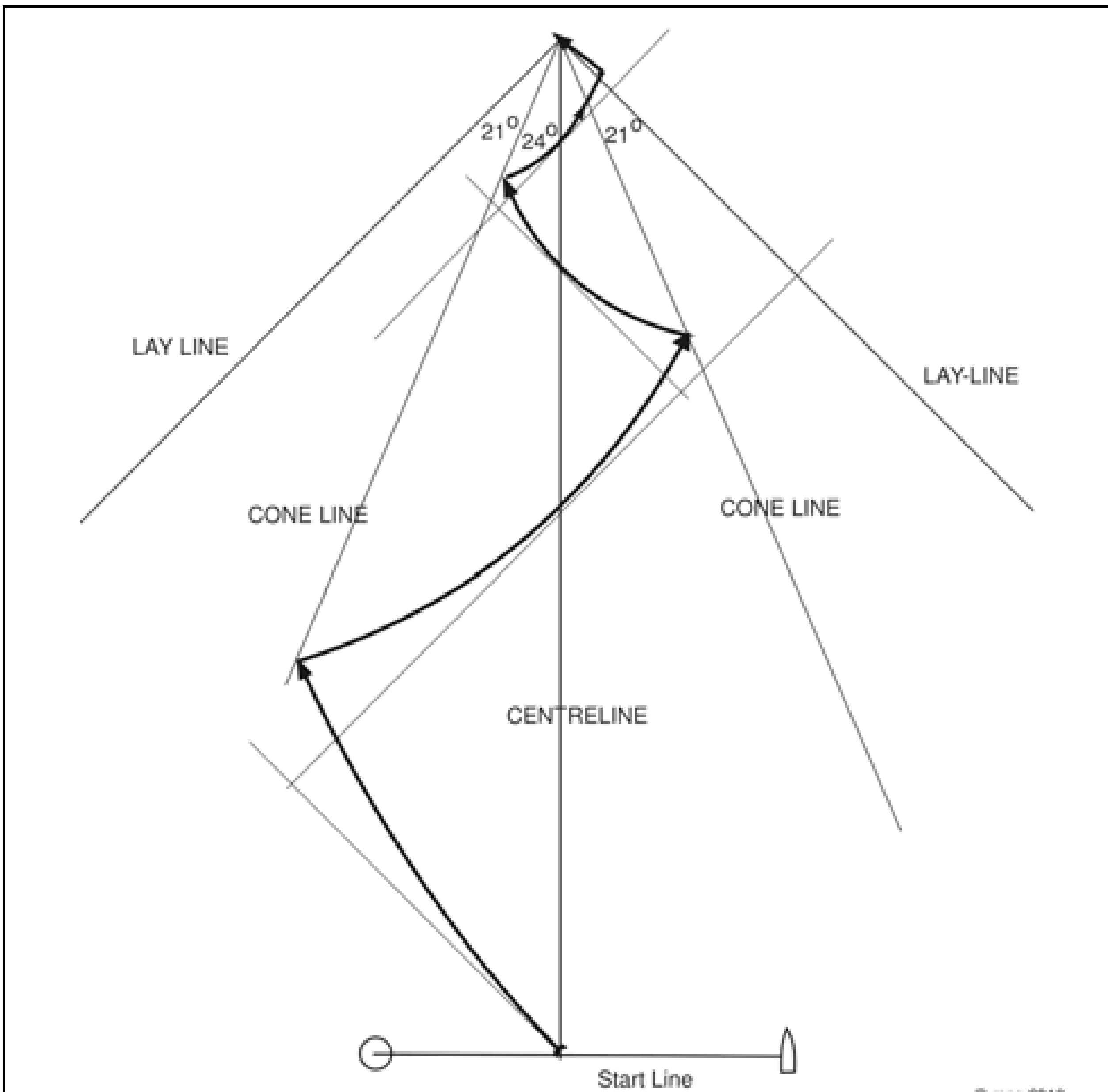
B.Sc. Naval Architecture (Durham), Dip M.B.A. (McGill)
National Judge, Canadian Yachting Association

*Wind is the Origin of Life* – Old Tibetan Saying



The Parts of this paper to appear in this and future *Catalysts*:

1. Explaining Performance Curves
2. Finding the Optimal Course to Target
3. Integrating Results to Whole Legs
4. Upwind Calculations and Practical Methods
5. Downwind Calculation and Unsolved Mysteries

## Abstract

The velocity that a sailboat travels towards its destination depends on a capability expressed by a polar performance curve for the wind, the angle of the boat's heading to the wind, and the angle between the wind and the direction to the destination. The velocity made good towards the destination, often is called "VMC" (along the Course) in offshore racing. It has complex roots, but can be established precisely for a given set of performance curves.

Study shows that fundamental theory published in sailing texts has been simplified excessively. This has been misleading, even to competitive sailors. This author examines traditional theory, provides corrected concepts, and seeks to illuminate the path to more precise results.

## Context and Purpose

Traditionally, sailboats have been raced by heading in directions relative to the wind, expecting then to set their optimum velocity. This set of papers makes the case that it will be faster to sail a boat in directions dynamically adjusted to the destination, and consequently that velocity will vary.

## Dedication

This work is dedicated to all, wherever they are, who find pleasure in working the wind on the water.

## Disclaimer

The arguments herein are developed for theoretical conditions of constant wind speed and direction. In practice, the expectation of changes in wind velocity may dictate a helming strategy based on those expectations. Such a helming strategy will not invalidate the findings of this paper, but can cause the application of them to be more stimulating.

