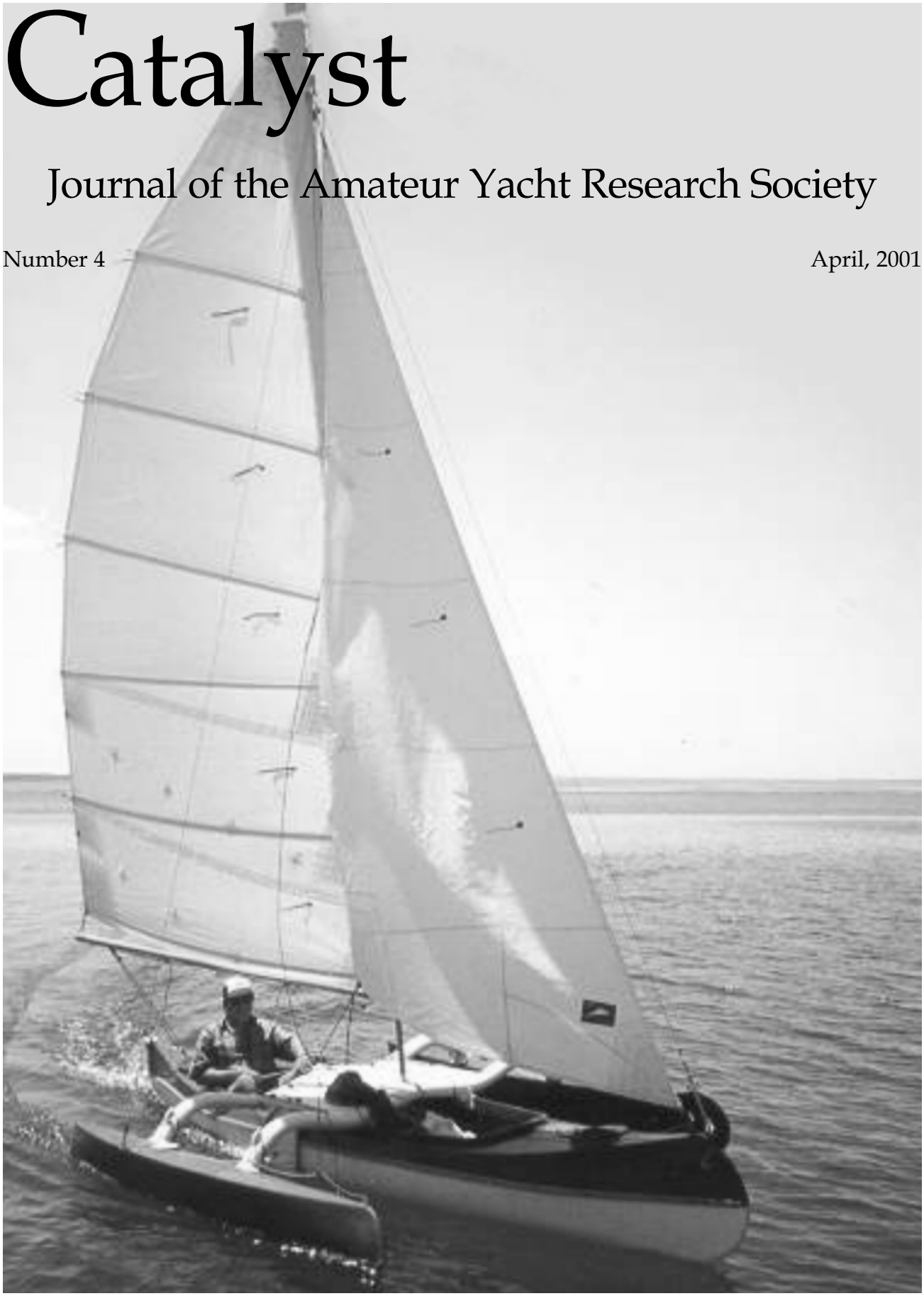
Catalyst

Journal of the Amateur Yacht Research Society

Number 4 April, 2001



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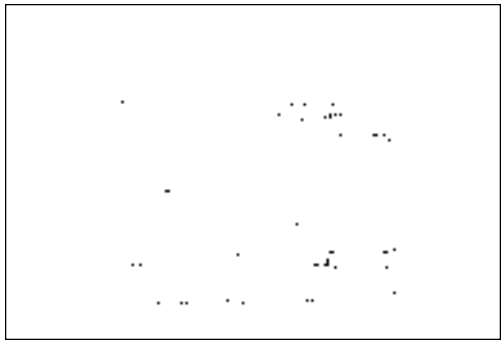
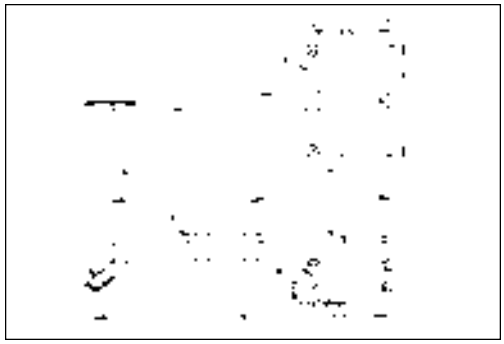


On the Cover –

Chris Evans' Trimaran Canoe *Sunshine.*

Photo: Gabriele Koegel.



Catalyst

Journal of the
Amateur Yacht Research Society

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Contributions are welcome from all. Email them to **Catalyst@fishwick.demon.co.uk**, 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.

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Alastair Stewart, 1940 - 2001

AYRS wishes to announce the death of Alastair Stewart, in January of this year, following a short fight against cancer.

A long-time AYRS Committee member, noted especially for his habit of telephoning other committee members in the middle of the night to discuss AYRS business, Alastair was never among the "generals" of the Society, but was always at the front of the troops when anything needed doing. A bachelor of independent means, he had a house full of odds and ends collected over the years, and a 26ft Eventide cruiser in similar condition, to which he would invite his friends for a weekend sailing (and to help scrub the bottom), and which his will has directed be sold and the proceeds given to the Society.

Willaim Alastair McCombe Stewart was born in Larne, Co Antrim, N Ireland, the second son of a school headmaster. At university, he read medicine, and crashed sports cars. His long and varied career involved periods with the British Army (where he held the rank of Major), an executive with NCR, a schoolteacher, and a financial consultant. An extremely talented bridge player, and a long-time member of MENSA, he joined AYRS at the London Boat Show having for a number of years wondered what we were about. He later lamented that he had not joined earlier. His enthusiasm earned him a place on the AYRS Committee where he delighted in helping organise the Boat Show!. His especial talent was cajoling others to undertake tasks they would not otherwise have done, using as his main method the long late-night phone calls!

His lively mind also took a particular interest in "leading edge" developments and inventions, and he was a supporter of the (London) Hampstead Engineering Society.

Definitely an "AYRS eccentric", a loyal friend and a good, though frequently maddening, companion, he is already much missed.

SNF, GGWW

Fred Ball's Workshop

Shortly after the London Boat Show, Fred Ball arranged an informal all-day get together just outside London, where ideas could be discussed and results talked over. He felt, to my mind correctly, that this is the sort of thing that could be run in any area where there are enough AYRS member s to sit round a large table. All it needs is for someone to organise it. So he organised it. These are my notes on the speakers.

Mike Berry

Mike is tall, around 6ft 8 (2m0) I would guess, and he can't find a boat that he can afford that is big (tall) enough for him to fit in. Even so, tall boats have lots of windage, so he needs to develop something with low windage but lots of space/height. He has built a 4ft (1.2m) long model, and is now finishing a 15ft (4.5m) version (still a model) with 5ft (1.5m) of headroom. It's a narrow catamaran, with a streamlined cabin that itself is designed to generate drive.

The rig will be complex, using jibs set on swinging bowsprits, and a loose-luffed mainsail with the clew on a sliding track. The idea is not only to trim the sail, but also to position it so that the interaction with the cabin top enhances the sail drive.

At the moment, the 15ft version is not launched, but should be this year, after which we look forward to more reports on this project.

Martin Armstrong, SP Systems Ltd

SP Systems not only manufacture epoxy and other resins and reinforcement materials (prepregs etc), but they also provide a technical advisory service on their use and will even design and prototype composite materials to meet your specifications. They are regarded as one of the UK's skill centres on composite technology, and were consulted on the design and repairs to Team Philips etc. (Martin works on that side of the company). They have an extensive website of data <www.spsystems.com> and produce a booklet (the Guide to Composites) and data CDROM to back it up. They can be obtained through the website or by email to <marketing.services@spsystems.com> or telephone +44(1983)828000.

Martin's talk was supported by the booklet, so I will not attempt to report it in detail, but refer readers to that. The notes I made were to emphase certain points for my memory - like the difficulty of bonding to honeycomb, the advantages of Corecell over cedar (just as easy to use, and a better material being more even in its properties), the usefulness of vacuum bagging as a means of obtaining high fibre-resin ratios (a figure of 70%:30% I have seen mentioned), the difficulty of vacuum bagging with honeycomb core as it traps air (possibly Team Philips' problem?). Other points concerned the usefulness of pre-preg systems (which SP make), especially in achieving low-resin ratios; and a note of a rule of thumb that a 10°C increase in temperature reduces resin working time by 50%.

James Crafer

James had brought his large (6ft, 1.8m?) model trimaran, with its lowerable wingsail rig, and expounded the benefits of model making as a way of solving problems. (See his article later in this issue)

John Perry

John was expected to bring his boat, however he did not realise this and all he brought was the mast - a stiff sickle-shaped needle of carbon fibre tube, which allows him to set a standard sailboard sail in a balanced rig. His hull is 16ft (4.8m) long, thin, with a foil under the bow and another under the quarters. It has wings on each side from which John trapezes. The rear foil takes 80% of the weight and sideforce, and also steers the craft. John has raised it to its foils a few times but not for long, the balance problem tends to defeat him.