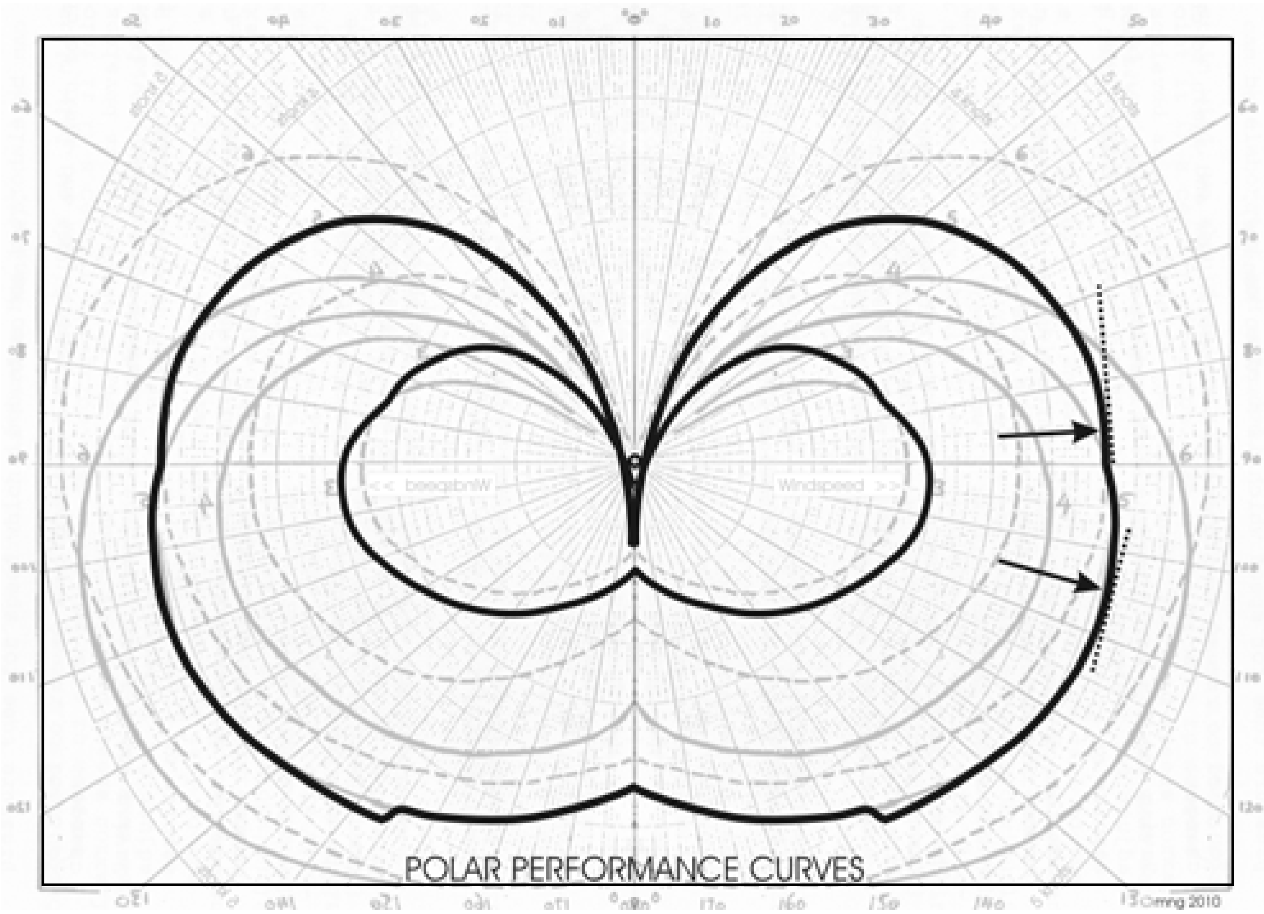
When compared with the variability of motion of a boat in a seaway, the potential gains from these methods may not be significant. In that case, though, this theory should stand, even if the calculation load does not justify its application in all circumstances.

The word "speed" is used when there is no sense of direction implied, while the word "velocity" implies not only speed, but also the direction of movement.

## Acknowledgements

I would like to thank my former wife, Margaret for helping with the recording, and to our children Debbie, Lynn and Tof who stayed out of the way while we did that. Also, for assistance with this script: Maurice Smith, Francis MacLachlan, Peter Schell, and Hugh Evans.

# Part 1 Explaining Performance Curves




## Original Performance Curves

Half a lifetime ago (or more, now over 40 years) I had experience in racing a Y-flyer and was starting to get into the idea of tacking downwind with successive gybes. It was in such a manoeuvre that my wife and I overtook #1 and #2 on the very last leg in Deep River to win the Red Fleet at the Canadian Y-Flyer Nationals in 1966.

This demonstrated a need to measure the velocity that a boat would go in each of its many directions. A Y-flyer is an 18 feet long scow, often home-built. As such, it was not a suitable platform to document this physical phenomenon.

My sailing platform didn't have to be large, and it didn't have to be expensive. It didn't need to be fast, but it did need to be stable and reliable, with enough working space to do the research and record the results. That was how I got to buy my Tanzer 22 – as a sailing office desk. A Tanzer 22 is a small cruiser with masthead rig, fin keel and spade rudder. So, in 1971, Tanzer 22 No. 40 was purchased and named "Mindemoya". This boat then had a Miller Genoa and a Miller cross-cut spinnaker. Now having upgraded to a tri-radial spinnaker, I expected higher reaching speeds.

The readings were taken mostly on the head pond of the Carillon Dam on the Ottawa River. This is an area without significant current and surrounded by open farmland, without trees. Because the Carillon Lock has a 65 foot lift, it will be evident to you that the head pond is a good-sized body of smooth water with consistent wind.

Throughout the work, our measurements were quite crude. We had water climbing up a pitot tube to measure boat velocity. I held that tube over the side (with one hand) while steering with the other. I put it in the stream half way up the front of the stern wave. The racing compass was used to measure the boat's heading, after taking the wind direction at the top of our run, while we were head-to-wind. A small pith ball in a tube was used to measure the wind velocity, the airflow lifting the ball in a plastic tube. I realised that one day, there would be instruments for such things, but we had never seen them. And, in any case, bringing up a young family, we didn't have the budget to equip ourselves in such a fancy way.

With those basic tools we took about 250 separate readings. These were plotted out. The initial plot for each wind-speed was done on squared graph paper to smooth the readings and eliminate errors. After getting a set of faired lines, the results were transferred to polar graph paper. The resulting curves, as in Figure 1, were published in Tanzer Talk in Volume 21 in January 1975.

Figure 1 shows the curves as published by the Tanzer 22 Class Association.

The dotted lines show the velocity that the boat would go carrying genoa and mainsail for each direction relative to the wind. The solid line shows the same for spinnaker and mainsail. The large numbers in the body of the curves are the wind speeds 3, 4, 5, 6 knots. The curves surging out from the origin represent the distances travelled by the boat in a unit of time: i.e. the boat velocity in knots. We also developed curves for the working jib and mainsail, and using the "double-slot" with spinnaker, genoa and mainsail. Those will not be examined here.

The curves are for a boat on port tack. A mirror image is applicable for boats on starboard tack.

Someone at North Sails in Toronto got wind of this, and I was invited there to give a presentation at the time. The whole idea was new to them, then. Rare at that time, such polar curves are relatively common now. They are mostly to be found for racing boats that have enough surrounding moolah to spend on getting the figures. The technology has become the order of the day. It seemed like I was ahead of my time.

The reason that "polar" plotting of performance curves has become of so much interest is that they present graphically the answer to whether it is better to sail faster over a greater distance or better to sail slower over a shorter distance. Sailors want to know if there is some happy middle ground (some "happy medium" direction) where fastest overall time can be achieved. When one plots speed against direction on squared graph paper, the idea of direction is not apparent. In polar paper, (nothing to do with white bears, but paper where the printed grid lines radiate out from a centre), points are plotted by speed and angle. This conveys an immediate understanding of the speed that a boat will go in any of the various directions, and how those directions relate to each other. It only remains to define which direction the wind is coming from. We usually use the top.

More recently, Velocity Prediction Programs have been written for computers, and results published, notably by US Sailing and Farr Yacht Design. Such predictions get verified by testing in experimental towing tanks, but are subject to approximations made during the programming. No-one programmed the curves we will use here, therefore even if a little rough, they do have a certain independent purity.

The Tanzer 22 does not have a planing hull. It becomes limited by hull speed fairly early. Therefore the use of these curves in developing sailing theory may be conservative.

The author suspects that navigators on board America's Cup yachts and Volvo Ocean Race winners will have determined for themselves what these papers set forth. Nevertheless, we can all benefit from a re-consideration of some basic elements. The findings should be of particular interest to companies that manufacturer navigational instruments, both of the installed and the portable variety.

### Eureka moments

Since that publication in the Tanzer newsletter, I have enjoyed three major break-throughs in my understanding of this subject. That is, three "ah-ha" moments have brought new insights. And now, there is a fourth insight. This new insight (developed in Part 2) appears to be of major significance. It is the driving force behind the preparation of these papers. We are making progress!

What were the earlier excitements?

## Ah-ha #1: The Cusps

Cusps are indentations, often like an estuary is shaped in a coastline. We will be using this word a lot.

It is clear that the cusp at the top of the performance curve explains the way sailors tack upwind. You cannot achieve any velocity heading directly upwind from the origin, instead, if you try, you will be blown backwards. Some working in this field, don't even understand this (Reference 1-11, paragraph 0034). "Lift" or forward force cannot be obtained from sails without the sails being at an angle to the wind – we say there must be a sufficient