Bob Downhill

Finally Bob gave us a preview of the results of the drag trials he has been conducting as a side activity at Weymouth Speed Weeks, trials which are not yet finished, and which he says he will not write up for Catalyst until they are! I was not able to copy his graphs, but I did note figures of around 60lbs (27kg) drag for Calliope (on foils) more or less constant over a speed range of 11 - 15 knots, A Rave needing 120lbs (54kg) at 8 knots, the "Dutch Monohull" from Speedweek 1999, having a drag plateau around 30lb (13kg) between 6 and 8 knots and the Wheelie which reached a drag peak as 6 knots of 60lbs (27kg), which reduced to 45lb (20kg) at 8 knots, then climbed again to 60lb at 12 knots. The Foiler 21 has a similar 17lb (7.5kg) plateau between 3-4 knots, increasing at higher speeds, and Slewcat's drag peak is at 6 knots (25lb, 11kg) falling off gradually to 23lb (10kg) at 8 knots. Bob also has figures for a 49er, taken by George Chapman, but I was unable to note these.

Bob then went on to talk about the boat he is building and intends to sail himself in this year's Speed Week. He refers to it as a "garage door". It is a flat elliptical hull, obviously intended to plane easily, beneath which are a set of hydrofoils for higher speeds. The rig is a staggered bi-plane like Icarus 2 or the Trifoiler. We look forward to seeing this too.

AYRS would like to thank Fred Ball for organising this day, which was held in a district hall close to London's orbital motorway - a handy means of access for many attending.

Simon Fishwick

Winds of Change 2001

– A Rally for Innovative Water Craft – 17th-19th August 2001

Royal Harwich Yacht Club, Woolverstone near Ipswich, UK

Following the success of Winds of Change 2000 we were asked by several happy participants whether this could become an annual event. Well here we go again - "Fools rush in where angels fear to tread", or is it "Nothing ventured, Nothing gained?" We have booked the excellent - one could say unsurpassed venue of the Royal Harwich Yacht Club situated with its lawns sweeping down onto the banks of the picturesque River Orwell (in Suffolk by the way not Essex as some would locate it!) for **FRIDAY 17TH, SATURDAY 18TH AND SUNDAY 19TH AUGUST 2001** for our second rally. Inventors, entrepeneurs, eccentrics, we aim to attract those among us who have new ideas or have had a re-think of an old idea or a project maybe sadly neglected that deserves to see the light of day.

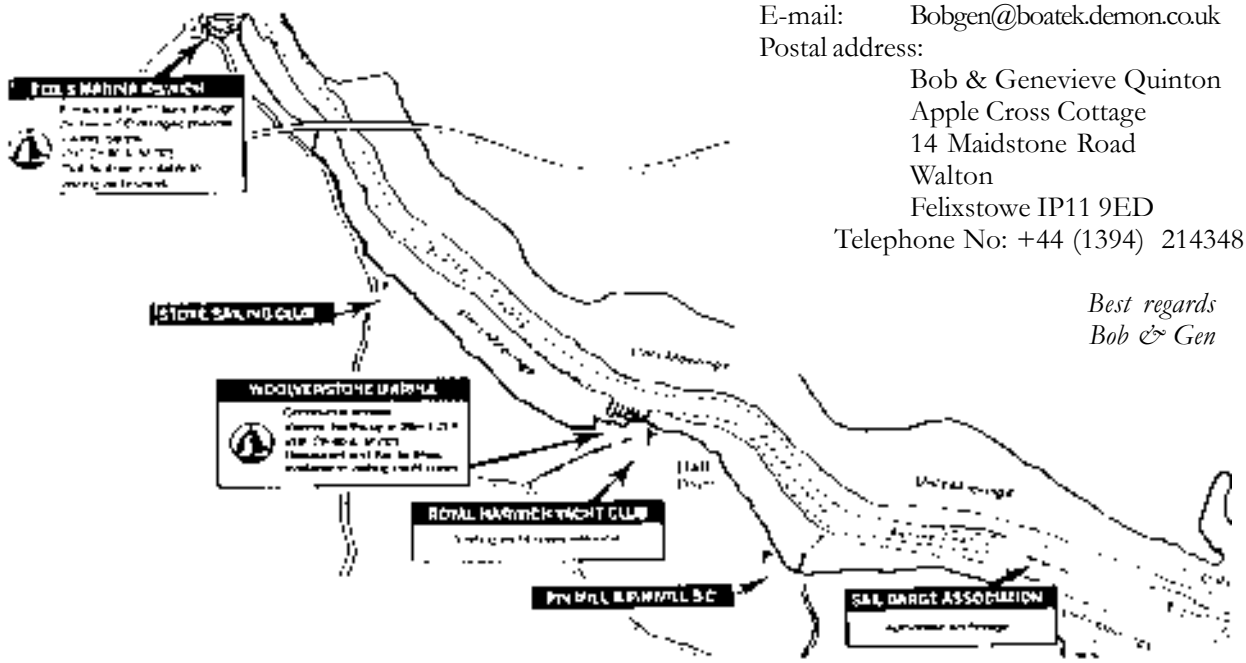
Perhaps there will only be a tenuous connection with water sports/sailing but are you keen to a) discuss your concept with like minded people b) bring along a non-working model and attempt to explain it c) bring along a working model and demonstrate it on the shore line or d) for those who have progressed to full size man-carrying craft there are two options. Choose to sail in demo mode or go down the speed course.

Sophisticated computerised equipment will record accurate speeds exactly as employed at the annual Weymouth Speed week and as last year we have persuaded the indefatigable Robert Downhill and his experienced team to take care of this aspect of the rally. We also encourage and welcome others to attend and participate keeping a watchful eye and helping wherever needed in the capacity of support boats, or indeed on foot.

This year's details are not yet finalised but we feel that the Year 2000 Saturday social evening (dinner followed by video clips and talks) with over 40 attendees on the Saturday night was a complete success and a fundamental ingredient to be nurtured thus furthering the camaraderie of the weekend. Generally we are aiming to follow the same successful format re the water borne activities as last year and we will have the full use of the club house with the availability of hot showers, toilet facilities, the excellent bar and restaurant, on site camping, and launching at all stages of the tide. If we can also book the same quality of weather we should have the same wonderful time as in 2000.

Further info (Subject WINDS OF CHANGE 2001) from:
E-mail: Bobgen@boatek.demon.co.uk
Postal address:
Bob & Genevieve Quinton
Apple Cross Cottage
14 Maidstone Road
Walton
Felixstowe IP11 9ED
Telephone No: +44 (1394) 214348

Best regards
Bob & Gen



Venue: *Royal Harwich Yacht Club, Woolverstone, Ipswich, England*

When will they learn?

Dear Catalyst

Now that an elite group of maxi-cats have proved, beyond any shadow of a doubt, their overwhelming superiority in the extreme conditions of' The Race', not to mention their astonishing speeds of 35 knots and more, surely it's about time that these monstrous and archaic monohulls (and their equally archaic designers) acknowledged defeat, and smartly left the stage?

After all, what wealthy entrepreneur with half a brain would want to lavish millions on a monohull sailing-vessel that has to drag several tonnes of keel through the water in order to stop it capsizing? And, by the same token, who would condone the fitting of an absurdly tall rig, the top third of which is doing no useful work at all, but merely contributing to the already colossal drag of the keel?

It follows that the 'twist' (and thus drag) of the sail encourages even greater heeling and bow-burying tendencies which all conspire to slow the vessel dramatically!

What a little "gem" of "head-in-sand" thinking on the part of monohull designers who are still playing with sticks, string, and canvass when, by comparison, aircraft designers left that quaint school of marine architecture behind more than 70 years ago.

Nevertheless, all on board this monohull dinosaur are blissfully unaware of their lack of real progress, and are delighted to exclaim: "I say, Chaps...she's hitting 14 knots!", forgetting that this "breathtaking" performance is only achieved at an acutely uncomfortable angle of 45 degrees, and pushing a veritable wall of water in front of her fat under-belly.

Needless-to-say, in order to control their vast area of largely useless canvas, a gleaming regiment of highly expensive and complex sheet-winches is 'de rigeur'...as is the obligatory squad of hearty, but mindless, "winch-muscle" to grind in the miles of multi-coloured cordage attached to their huge wardrobe of sails.

When not demonstrating their prodigious feats of futile machismo, these "Hooray Henrys" perch, in their brightly colour-matched, and voluminous storm-gear, like a bunch of crows on the weather gunwale, in the fond belief that they are keeping the ship from falling over!! Whereas, in fact, their combined windage probably accounts for the loss of at least 1 knot in the yacht's already abysmal performance.

In the light of all this needless complication which epitomises the monohull, let us take, as a classic example, the epic voyage of Ellen MacArthur in the recent Vendée Globe race. An extremely brave, and highly competent yachtswoman, even she was reduced to tears of impotent rage and exhaustion by the sheer physical difficulty of removing and repairing one of those vulnerable and unmanageable dagger-boards on her boat *Kingfisher*.

Knowing full well the dangers confronting Ellen MacArthur on this tough event, surely the designer must have considered the wisdom (and prudence) of installing pivoting boards which could ride up when struck by a submerged obstacle and which could also be easily raised and lowered, using a simple purchase-tackle?

The mind boggles at the utter incompetence of these monohull designers, not only in the matter of vulnerable appendages below the waterline, but also the dangerously inadequate strength of standing rigging and masthead components, which forced this indomitable young woman to climb the mast in wild conditions, thus risking her life unnecessarily.

It is high time that monohull designers emerged from the dark ages, and took a leaf or two out of the aircraft industry's design-manuals.

With all the high-tech materials currently available, why waste time, (and outrageous sums of money) on archaic soft sails with their relatively short life, and lamentably poor performance when...with properly engineered aircraft technology...rigid wing sail rigs will safely out-perform, and out-last conventional sails.

So... sell that piece of "monohull-history" wallowing in the Marina (and, no doubt costing you an arm-and-a-leg). Go sail on a BIG BEAUTIFUL CAT, and discover what you've been missing.

James Crafer
<jcrafer@yahoo.co.uk>

Speedweek – the new millennium

In the mid November issue of Yachts & Yachting was an interesting article from Jeremy Evans (norelation) titled "Not so fast!". The essence of the piece was a summary of the event of October 2000 but it also questioned the future of Speedweek in general, and reflected upon the obscure chances of it ever regaining its past glory.