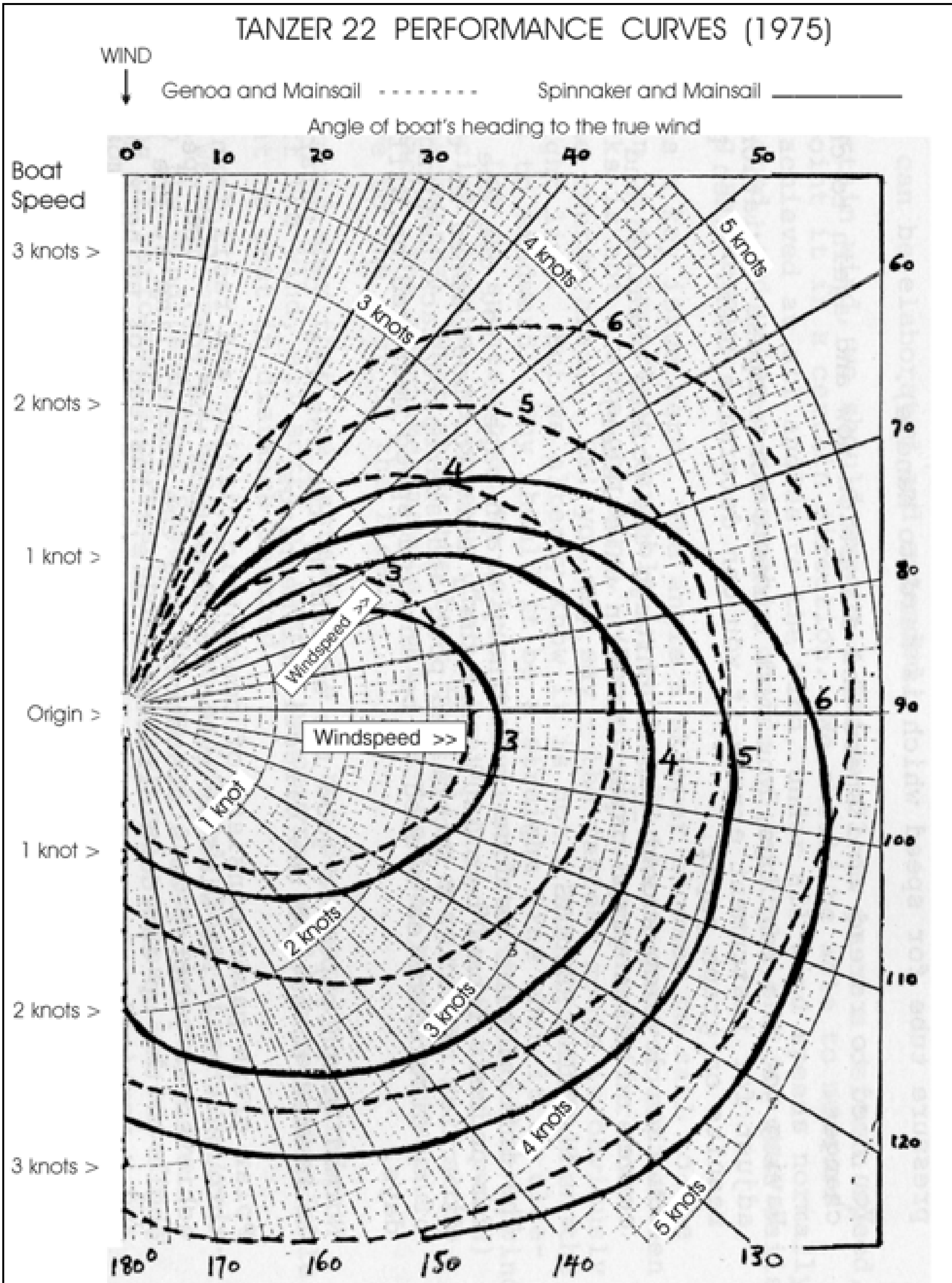
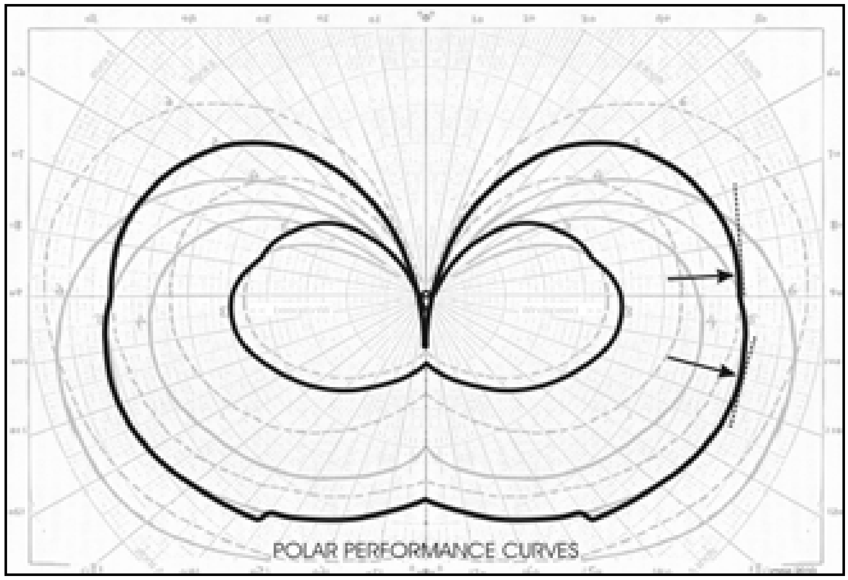



FIGURE 1 - SPINNAKER AND GENOA CURVES




angle of incidence. The minimum angle is between 16° and 20° (Ref 1-1, figs 82 and 83). Therefore you have to sail off to the side and then sail back to work your way up against the wind. That is the only way.

There is a similar, though less pronounced, cusp downwind (at 180°). The curves show clearly that a boat will suffer a reduction in velocity if she tries to head directly down wind. There are three reasons for this, which the reader will find explained in Ah-ha #2, below. The downwind cusp shows that tacking downwind is desirable, a process not unlike going upwind. To some, it is interesting to determine the actual angles. Not only did we have evidence from the Deep River experience, but even in the mid 1970s (Montréal Olympic Games) we noticed that Tornado catamarans tacked downwind all the time. So it was becoming clear that between any two cheeks of the curve, there would be a sector within which it would not be profitable to aim.

It is an anomaly of sailing terminology that one "tacks" upwind by "*tacking*" (changing sides) but one tacks downwind by "*gybing*". These words are equivalent.

In studying the curve carefully, you may notice that a different kind of cusp exists near the arrows between 80° and 100°. This is because two different sails are involved. The upper curve applies to a genoa jib with a mainsail. The lower curve applies to a spinnaker and mainsail. The two curves join at an angle. The cusp then lies between the *vectors* from using a genoa and those from flying a spinnaker. Oh, Ho! What does that mean?

Wallace Ross (Ref 1-5) recognizes these cusps on his page 427 but does not draw any helming lessons from them. Sailonline.org and the companion website -sailplanner.net- (Ref 1-9) pretend they do not exist.

I first experimented with this theory when sailing the Lieutenant-Governor's Cup in the Gulf of St. Lawrence in 1972. Here, crossing the shipping lanes on a lovely morning, we got confirmation that there was a potential benefit for the boat, given the right conditions. We could sail up a little with the genoa, and then sail down a little with the spinnaker. So we tried that. It seemed to work. In both cases, the sound of the bubbles from the bow was better than when trying to sail between those two directions. We were heading south towards Matane where the finish line lay.

Later, in 1992, the wind was just right to use this method seriously in a 200 boat fleet. This was at a Hudson Yacht Club annual Labour Day regatta.. A Soling, finishing just behind us in the Long Distance Race, queried what we were doing "up there". We had sailed along a shoreline, dipping into the bays to take advantage of the reverse eddy currents. We flew the spinnaker going into each bay. Then we switched to the genoa to climb out and round the next headland. Everything was going well for us! The wind and the eddies in the water both lent us speed.

That confirmed, if the angle was right, it would be faster to travel close with the genoa, and alternate that with travelling loose with the spinnaker. It would indeed be better than hoping either sail could handle the slow part in between. This Ah-ha was a success.

## Reference

The second insight occurred when it became a suspicion that the curve at the bottom might not be smooth. Sailing down at 180° everyone realizes now is slower than reaching off, gybing and then coming back. Reaching off is faster because a) the wind flows over the mainsail, developing suction or lift, rather than simply pressing on it; b) the spinnaker and mainsail present a larger projected area to the wind; and c) the apparent wind velocity (both angle and pressure) are changed beneficially by the boat's direction of travel.

Various authorities have started to tame these ideas by publishing a set of "target boat speeds" for each design at each wind-speed. Getting pre-calculated data is an approach that does not require laborious work on board with a compass and a wind metre.

In Case (a) – laminar flow – when the flow breaks down into turbulence, the power from aerodynamic lift is lost. It would be useful to find out whether this breakdown is something that develops gradually and progressively across the sail, or is there a sudden collapse of lift? Does this depend on the camber of the mainsail? Is there, in effect, a cliff edge (at "P") over which one would fall? Having fallen, does one then head up, overcompensating, in order to re-attach the flow (at "Q"); get the airflow back; then the boat velocity, then progressively head down to P again? Once the velocity is back, then the apparent wind angle is more favourable, and there is a certain stability, at least for a while. The technical term for this type of loop is "hysteresis".

The polar curves that this author has seen suggest that such a cliff edge may indeed exist, though it is never shown. There is support for the idea in these words by Honey and Teeters (Reference 1-10): *"This can be a stable state and the boat can stay at target TWA, but continuously sailing far too slowly, and never accelerating to the downwind target speed. So, when steering to target TWA, the helmsperson needs to watch the target BS and be sure to sail hot of target TWA until the boat-speed reaches the target BS, and then bear off to target TWA."* [Note:- TWA = True Wind Angle, BS = Boat speed.]

Those who publish curves from measurements may be eliminating the cliff on the basis that it seems to represent an incorrect charting of their readings. Those whose curves were programmed may never think to put it in. So this "Ah-ha" supports the idea that most published performance curves are not accurate at this most critical point.

This is a particularly important issue because, if the diagram is correct, P may be at the best angle to sail downwind over quite a wide range. Heading below P you would simply fall off the cliff.

To assist you in assessing this when on the water, the apparent wind angles "AWA" in figure "A" are shown around the edge for each 10 degree point in the curve. I have included the figures for 145° that show that this direction "sees" 100° apparent, an angle where you should look for some air flow instability. You may notice your wind vane fluttering erratically in the tip vortex at the masthead. Please write me if you can confirm or disagree with this phenomenon. (mng@kingston.net) .

The angle of 100° is supported by noting that the *shrouds* are mounted at 95°. These limit the camber, especially with *spreaders*. Optimum *lift* from a 10% *cambered* sail occurs at 15° angle of incidence of the *chord* [Reference1-1, figure 83]. Marchaj shows that with this amount of *camber* there is rapid fall-off of lift when the angle of incidence rises to 20°. Such a sail then appears to lose its *laminar* flow abruptly.

A downwind cliff edge would not exist in square riggers or boats with *junk* rig because the leeward shrouds do not impede the rotation of the yards. In Catalyst January 2010, Slieve MacGaillard reported sailing his junk rig around the Isle of Wight, and notes particularly its relative success downwind.

Items (b) – increased projected area – and (c) — apparent wind improvement – are both smooth, progressive transitions. It is unlikely that any error has crept into curves on account of those.

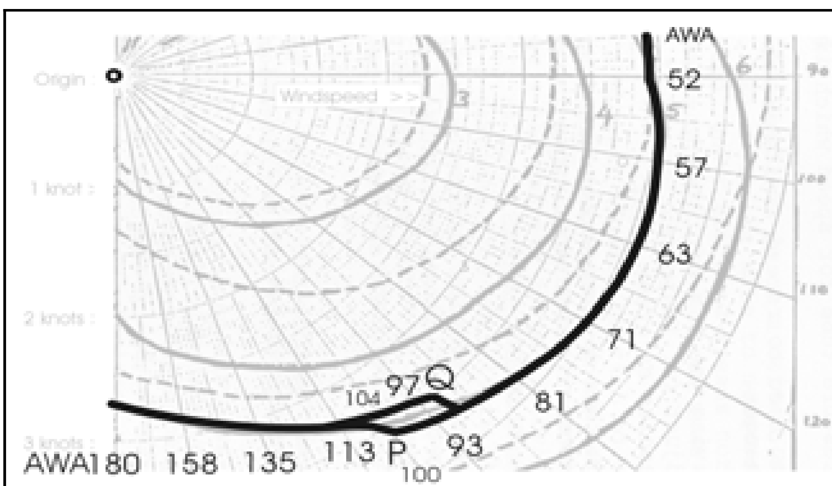



Figure A - MAINSAIL STALL THEORY

mng 2010

## Ah-ha #3. The giant airfoil

We encounter this issue from consideration of the slot. Skippers used to tell me that "You have to get the slot right". I never understood what this slot was all about. It seemed to be simply the space between two sails and appeared to be constricting the flow over both of them.