My reading of the article detected a feeling from the author that it was now a non-event, supported by "old faithfuls that tear or plod down the Speedweek course at much the same rate of knots each year". He feels it is incapable of attracting any serious record attempts, in part because there are no sponsors of the event who would come up with the necessary big bucks required to cover even the expenses of a serious record attempt, let alone any prize money.

In truth I have to agree with that sentiment, and would add that not only are the sponsors thin on the ground, so too are serious contenders to the world sailing speed record. However, I did write to Y&Y explaining that it was still a lot of fun for those who did participate, and that whilst the speeds attained might be much the same as the previous year, there were degrees of achievement if improvements could be shown to have a speed advantage over previous runs.

Anyway, this article not only prompted me to take up some defence of Speedweek but also to consider what I liked, and also what I did not like, about the event, as well as the direction I would like to see it go for the future.

Unfortunately I missed the glory years that Jeremy Evans lamented in his article. It was not until 96 that I attended with my sailing canoe "Sunshine". I did not compete but had a wonderful time enjoying the friendly atmosphere and inspecting some of the weird and wonderful sailing machines.

The following year I returned and competed with my Tornado "Mistbock". My fastest time was around 19 point something knots. Sadly I was pipped to the fastest boat of the day by Jim Pain. Ah well, second is still an achievement. The more important thing was that I was hooked, and have been attending each Speedweek event since then, and hope to attend many more.

It was clear to me from my first visit that so much depended upon the organiser, Bob Downhill, and his loyal and dedicated helpers who would spend long hours out on the stake boats logging the competitors on and off the course. This duty appears to me to require a huge amount of dedication , and not for just one day but the whole week!

As much as I appreciated this dedication of the event organisation I was shocked by the sloppiness of the Sailing Centre administration. The showers and toilets were not just dirty but scruffy and smelly. In the bar, if one wanted to meet and chat with other competitors after 7pm, one was greeted with an air of disdain and comments that the bar was about to close.

Out on the slipway and boat park, Speedweek competitors often took second place to training events or winter haul out of the many cruising yachts. Consequently many found themselves squashed into a confined area with access to just one of the two slipways.

The good news was that the naval station across the water would soon be empty and plans were for the Royal Yachting Association to take it over and create a Sailing Academy. Here was plenty of space, newer amenities and a position closer to the desired course along the inside of Chesil beach. The bad news was that the administrators of the sailing centre were going to run it!

So it was that I arrived with my camper and boat at the 2000 event full of curiosity how this new venue would be. There certainly was space, lots of it. And plenty of slipway, in fact there were three very wide slipways. Unfortunately they had not been scrubbed for weeks and were extremely dangerous with the slippery slime that coated them. Just to stand upright was difficult enough; to handle a boat on or off its slip trailer was fraught with hazard, and I saw many people slip and fall many times over the week. The real tragedy was when George Chapman had a bad fall, fractured his pelvis and was hospitalised.

Inside the buildings there was a familiar scene. Still the same old scruffy bar furniture, even more rough looking with knocks and scuffs from the recent removal from the old premises to the new. The building itself was modern enough with large windows that gave great views out over the harbour. The toilets and showers were well equipped and at least free of the mouldy aroma of the old venue. But there were the visible signs of grime building up indicating a very lax cleaning regime. Deja vu ?

Of course there is more to an event like Speedweek than the quality of the site, but it just seems rather shameful to me that the site is compromised not by its lack of facilities but the uncared-for condition of facilities. I live in hopes that the RYA will tighten its grip on the administration and matters will improve.

One can hardly blame Robert for the condition of facilities, however, I do have suggestions for the future events, and I would like to emphasise that these are only suggestions and not criticism.

Firstly, why so late in the year? The only answer I have heard is to ensure some strong winds. This seems rather absurd when England is almost continually pelted with one low pressure area after another. It is seldom that there is no wind in Britain. Furthermore, what do most competitors do when there is a strong wind? Use smaller sails or find an excuse to stay ashore and repair something. I am one of the latter. Indeed, I prefer to use bigger sails when there is not much wind.

Second, whilst most would agree that Speedweek is oriented towards flat out speed, I still believe there is much to be gained from having an award for best boat-speed to wind-speed ratio. It was with this in mind I contributed a bottle of German Bubbly for the best daily run in this category. However, when one looks at the booklet with all the results, one sees some disturbing figures like wind speeds of 386 knots! Wind/ speed ratios of 4.005:1? Some mistake, surely! Of course these are probably only glitches in the system but it would be nice to get rid of them, Bob, and come up with some really accurate ratio figures that could be trusted. I'll supply the wine!

Of course an alternative to changing the date would be to have another speed trial to fill out the calendar maybe at another venue? Maybe on the East Coast where Simon Sanderson is based with his 60 "Bootiful" speed machine? If "Bootiful" can't come to Speedweek, maybe Speedweek should go to "Bootiful"?

We do though have "Winds of Change" that not only allows the inventive to show off any ideas related to boating, but, with the co-operation of Bob Downhill and his faithful volunteers, is also able to provide a speed course for the very few speed freaks. Hopefully there will be more at the next event. It's a great venue, and the clubhouse is first class - which illustrates my view about the importance of such details. Equally, and not surprisingly, the club members are most friendly and helpful.

I heard on grapevine at last year's Speedweek that George or Jody Chapman had been heard to suggest an event in their cruising waters at Plymouth. Could there be any truth in that? Sounds a good idea to me and one that I would love to support with an entry, especially if it was earlier in the year.

I think it worth mentioning the placing of events (calendar-wise). In particular I would like to see Speedweek start on a Monday and finish the following Sunday. The advantage to competitors would be a weekend to arrange travel and setting up. This would also be a chance for the organisation to get equipment sorted and up and running all ready for the Monday. It would also give some others, who have to work in the week a chance to set up on the first weekend and then return the following weekend to compete.

To round off I would like to add that if this all sounds like a moan then I am sorry. Speedweek is a great event and I hope to be there for the next. The fact is that I enjoy it so much that I want more.

Chris Evans

The Bauer Vehicle

Scepticism about the ability of the Bauer vehicle (PAS, Catalyst No 3) is to be expected. As described, the windmill which was propelling it downwind was turned into a propeller, whose thrust then accelerated the vehicle.

I deduce that the motive power for the propeller was the flywheel energy stored in it when it was a windmill. This energy would soon have been dissipated and the vehicle must then have slowed down for lack of an energy source.

The description of the Theo Schmidt device is more easily understood if it is realised that the ruler in the Propeller Mode diagram must have the force applied to it in the OPPOSITE direction to the arrow, i.e. the ruler is carried backwards. A simple experiment with some Meccano confirms this. Since the applied force opposes the wind, I find this analogy unhelpful.

In the turbine mode on the other hand, the force on the ruler must be in the direction of the arrow and the ruler moves in that direction relative to the table. This analogy makes more sense to me than the other.

The convincing theoretical calculations in Bernard Smith's book "The 40-knot Sailboat" about his Lifting Aerohydrofoil craft quotes a downwind Vmg of 18.8 knots in a wind speed of 13.4 knots (boatspeed 26.5 knots at a course of 135° from the wind). Vmg upwind is 13.2 knots at a course of 45°. I calculate that at a windspeed of 25 knots, the upwind Vmg is 46 knots (1.8 ´ windspeed); the downwind Vmg is 46.4 knots (1.86 ´ windspeed) – in theory.

Michael Collis
Chartered Marine Engineer
Sharnbrook, Beds, UK

The AYRS John Hogg Memorial Prize

The Amateur Yacht Research Society announces the establishment of a Prize to be awarded in memory of John Hogg, the distinguished yachting researcher and amateur, who died on July 24th 2000. The prize, of a value of £1000, will be awarded for the most meritorious contribution to innovation in yacht science made by an amateur researcher. The prize has been donated by his family to celebrate John's life and work.

REMINDER!

Applications for the prize, which is open to anyone of any country whether or not they are members of the Society, should be submitted to the Secretary of the Amateur Yacht Research Society, BCM AYRS, London WC1N 3XX, to arrive by 15th October 2001. **Early/ provisional application is encouraged.** Applications should be supported by evidence of the merit of the work done, peer review if any, details of publication (which may be in a recognised journal, or the Internet), and all other information that may be of use to the Prize Committee. If the work or any part thereof has been supported by grants or other funds, full details should be given. Receipt of such funds will not in itself be a bar to acceptance, but since in part the purpose of the prize is to encourage work by amateurs, it is a consideration. Research carried out as part of normal employment will not normally be eligible. All information received as part of a application will be treated in confidence.

Award of the Prize will be adjudged by a Committee chaired by Mr. George Chapman, who is himself distinguished by his contributions to sailing hydrofoils and marine instrumentation, and a long-time friend of John Hogg. The award will be announced at the London Boat Show, January 2002.

GET YOUR APPLICATION IN NOW!!

The Amateur Yacht Research Society acknowledges with gratitude the generosity of the Hogg family that has made the establishment of the AYRS John Hogg Memorial prize possible. John Hogg's writings in AYRS publications rank with those of, for example, Edmond Bruce and Harry Morss, and are a lasting memorial.

He was a good friend to the Society who will be sorely missed.