Some authors claimed that the jib was significant because it added the slot, and this increased the airflow over the mainsail, making the mainsail more efficient. Others claimed that most of the work was done by a genoa: Adding a mainsail was valuable, because it increased the flow of air over the genoa! Colin Mudie writing in AYRS Catalyst 28 (Ref 12, page 16) discusses the importance of the slots between the sails on square-rigged ships.

From seeking the truth through consideration of the performance curves, there emerged an understanding that two sails work together to create a *virtual airfoil* that is larger than either of them.

In this interpretation, the jib sets the line of the lifting area at the "upper" (leeward) front of the airfoil, while the mainsail sets the shape of the "lower" (windward) face of the airfoil, aft. The two sails together force the air to respond to the virtual airfoil shape that the sails have defined. This airfoil expands the effective area beyond the boundaries of the cloth. Sails that do not align properly for the airfoil (including the twist at each level up to the masthead) are not working efficiently together.

It is easily possible to draw the shape of these virtual airfoils. To do that requires that the alignment of the sails be appropriate. Thereupon we will find that, when close-hauled, the airfoil is slim and powerful, and when running, the airfoil is short and stubby. These shapes conform to the configurations dictated by the apparent wind velocities.

In the airflow around the foil, some goes the long way around and some goes the short way across. Some of the air gets "stuck" and doesn't initially go either way. The point at which this happens is called the "Stagnation Point". On these sketches I have marked the stagnation points with +. Notice that both these stagnation points are well away from any sailcloth.

As drawn, these diagrams indicate that telltales along the trailing edge of the mainsail would be streaming. If both sails were sheeted in tighter, then the trailing tip of the airfoil would move forward to the end of the main leech.

I leave it to you, the reader, to draw your own illustration of the reaching airfoil. Then you will find that thinking about these giant virtual airfoils helps you trim your sails better. That will make you go faster.

And next is the fourth insight. It is called Ah-ha #4 - VMG (Target). This subject is developed in "Sailing a Faster Course" Part Two.

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Ontario, K7L 4V1

Revised to 10 04/28

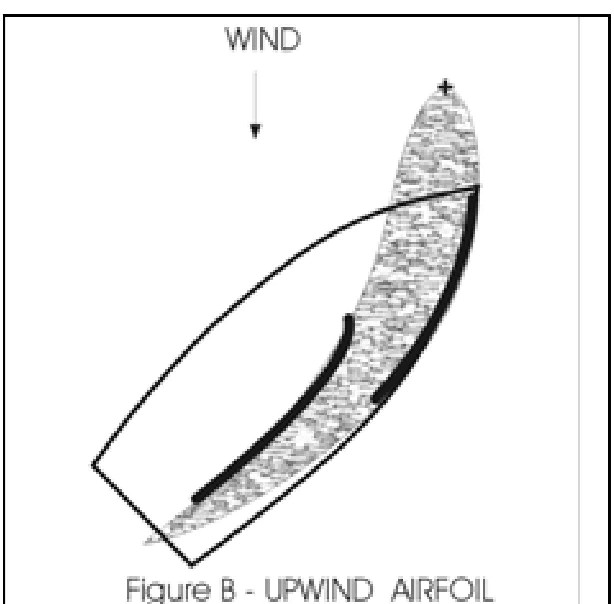


Figure B - UPWIND AIRFOIL

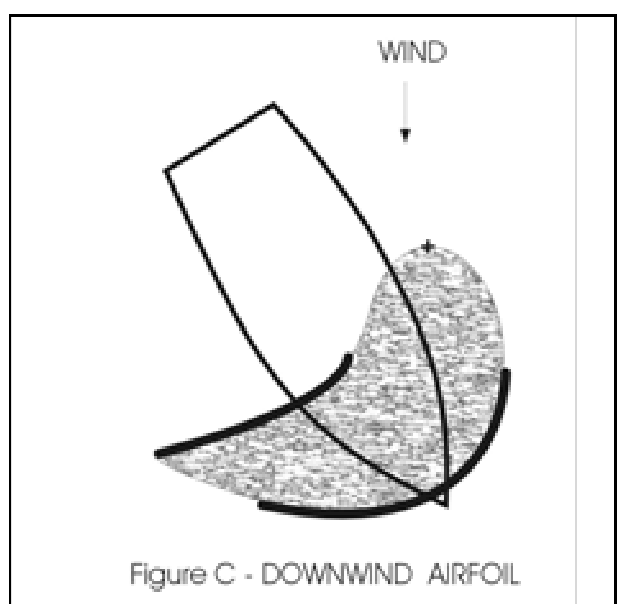


Figure C - DOWNWIND AIRFOIL

## References for Part 1


1-1 C.A. Marchaj. Sailing Theory and Practice Dodd, Mead, 1964
1-5 Wallace Ross "Sail Power" Alfred Knopf, New York, 1975
1-9 sailplanner.net. A Swedish web page offering computer-simulated sailing.
1-10 Stan Honey and Jim Teeters. "Get your performance on Target" Sailing World, June 2008 - http://www.catalina320.com/filemgmt_data/files/Sailing%20World%20Polar.pdf
1-11 Craig Summers Application for US Patent 2009/0287409. November 19, 2009
1-12 *AYRS* Catalyst No 28. July 2007