Two Speed Issues in The Race

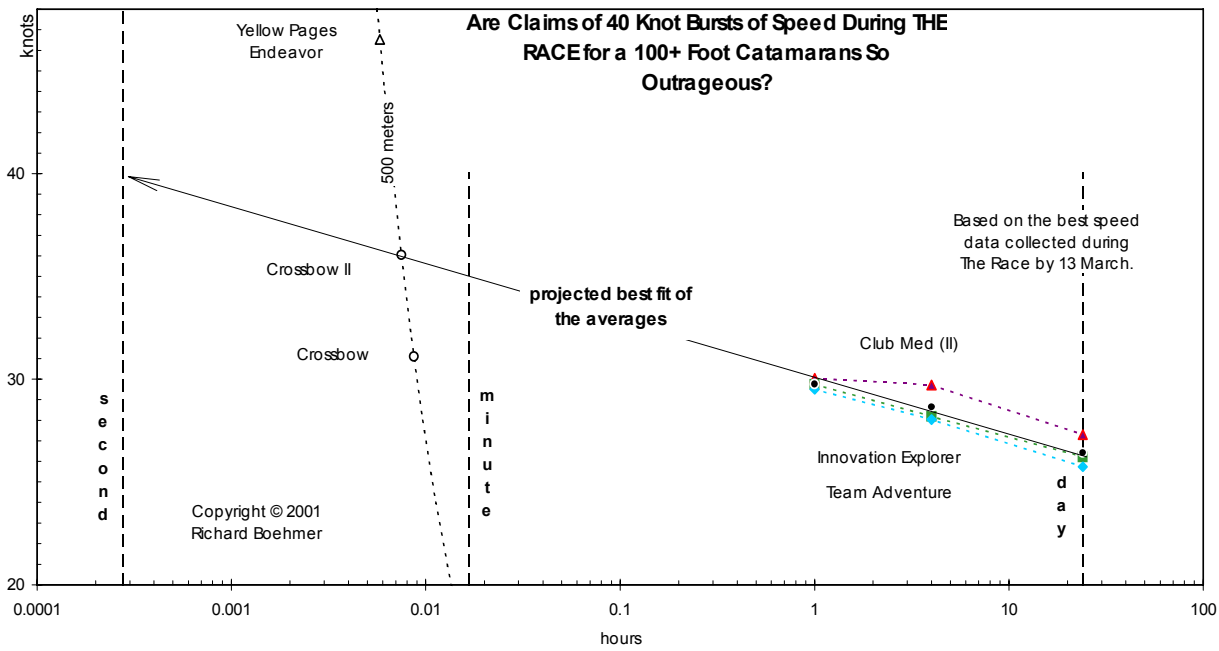
The spectacular performances reported for the three Gilles Ollier designed 100+ foot maxi catamarans, Club Med (II), Innovation Explorer, and Team Adventure, that dominated The Race raised some questions about their actual speed. I'll address two of these questions that concern the ends of the time spectrum: Can these catamarans actually sail at 40 knots? How fast did the winning Club Med go around the world?

40 Knots! - During The Race, the following reports about 40 knot bursts of speeds appeared in the news releases on the Internet:

> "Yesterday evening we had to rig the storm jib because we started to go over 40 knots. It wasn't very reasonable... We had about 36 knots of wind; we filled the aft ballasts, and the boat [Team Adventure] was holding well, but at 40 knots it's not easy!" - Jacques Vincent (29 January 2001)

> "The Team Adventure report was bit shocking. Looks like Cam and Jacques are really having a go with all this 40 knot stuff. Somehow I just can't imagine sailing at 40 knots for more than a few seconds (and scary ones at that) on this boat [Innovation Explorer]. I hope they know what the hell they are doing, and good luck to em." - Skip Novak (30 January 2001)

> "The big kite is up with full main set, and we reached over 40 knots a few hours ago. I was helming and at one point; it just started to go faster and faster, and I looked down and saw the speedo hover over 40 for a bit." - Grant Dalton (01 February 2001)



Although some might consider Dalton's and Vincent's comments a bit of exaggeration, there should be little question about the speeds of these large and powerful catamarans based on the GPS fixes posted publicly on the Internet (www.therace.org, www.catamaran.clubmed.com, etc.). From this data, we find that Club Med's best speeds were 30.0 knots for one hour, 29.7 knots for four hours, and 27.3 knots for 24 hours; that Innovation Explorer's were 29.8, 28.2, and 26.2 knots; that Team Adventure's were 29.5, 28.0, and 25.7 knots. These speeds are conservative in the sense that with more frequent polling the odds are that higher maximum speeds would be found for these time periods. To be more conservative, we'll consider the mean speeds of the three cats which are 29.8 knots for an hour, 28.7 knots for four hours , and 26.4 knots for a day.

As shown in the accompanying TREP plot, an extrapolation based on these conservative average maximum speeds indicates 40 knots for a second. A projection from Club Med's four and 24 hour speeds would yield Kovak's estimate of a few seconds.

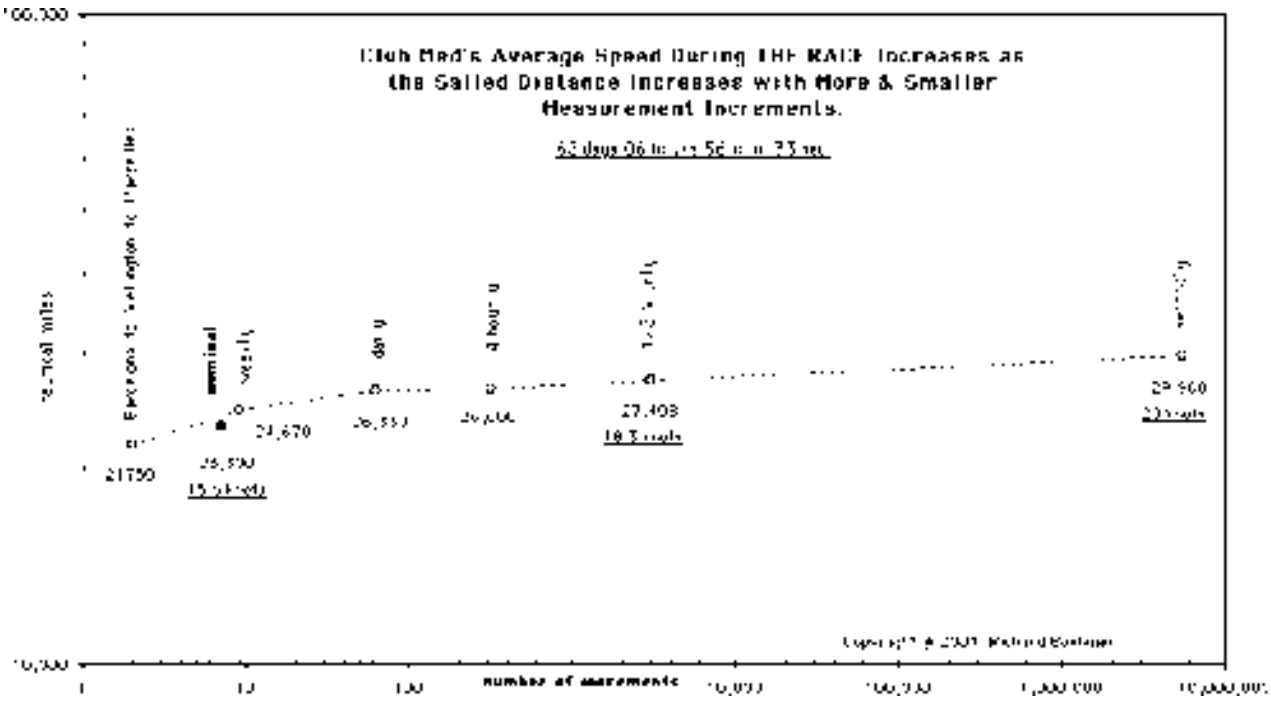
15.6 or 18.3 knots? - When Club Med finished The Race with an elapsed time of 62d 06h 56m 33s, press releases initially announced that the catamaran had gone around the world at an average speed of 15.6 knots; this was quickly upped to a more respectable 18.3 knots. Which is right? Or, is it more, or less, or something in between? Some might quibble over the seconds and a few others over the minutes, but I doubt that anyone will argue over rounding off Club Med's time to 1495 hours which leaves us with four digits to work with. But, the problem of determining Club Med's speed lies with the distance not the time.

Just how far is it from The Race's start at Barcelona to its finish at Marseilles? As the crow flies, it's about 185 miles. So did Club Med do only 0.12 knots? Of course not! But, determining the distance that Club Med sailed around the world isn't as simple as it might first appear.

Assuming that the earth is a sphere, any great circle distance totally around it is 21,600 (60x360) nautical miles. The great circle distance between Barcelona and Marseilles, the long way, is therefore approximately 21,415 (21,600-185) nautical miles. Remembering that The Race's course passes through the Cook Straits – let's plug nearby Wellington into the mix. The distance from Barcelona to Wellington then on around - not back the same way - to Marseilles is approximately 21,750 nm. But, of course there is a problem with this simplistic route; dry land is in the way. So, The Race's course must be measured in increments somewhat clearing large land masses.

Evidently someone in The Race's organization did this and came up with the figure of 23,300 nautical miles as the official or nominal distance for their race around the world. Because I've calculated 23,297 nm. for the accumulated distances between Barcelona -> Gibraltar Straits -> Cape Verde Islands -> Cape of Good Hope -> Cook Straits -> Cape Horn -> Gibraltar Straits -> Marseilles, I think that they did likewise. If you divide 23,300 nm. by 1495 hours, you get the initially released 15.6 knots.

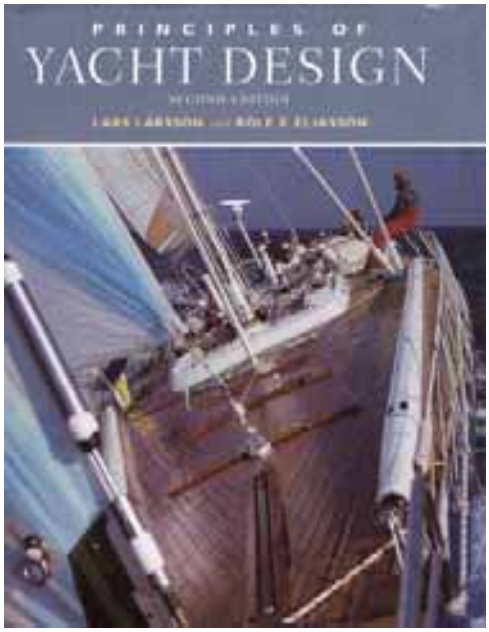
The 18.3 knot figure is another matter. Essentially Club Med took nine weeks to finish The Race; the accumulated distance between the weekly fixes is 24,670 nm. As shown on the accompanying plot, this increases to 26,330 nm. for the accumulated distance between the daily fixes, and to 26,600 nm. for the six "4 hourly" fixes per day. Mireille Vatine, The Race representative, informed me that, "The distance covered for all boats in this race is calculated by a great circle distance between the position polled every half hour added together." For Club Med this accumulated distance was



reported as 27,408 nm. which when divided by 1495 hours yields the more respectable 18.3 knots. The accompanying plot shows that a "continuous" polling of distance every second should yield a speed of 20 knots, but don't let the PR people know this.