## Glossary

| | |
|---|---|
| AWA | Apparent Wind Angle. The direction, measured from the boat's bow, from which the wind comes. |
| CORK | Canadian Olympic-training Regatta at Kingston. A regatta-sponsoring organization. |
| Chord | The line joining the leading and trailing ends of a curved arc, such as a sail. |
| ISAF | International Sailing Federation. An organization concerned with developing sailing as a sport. |
| Junk | A Chinese design of sail that is used on an unstayed mast. |
| Ishkoodah Cup | A competition on Lake St. Louis near Montreal that predates all yacht clubs in the area. |
| Laminar flow | Airflow over a sail without turbulence, eddies or vortices. |
| Lift | The side force generated by an airfoil in the presence of laminar flow. |
| Virtual airfoil | An airfoil that is sensed but which may not be real. |

### About the Author

Michael Nicoll-Griffith has spent much of his life along the waterfront. He has owned one or another sailboat for over 60 years. He became owner of his father's 12' dinghy when 18 years old, and kept her for some years at Hamble, Bursledon, and Weston Shore in Southampton. At that time, he was a student member of Royal Southern Yacht Club and apprentice Naval Architect with John I. Thornycroft & Co., Woolston.

Educated as a choirboy at Pilgrim's School, Winchester, he had attended Marlborough College and gone on to a degree in Naval Architecture from King's College, Newcastle. On emigrating to Canada in 1954, Michael's first task was the design of the hull piping for a major icebreaker, the Louis S. St.Laurent, still in service in the Arctic.

Starting in the late 50's he sailed a Great Lakes scow design, a "Y-Flyer" on Lake St. Louis, just West of Montreal, winning some prestigious trophies, such as the *Ishkoodah Cup* dating from 1897. In 1971 with a young family, he cruised and raced his Tanzer 22 "Mindemoya" in Newport, Rhode Island, and the Gulf of St. Lawrence, winning the US National title as well as the Lieutenant-Governor's Cup for the Province of Quebec. He remains a formidable competitor in the same boat he has owned for 40 years, and which is the subject of this article. He was five times North American Champion of the Tanzer 22 Class.

Now retired, he lives in Kingston, Ontario. This is the home of the largest fresh water sailing regatta in the world. This was the site chosen for the sailing events of the Montreal Summer Olympics in 1976. Nowadays, the *CORK* organization (www.CORK.org) holds Olympic trials, numerous World and Continental Championships, and included the *ISAF* World Youth Championship in 2007.

His waterfront activities have included acting as President of the St. Lawrence Valley Yacht Racing Association and Commodore of the Pointe-Claire Yacht Club. Michael chaired the Protest Committee for the Marblehead to Halifax race in 2007. He has also judged the last three runnings of the international Route Halifax-St.Pierre.

The movement of vessels, their wakes and wave-making, as well as the performance of sails in wind have long fascinated him. This set of papers has been assembled after extended periods of reflection starting in the Solent and finishing on the lakes, rivers, harbours and estuaries of Eastern Canada and the United States.

# *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**

## April 2010

**21st – 23rd Marine Renewable & Offshore Wind Energy**
RINA Conference, 10 Upper Belgrave St, London SW1X BBQ. Details from conference@rina.org.uk.

**25th Beaulieu Boat Jumble**
The National Motor Museum, BEAULIEU, Hampshire, UK. AYRS will be there!

## May 2010

**10th—15th Boat trials, Weymouth**
Location to be determined (not Castle Cove this time but somewhere else in Portland Harbour). We expect to have facilities for making drag measurements on boats if there is no wind. Contact: Norman Phillips email: wnorman.phillips@ntlworld.com; tel: 01737 212912.

**28th – 31st *Broad Horizons* – AYRS Sailing Meeting**
Barton Turf Adventure Centre, Norfolk UK, NR12 8AZ. Contact AYRS Secretary AYRS Secretary, BCM AYRS, London WC1N 3XX, UK; email: office@ayrs.org. Note: All boats limited to 1.2 metre max draft!

## June 2010

**4th – 6th Beale Park Boat Show**
Beale Park, Pangbourne near Reading, UK. Open-air boat show with a number of boats available to try on the water. AYRS will be there again, selling publications. Contact: Fred Ball, tel: +44 1344 843690; email frederick.ball@mypostoffice.co.uk

**30th - 1st July Innov'sail 2010**
Second International Conference on Innovation in High Performance Sailing Yachts, Cité de la Voile Eric Tabarly in Lorient, Brittany, France. Organised by RINA, IRENAV and the Ecole Navale Francaise. See http://www.rina.org.uk/innovsail2010

## October 2010

**16th – 22nd Weymouth Speedweek**
Portland Sailing Academy, Portland Harbour, Dorset UK. See www.speedsailing.com.

**20th *Speedsailing* – AYRS Weymouth meeting**
19.30 for 20.00hrs at the Royal Dorset Yacht Club, 11 Custom House Quay, Weymouth. Location Map: www.rdyc.freeuk.com. Contact: AYRS Secretary, BCM AYRS, London WC1N 3XX; email: office@ayrs.org

## November 2010

**6th *Your Projects* – all-day AYRS meeting**
9.30am to 5pm, Thorpe Village Hall, Coldharbour Lane, Thorpe, near Staines & Chertsey
Bring your lunch - tea and coffee available. Donations invited to pay for the hall. Details from Fred Ball, tel: +44 1344 843690; frederick.ball@mypostoffice.co.uk

**27th NW UK AYRS Group Meeting**
12 the Boleyn, Lydiate, Merseyside. L31 9TP. Contact: Mike Howard for details Tel: 0151 531 6256; or email: ecotraction@aol.com

## January 2011

**7th – 16th London International Boat Show and**
**13th – 16th The Outdoor Show**
EXCEL Exhibition Centre, London Docklands. AYRS will be there. Helpers are wanted to staff the stand, sell publications and recruit new members. If you would like to help (reward: free ticket!) please contact the Hon Secretary on 01727 862268 or email office@ayrs.org

**29th All-Day AYRS Meeting**
9.30am-4pm, Thorpe Village Hall, Coldharbour Lane, Thorpe, Surrey (off A320 between Staines and Chertsey – follow signs to Thorpe Park, then to the village). Details from Fred Ball, tel: +44 1344 843690; email frederick.ball@mypostoffice.co.uk

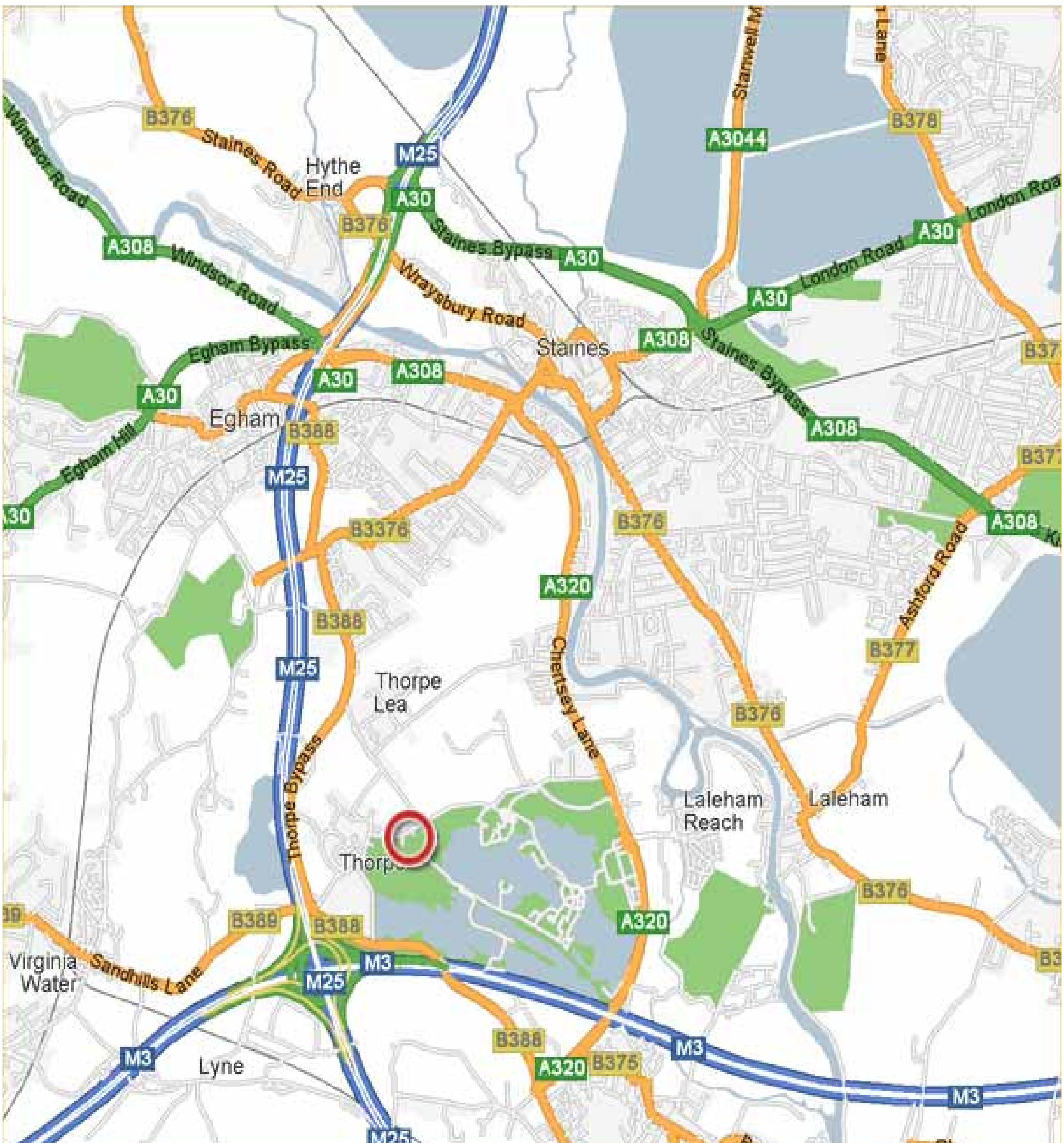
**29th AYRS Annual General Meeting**
4pm, Thorpe Village Hall, Coldharbour Lane, Thorpe, Surrey (as above). Details from the AYRS Hon. Secretary tel: +44 (1727) 862 268; email: secretary@ayrs.org
Note: Items to be considered by the AGM, including nominations for the Committee MUST be received by the AYRS Secretary before 22nd December 2010 (post to AYRS, BCM AYRS, London WC1N 3XX, UK, or email: secretary@ayrs.org)

# How to get to Thorpe Village Hall, TW20 8TQ

(for the meetings on November 6th & January 29th)

By car: From M25 Junction 13, go South on the A30, and take the B388 into Egham. Continue on the B388 until Ten Acre Lane where turn left, . Continue on Ten Acre Lane until the end, turn right into Coldharbour Lane and the Village Hall in on your left after 70 yards.

From M25 Junction 12: Take the A317, then A320, following the signs for "Thorpe Park". Go past Thorpe Park and turn left into Norlands Lane, signed "Thorpe Village Hall". Continue for a mile onto Coldharbour Lane and the Village Hall will be on your left, 50 yards after the width restriction.



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

## On the Horizon . . .

Sailing a Faster Course - further parts

The Dolfin Project

The UCD Robo-Boat

More sources and resources ...

**Amateur Yacht Research Society**
BCM AYRS, London WC1N 3XX, UK

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