There's one last question that I'd like to address before closing. Does Club Med's winning time represent a circumnavigation speed record? I say - NO. This rejection has nothing to do with the distance and therefore Club Med's speed which as we see varies with the increment of measurement, nor with the start of The Race differing from the finish, but rather with the lack of antipodes along their route. The antipodal requirement for a circumnavigation speed record was suggested by the first speedster, Sir Francis Chichester, to prevent short cuts, and later supported for decades by the Guinness Book of Records.

For a deeper mathematical discussion about the phenomena of length increasing with smaller increments of measurement, read "How Long is the Coast of Britain", Chapter 5 of Benoit Mandelbrot's The Fractal Geometry of Nature (1977).



"Principles of Yacht Design",

Lars Larsson & Rolf E Eliasson,
Adlard Coles Nautical, ISBN 0-7136-5181-4, £35;
McGraw-Hill, ISBN 0071353933 $45.

'Larsson & Eliasson' is probably the best-known modern work on sailboat design techniques (replacing the old classics like Chapelle's *Yacht Design*) and has become a standard textbook for naval architecture students. The second edition, published this year, expands upon the first — including more information on powercraft, and a lot of information on the ISO and European Community design standards.

For those who have not yet met it, the authors take the reader through the whole process of yacht design from the preliminary sketches to final evaluation and velocity prediction, with copious examples using a 40ft sailing monohull. They won't tell you what shape to make your boat, or how to lay out its accommodation, etc, but they will take you through all the processes you need to follow to be sure that the end result can be built, will be as strong as you want it to be, and will comply with the appropriate legislation.

My one regret is that it does not yet consider multihulls. Monohulls may be the mainstream of commercial yacht building, but as AYRS Editor, I know well that most of the queries we get from budding students concern multihulls in some aspect or another. Although much of the work covered in the book relates to hulls, however many there may be, it would have been nice to have a chapter devoted to the special problems of multihulls, ensuring adequate cross-beam strength, torsional stiffness, etc. Whilst, in many critical cases, a professional naval architect will use the services of a specialist structural engineer, students and amateurs need some appreciation of what is involved, so that at least they can follow the experts' reasoning.

That carp aside, for those who need an understanding of mainstream yacht design, this book will do exceeding well. Highly recommended.

Simon Fishwick

The Design and Development of Sunshine

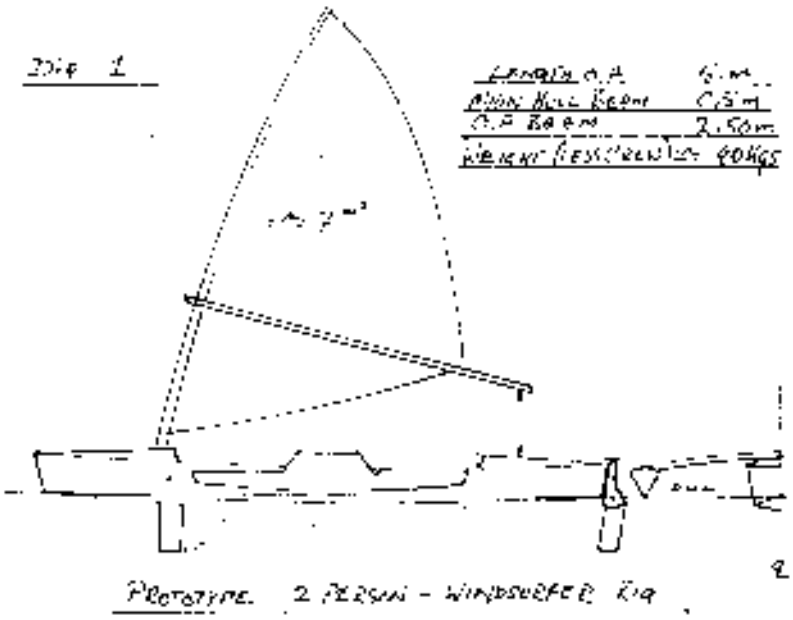
Chris Evans

Sunshine is the name I gave to my multi purpose Canadian style canoe. The name reflects upon the joy that one feels in these northern climes when one is bathed in warm sunshine. It is a similar feeling to that when I sail my boat, "Sunshine".

The boat was born out of frustration when faced with an annual summer holiday in the Adriatic islands of Croatia without a boat. The problem was that whilst I had a Woods Strider catamaran I was having problems importing its road trailer into Germany, where I live, and consequently unable to transport it with my German registered camper.

So it was that I hastily modified a plywood rowing skiff I had build some years previously and was collecting dust in the roof space of my workshop. First job was to knock up a pair of Amas (Floats) using the well-tried stitch n glue method with 3 mm. plywood. (Dia. 1). Length was dictated by the size of the plywood sheet and the other dimensions where mostly from a good guess rather than a bad measurement. Each Ama has about 65 Kgs. displacement. An Aka (crossbeam) was constructed using three pieces of 25×50 mm battens sandwiched between two pieces of 3 mm plywood and laminated in an arch. This Aka rested on wooden dowels protruding from the gunwale sheerstrake and was fixed with 6mm bolts.

The rig came from an old windsurfer and provided about 6m^2 of sail area. Small fore and aft decks were added and provision was made in the foredeck for the freestanding windsurfer mast to locate through a hole in the deck to a round block of wood epoxied to the bottom of the boat. The mast was stepped well forward to create what the Americans would call a Cat Rig. The most logical place for a centreboard would be right where a passenger would sit, so that was out of the question.



However, I had seen a design of Nat Herreshof that incorporated the radical feature of a centreboard right forward behind the mast of a cat rigged boat. It had worked for him so why not for me?

The fact was that it worked very well indeed and the boat would point up like an arrow. However, I discovered to my surprise one squally day that the strains on the rudder were enormous. What happened was that I was hit by an extremely violent gust of wind. The boat took off like a rocket and the trailing log showed 9 knots until there was a sharp crack sound and the boat slewed to weather and I found myself without steerage. I then discovered that the 6mm plywood rudder blade had snapped off cleanly along the waterline.

A replacement was made using polyurethane foam that was sanded to shape by using a piece of the foam that was cut to shape on a bandsaw and then had a piece of very coarse (40 grit) sanding paper attached with double sided tape (Diagram below). The block to be shaped was first rough cut on a bench saw and then sanded with the prepared sanding block until the sanding block came to rest on the workbench which formed a datum. These two halves were epoxied together sandwiching a layer of glass fibre. The outside was then laid up with epoxy and glass fibre. The finished foil shape was very strong and I had no further breakages, I also discovered just how much more efficient this foils shape was by the way the boat now responded quicker to smaller rudder movements. I was tempted to make a new foil shaped centreboard but that would have required a new box and as I was beginning to think about a new boat anyway decided not to.

This prototype fulfilled every wish expected and was not only a source of much pleasure but proved to be extremely practical. I have already mentioned that I owned a 9 meter Strider catamaran, and whilst I loved the boat it was a lot of work to prepare it for the water and vice versa for road transport. Ironically the pleasure I had sailing my tiny modified skiff showed that pleasure has little relation to size. Furthermore the ease of assembly and the fact that it could be transported on a roof rack made it very attractive, especially as I was not getting any younger.

However, shortcomings did emerge that were the fault of the design and this prompted me to consider what I would really like to build. It was clear that the freeboard of just 18 cm when burdened with a crew of two was inadequate as my wife and I

discovered with some concern when we were almost swamped by the wash of a large power boat skippered by a moron. Likewise the Aka picked up the tops of small waves which slowed the boat and frequently caused quantities of water to come aboard requiring the crew to settle into a gently baling rhythm. The Amas performed brilliantly and the simple vee section actually produced dynamic lift but they were too small as I discovered in the deep-water harbour of Krk when I wanted to get ashore. Normally I would beach the craft and wade ashore but here the water alongside the quay was deep and the Amas had insufficient buoyancy to support my weight. After searching I found a slipway.

I was also aware that the long straight hard chine made the craft very slow to come about so my next boat would have more rocker or, at least, round softer chines. This factor focused my thoughts on a Canadian type canoe. I had been considering building such a canoe for exploring some of the splendid rivers that abound throughout Germany, and this way I could build a craft with more than one function. Indeed, I soon had the idea to create the option to power it with a small electric motor that anglers use to troll their boats.

Having decided on a Canadian canoe as a basis I then considered construction details. The obvious choice was to buy one off the shelf but the ones I considered suitable were too expensive. So I would build my own strip planking was considered but I felt it would be too complicated and take too long. I thought of construction with plywood and compounded stitch 'n glue but models showed that I would not get the hull shape I desired and would end up with a rather deep-bellied tippy craft that would be totally unsuitable for use a canoe. I finally settled on the idea to hire a canoe of my favoured choice and take a mould from it to form the lower section of the canoe. The upper section I would construct with 3 mm. plywood. The canoe I chose was designed to carry four persons or 400kgs. It was 5 metres long with a beam of 0,9 metres.

The ethics of pirating the hull shape did not disturb me. Firstly it was a one off for private use, which I understand does not infringe German copyright law, and secondly I did pay a fair hire charge which I considered entitled me in some little way to make a copy. So, with the Canoe in my workshop I spent a day preparing the hull and polishing it with plenty of releasing polish. The following day I laid up the mold and corresponding formers that would maintain the shape after removal from the canoe model. The next day I set about separating the two by inserting wooden wedges at the most flexible places and then inserting a hose pipe to fill the mold with water and float the canoe out. A few gentle taps with a rubber mallet were required to encourage things along and soon it popped out completely.

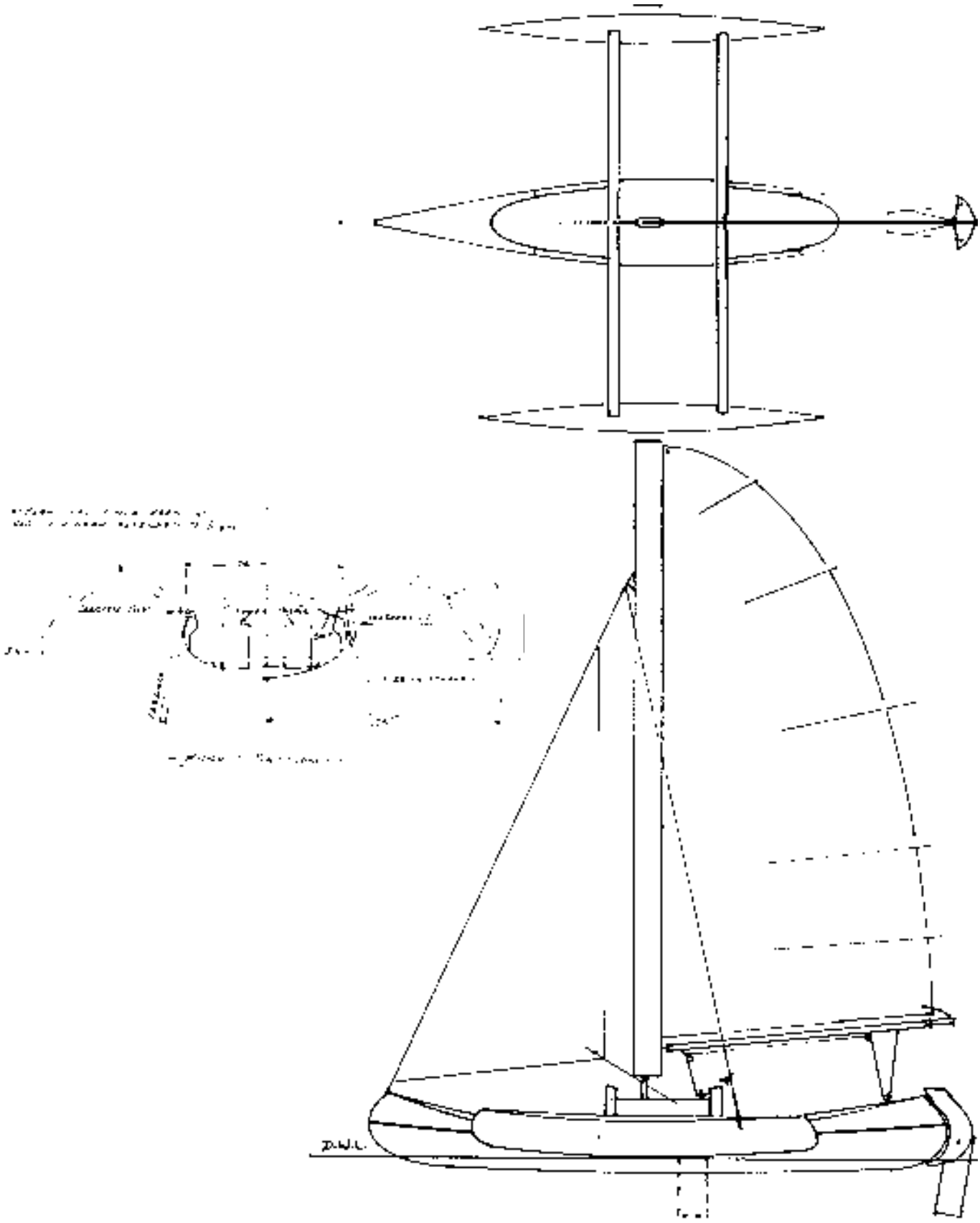
There were a number of pinholes and voids to patch up but that was soon accomplished and by the end of the week I had the finished Epoxy/ glass lower hull section. I had chosen to use Epoxy for strength consistent with lightness and the finished canoe, alone, weighs in around 25kgs.

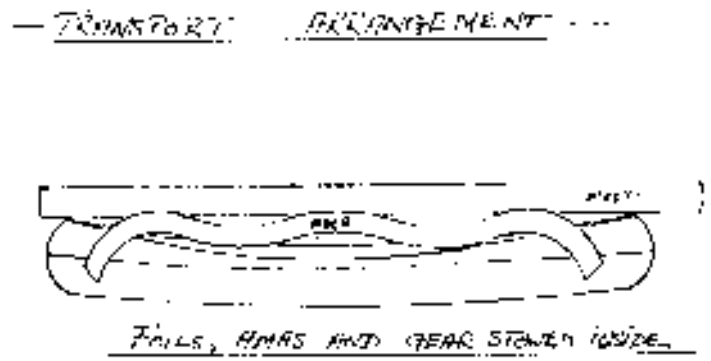
Work started in earnest on creating the upper section and required about 40 hours to complete. I made fairly large water tight compartments in the bows and stern that would provide enough buoyancy to keep the craft afloat if swamped. I installed 30cm. sealed hatches to give access through the decks. The foredeck also had a hole cut to accommodate an extended windsurfer mast that I intended to use with a 9m^2 board sail.

An important consideration was that the pieces needed to transform my Canadian canoe to a trimaran should pack into a neat package within the dimensions of the canoe. Therefore I made drawings for the Amas that would fit inside the canoe cockpit. Calculations indicated that each Ama would have a displacement of about 120 Kgs. I wanted the Amas to be as long and thin as would possibly fit in the cockpit and this entailed scarphing two sheets of ply together to get the required length. This task I have made straight forward with the simple construction from 9mm ply offcuts of an attachment that bolts onto the side of my electric planer and tilts it to the required angle.

Whilst at my drawing board I considered design factors concerning the Akas. Firstly they had to have as much wave clearance as was practical. I would have preferred to use straight aluminium poles for simplicity but could not get the clearance I wanted with that method and soon realised that I would have to make my own in a rather graceful series of curves. The solution was to take a suitable sized board of MDF and fix blocks of wood on its surface that created clamping points that I could use to laminate 25mm thick slabs of polyurethane foam with glass fibre sandwiched between to form the basic shape. This was then sanded with a foam block as previously explained to the required oval section and then laid up with glass and epoxy.

I gave much consideration to the overall beam; I wanted a beamy craft but was well aware that for the local lakes where I expected to use it most I might have some problems with gateways smaller than 2,5 metres wide. Consequently I settled for 2,5 metres.





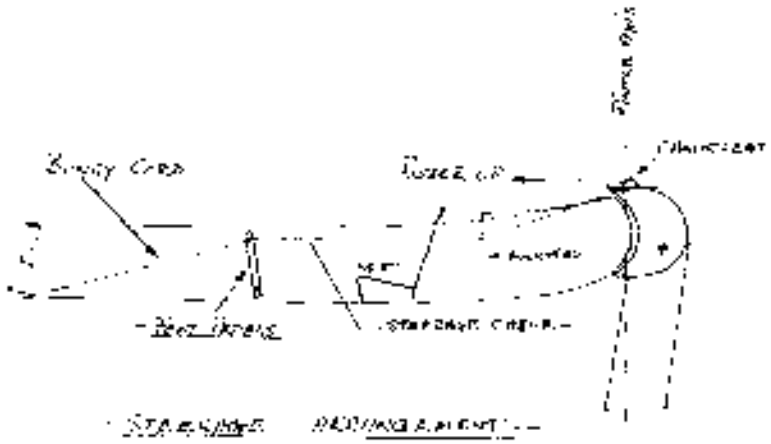
I decided to create a decked section between the two Akas that would cover the center area of the boat and provide a sheltered storage area for items one would like readily to hand (Like a crate of beer, for instance.) . I also had to consider how this unit would be stowed and consequently made it so that when the unit was turned 90 degrees it would sit on top of the canoe with the Akas pointing fore and aft and wide enough that the Aka ends would overshoot the gunwale and the whole thing would sit snugly.

Attaching the Amas to the Akas had to be quick and simple. The result was a mortise and tenon joint held together with a lashing of 5mm bungy cord. Likewise I wanted a simple attachment of the Akas to the Canoe and decided upon four suitably sized door bolts with springs that held the bolts in place. These bolts were mounted on the Aka unit so that the bolt would project into a reinforced socket in the canoe's cockpit coaming. This system has since been improved with the addition of two 4mm machine-screws at each bolt that positively binds the Aka unit with the coaming. This was found to be necessary when sailing in gusty conditions in Greece. Sailing single handed I was rather taken aback to discover that conditions had caused the hull to flex enough for the bolts to wiggle clear of their respective holes and the whole Aka unit was in great danger of sailing away on its own. I saved the situation by leaping with adrenaline induced agility to deposit my own weight on the unit from where I wrestled to lower the sail and gain control. A very hairy moment.

Steerage was via foot pedals. On my prototype I had tried a rod attached to the rudder stock which required pushing backwards or forwards to turn the rudder. I found it most unsatisfactory and always ended up going the opposite direction to that I desired. I changed the system to foot pedals operating pull wires to the rudder stock and found this system superb - not only for its accurate control but also it allowed freedom for the hands to do other things like trimming sheets and reaching beneath the central deck area for another bottle of beer. Seriously, it was like having another crew member on board but without the weight.

There are a number of considerations to consider regarding such steering geometry. Ideally the cables should attach to the rudder stock on a line athwart the fore and aft line and bisecting the pintle (Dia) and it should run onto a quadrant if one wants to maintain an even cable tension through the turns. However, this is not always possible and I discovered from the canoeing community, that one can skip much of the technical exactness by attaching a separate length of 8mm bungy cord to each of the pedals that is led forward and fixed to a convenient anchor point. This will maintain an even tension on the pedals and keep the cables to the rudder taut. Any discrepancies in the geometry will be compensated with the bungy cord.

Because of the small stern deck it was not convenient to reach the rudder stock so lowering and raising the rudder blade had to be achieved by lines. Early system had a line for up and another for down but I changed this to a line for down that locked into a camcleat on the rudder head and turned with the rudder, and strong bungy built into the rudder blade that pulled the blade up. This way I only had to release the camcleat and the rudder blade would pop up out of harms way. Especially useful when beaching.



Because I wanted to be able to use the canoe as an entity on its own I was reluctant to install a centerboard case. The solution was leeboards. These I mounted on the Aka assembly at a point I calculated from drawings of the sail and canoe profile. They were pivoted on a simple 10mm dia stainless steel tube and hung so that they would trail when not hauled down. Once again I used bungy cord to pull the leeboards up when released. I have been absolutely delighted with these boards and my only criticism can be why I did not make the leeboards asymmetric so that they gave increased lift to windward. I have since made new leeboards but have to rearrange the pivot pin to get them working properly.

One has to change the leeboards at each tack but that is very simply done by releasing the pull down cord well before tacking and allowing the pressure induced friction to hold it in place. Then one tacks and immediately pulls the other leeboard down ignoring the one already down for that one will pop up of its own accord when it ceases to have any pressure on it.

I will most certainly consider leeboards on any future multihull, especially trimarans where they will be hidden by the Amas and will not clash with the aesthetics of the boat's profile.

- They can be asymmetric to improve lift to windward.
- The shape can be easily modified.
- They are outside the hull which affords easy access and does not take up space inside.
- They are equally efficient.

That, in essence, is Sunshine. I first tried it at Speedweek in 97 and it performed very well in what were light airs for most of the time, and were conditions that suit this craft particularly well. Indeed I took great delight in running rings around some of the boats that would have shown a clean pair of heels in stronger breezes. Call me spiteful but I just could not resist slipping gracefully past - to leeward, of course - and raising my beer to toast them with an air of "Look! No hands."

Since then I have made and installed a new 6-meter rotating wing mast (the construction method I will explain in another article) with a fully battened mainsail and jib of about 11 Sq. Meters total. I have also increased the overall beam to 3,4 meters and now carry a chainsaw for any offending gateways. I have not tried Sunshine personally with the new overall beam, but my son, Daniel, tried it at Speedweek 2000 and it didn't break. Roll on Springtime!

Sailrocket

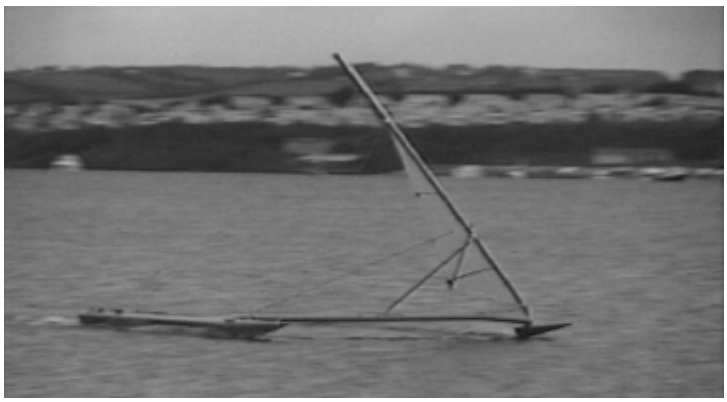
A New UK Challenger for the World Sailing Speed Record

Malcolm Barnsley

Introduction

One of the beauties of speed sailing is the variety of approaches that are possible in order to set new records. We now have a situation where the extremely large (55m) ocean-going catamarans are showing 40 knots plus capability whilst that smallest of man carrying craft, the windsurfer, lags only a knot behind the outright record of 46.5 knots.

A common thread running through the development of many intermediate size speed machines however, is the inability to realise theoretical speeds due to unwanted (and drag inducing) pitch/roll/heave excursions, either in response to gusts or due to inherent instabilities.



Concept

The design of *Sailrocket* is based around the simple yet elegant concept presented by Bernard Smith in his book 'The Forty Knot Sailboat' published in the 60s', in which the sail is inclined and set to leeward, and an equally inclined hydrofoil is located to windward. The result is a craft in which both the roll (capsizing) moment and the sail vertical upward force can in principle be automatically neutralised to within quite small tolerances for any wind and boat speed. It then remains only to carry the (constant) craft weight by some means. The major advantages that follow are;

- There is no definite limit to roll and vertical stability and thus no limit to the transverse sail loading that can be sustained
- Stability is not dependent on weight or ballasting in any shape or form. This permits lightweight high-tech materials to be fully exploited.
- There is no need for human response to gusts in order to keep the craft flying level.
- A single pilot is sufficient , which in turn reduces all up weight.

Although the idea has been around for some time, very few craft seem to have come close to fully exploiting this great potential. One of the reasons perhaps, is simply that it presents a formidable and daunting set of theoretical and practical challenges to the would-be designer, many of which cannot be readily met by recourse to 'conventional' sailing experience or knowledge.

Key design features

Sailrocket is a single tack boat. Although the ability to make unassisted runs in both directions is an advantage in getting the most out of a particular sailing window, it undoubtedly compromises the ultimate speed potential significantly . It should be noted that *Yellow Pages Endeavour* clocked her B-class record of 44.5 knots after only 18 minutes of sailing time!

Being towed back to the start allows the pilot to relax, inspect the boat and then 'psyche' him/herself up for the next attempt. A system has been devised with which the pilot can quickly raise and lower the rig at the start and finish of each attempt.

The hydrofoil emerges from a highly loaded planing surface which helps to suppress spray and

ventilation (as in windsurfers). Even so, cavitation and ventilation of the hydrofoil will be hard to avoid at speeds over 45 knots. We therefore have the ability to easily swap in a new foil if ,for example, we want to try a fully ventilating design. Overall geometry can be also adjusted easily for fine and coarse tuning.

Twin wishbones allow very good control of sail twist and thus vertical centre of effort – a further aid to fine tuning.

At high speed the horizontal crossbeam to the mast base operates as an efficient wing in 'ground effect' carrying up to 40% of the craft weight and unloading the (less efficient) leeward planing float.

Main hull length is 9.0m and overall width 8.4m. Sail area is 21.8m^2

1:5 Scale model testing

Model testing was felt to be necessary primarily for investigation of control and stability characteristics, both at design conditions and in the low speed and 'take off' speed ranges.

We did not want to fall into the trap of not being able to get to the design condition because of either excessive hump drag, or inadequate control.

Although some indication of speed potential can also be gained, scaling effects are quite difficult to quantify and results need to be viewed with some caution.

Model testing commenced in March 2000. Some adjustments to the original forward planing surface geometry were required before achieving adequate pitch stability through all speed ranges.

Control in displacement mode was found to be generally adequate as long as backwinding is prevented.

In recent trials, average speeds of 14 knots over a 100m course were measured with full control and no instabilities. At these speeds it became evident that the sail servo was being overpowered and it was consequently not possible to achieve sheeting angles of less than 15 degrees. Furthermore these speeds were measured at 80 degrees to the true wind. We are thus confident that significantly higher speeds will be realised when we recommence trials in December with a more powerful sail winch allowing full sail control.

How fast will *Sailrocket* go ?

Neither model testing nor calculation can answer this question to the nearest knot (or two) and that is why we have to build *Sailrocket*. However an encouraging comparison with *Yellow Pages* (with B class rig) can de drawn:

• *Sailrocket* has less parasitic windage being shorter , narrower overall by 3m, and more aerodynamically fair.

• *Sailrocket* is much lighter at 250kg all up compared to 340kg

• *Sailrocket* will not have the added drag of intermittent float contact

• *Sailrocket* uses the 'ground' effect for more efficient support of weight.

Against these factors we have to allow only for the fact that *Sailrocket's* rig efficiency is somewhat lower due to both inclination and being a soft sail.

A performance prediction has been undertaken assuming all the usual criteria , such as no waves and steady wind etc. Using fairly pessimistic lift and drag characteristics for the various components, speeds of well over 50 knots are predicted in winds of 23 knots. Even, for example, using the rather poor characteristics of a Finn dinghy sail, 50 knots is predicted – but it then needs 28 knots of wind !

The important point is that steady state predictions are only meaningful if a reasonably steady state is maintained and the evidence is that the *Sailrocket* design can realise this in practice.

Of course the devil (and a lot of the hard work) is in the detail and it remains to engineer *Sailrocket* to the highest standards in order that it is strong enough yet light enough to achieve its goal.

For further information on the project look at our website at http://www.sailrocket.fsnet.co.uk, or if you have any enquiries e-mail to <mjb@sailrocket.fsnet.co.uk>

Designing Racing Dinghies – the Transcript

I sat some well-known designers round a table, and talked to others by email. The results will surface in various forms over the next year or so, but I think AYRS Members are sufficiently aware of what's being discussed to find a transcript of interest. There's a fair bit of this, so it will be divided in sections and appear in more than one magazine. Hope you enjoy it!

Jim Champ

Photo: Jim Champ

Andy Patterson's own Patterson 7 Cherub

Participants:

Julian Bethwaite. 18s, B14, 49er, 29er. Has a background in Industrial design, and worked for Ian Bruce (Laser designer) in Canada. Julian is now full time with Starboard Products, the Bethwaite family business which is the Australian arm of the International consortia behind the 29er and 49er.

Paul Bieker. - Worlds winning I14 designer. Shocked the Australians by designing faster boats than they do! Professional Naval Architect

Andy Paterson – Cherubs (Patersons 1-7) and Moths (Axemen 1-7). Degree in physics and chemistry.

Simon Roberts – Cherubs (Dog, Platypus and Slug). Works for the UK Motor Industry Research Association as a noise and vibration engineer specialising in low frequency structural dynamics.

Dave Roe – Cherubs (Italian Bistro, Pasta Frenzy) and 14 (Indian Takeaway). Trained at Southampton, but dropped out of the Naval Architecture course into straight Engineering. Now works on non-destructive testing in the Building industry

JC - So what made you want to design boats?

PB - I just ... ... It's funny, I did it from when I was really little, my Mom would get me 500 sheet packages of typing paper and I'd go through it and sketch boats. So I always wanted to design boats, and when I got to high school, when other people were doing architectural drawings I was always drawing boats. When I got to the end of High School I was convinced by elders it wasn't practical to design boats so I went to Architecture School - and bailed out within two years and went to Naval Architecture school. So it's compunction.

DR - It's a natural progression from being curious about what makes boats go. So when I started sailing I was always technically minded, I was always curious about it so it seemed a natural thing to do - design one as soon as you're in a fleet that would actually let you do it.

PB - You're in a fleet that allows that opportunity. In a lot of other classes you wouldn't think its possible and it wouldn't even cross your mind that you could actually change something.

DR - So I was sailing Mirrors originally which you can play around with only a little bit, so I did - to the limit (and some). Then I got a Cherub, it was always "Well I'll get a second-hand Cherub, and when I know what makes them tick I'll get my own one". Always the plan. Here we are still!

PB - Kind of like me and the 14 - I got into the boats just for that reason. 'Cause I knew there was an opportunity to design them.

DR - I couldn't stand the thought of being in a class where they wouldn't let you fiddle with it. I couldn't get a one design.

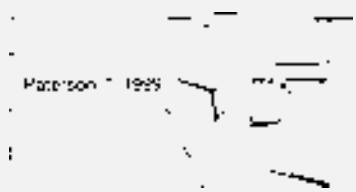
SR - It's surely logical. You spend all this time learning how to sail fast; you know "what are you sailing?"

PB - Wanna sail faster

SR - So you might as well design what it is you're sailing because - It's interesting - you know to try and design something and build something and find out if you've really dropped a clanger

PB - And show the others what not to do!

What is a Cherub?



Its a 2 person twelve foot racing dinghy with spinnaker and trapeze. Perhaps as good a description as any - at least for northern hemisphere sailors - would be to call the Cherub a baby 18 foot skiff, although the Cherub is more moderate. Originally designed in New Zealand by John Spencer, Cherubs are sailed mainly in Australia, New Zealand and Great Britain.

Its a Development Class, not a One Design - a class for designers and builders as well as sailors. One of the aims of the class is to provide an inexpensive platform where prospective designers can try out ideas. The majority of boats have always been homebuilt, and the class has pioneered home building in foam sandwich in the UK. Perhaps an ultimate achievement in sailing is to win a significant International championship in a boat you have designed and built yourself. The list of people who have done that is both short and distinguished.

Dimensions

Hull -
Length Overall & WL 3.7m (12 ft 1.5")
Weight of Bare hull 50kg (110lbs)
Max. Beam 1.8m (5 ft 11")

Spars -
Mast around 22 ft (6.7m)

Sails -
Total main and jib 12.5 sq m. (135 sq.ft.)
Spinnaker 15sq.m. (160 sq. ft.) nominal

SR - Yes, well it's interesting

DR - Kevin Ellway [Cherub sailor and successful designer during the 80s] was saying he rated himself as a pretty poor sailor so his only hope was to have a faster boat, so that's why he designed them [Laughter] Only chance. All [?] That's why.

AP -I first wanted to build a Cherub in 75/76. There seemed to be a lot of different designs around at the time, just after the 74 worlds in UK. The Aussie boats were looking 'nicer' in the few photos I saw, so I thought I could do at least as well as some of the others, and just went for it. The main UK design with plans at the time was outdated, so I planned to build my own design.

JB - A feeling or desire to do better than what I was been dished up as "state of the art" or as being "the best that could be done" when all that was really being dished up was some else's view, quite often very dated perspective view on matters.

JC - Any Heroes, Influences?

DR - - No

SR - - No, never really got into it that much, I just designed my own boats. You look at some of the big names, see some of the boats they've designed, and you think that's crap. But its because on a different basis, they're doing it professionally. All these plastic ones at the shows are designed by famous boat builders and you think "I wouldn't buy one of those with a bargepole", you think "I'm sure its well designed for what its supposed to do"-, but with quite a different set of parameters,

JC - Yeah, though I wonder with a lot of those whether its just that they don't have experience with a real Internationally distributed class like the 14s are now, but weren't when Howlett was designing them. They had no contact with Australia or NZ

DR - - Designing a very different boat - half as heavy again, rigs were less efficient, it was more like the yachts he was used to in a sense so it was always going to look different from what they are now

SR - I don't really have heroes, not in that field; I'm too much of an amateur in that area really.

DR - It was always a technical exercise [agreement] curiosity made me want to find out how a boat works seemed natural to embellish on that in what ever way you see fit and design and build one. It's not like 'I wanna grow up and be like such and such designer'

PB - But you know, Uffa Fox sailing to France

DR - You know someone like Uffa Fox you can admire what he did because he was so far ahead of his time, but its not to say he was a hero...

AP - No. I think I read all the sailing / design books I could find. However some of the yacht designers' Cherubs were very slow, so I realised that the theories didn't always apply.

JB - Manfred Curry, Uffa Fox, Hobie Alter, Ian Bruce, Ben Lexcen, Paul Elvstrom and I should include dad but he will always be dad.

Of those Ian Bruce has to stand out and still does. His skill and brilliance as a conceiver and as a brilliant Industrial Designer stands him apart as a true genius. I must preface that by saying I have never met Hobie Alter. Elvstrom is also inspirational especially when you meet him!

JC - So going on to the technicalities, how do you start? Sketches? Idea in your head

SR - I've always started from what was already there. In a sense its always been - I've always designed Cherubs so you think, "I know what a Cherub is like - approximately", and you think know, too wide, so its always been, well, so wide.

I suppose the only one where I've had to make a complete guess designed after asymmetrics, but that was, loads more lift at the front so you can go really flat and narrow, fine and it worked, but generally its always been a development

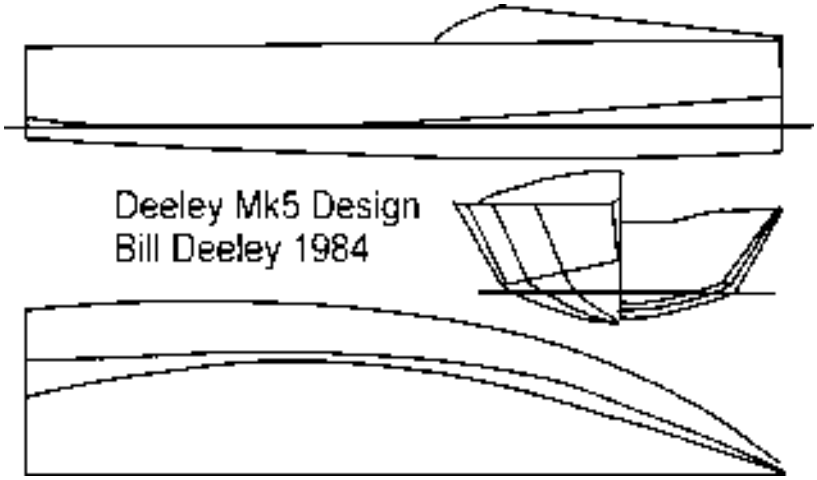
DR - Designing anything is identify the problem first Basically you need to step back from it and find the problem in order to develop the solution. So OK, I primarily design Cherubs, did a 14, but firstly you need an understanding of the fleet you're designing into, then you need an accurate benchmark of what's gone before to start to quantify that to make a sensible numerical guess at what you want to make.

PB - Yeah, the best thing that a class can do is to publish the lines of some of the boats that have come before. That helped me when I just got onto 14s - to see what other people... To have a reference point [agreement]. For me that's part of it but when I get to the actual design of a boat I'm a little bit more analytical, but that's probably just because I've been trained in the process of creating a hull design. So I do a weight study, figure out where the centre of weight is, and the amount of weight. Then you roughly know how fast the boat is going to go (what sort of design speeds) allowing you to choose a prismatic. If you know you've got a boat that's kind of underpowered so it is not going to be pushing its hull speed all the time you choose a lower prismatic say .56 - .57. If it's pushing its hull speed a greater proportion of the time you go to a prismatic like .6 - .63 *- much higher than a regular keel boat would have. The other thing the more powered up the boat is the more forward moment and driving force there is in the rig so you've got to adjust your longitudinal centre of buoyancy to account for it. On a 14 you look where the guys stand - with no power on the sails you'd be doing a tail stand but when everything's added up the boat's in balance. Anyway, once you have a target centre of buoyancy, a target prismatic, an amount of buoyancy and a waterline length, your midship section area is defined. Then, once you decide on a waterline beam, you can draw your midship section. From then on the design is a fairing exercise - subjectively balancing wetted surface, planing speed control characteristics, etc.… I do it on a computer; it spits it out all of the static flotation characteristics as I go, so I can iterate till I get the prismatic, longitudinal centre of buoyancy, transom immersion, and general shape characteristics I want. Sometimes it goes easily - other times it's a struggle.

DR - That's sort of what we do - The particular case with the Cherub is you might want a certain transom immersion, you might want a certain stem immersion, and no more and you want a certain displacement in a certain place. You draw it and see how it floats and you realise it doesn't all add up - too short, so you end up compromising a great deal - it's a very short boat! But basically it's a very similar process, you start off with an approximate prismatic coefficient you want to achieve, you know the displacement, the centre of displacement is a variable - the crew weight is so great you just put it where you want. But what I always try and do is get quite a large difference between the centre of displacement and the centre of buoyancy because that will minimise the pitch, and that's quite key on a twelve foot boat. So that's the angle we're coming from, but basically a similar approach, but the size of what we're designing puts different constraints on what we evolve.

PB - Yes, I always look at the boats in different weight configurations, you know a high speed, a medium and light with the weight all the way forward and look at the properties of each one. In light airs, bow down you wants lower prismatic & things like that so you can look at it in each of those conditions

SR - Yes, and the other thing I always - Its quite interesting, I don't know whether it means anything but you actually look at the



waterplanes, you know they change enormously according to where you stand on the boat, again in the Cherub with something so short you've got to get out to your beam in the length and you change the centre off mass where the crew is standing your water plane goes all over the place and you can get a large change in trim, and that's quite interesting, cause you can do it to a static thing and think your waterplanes are a really poor shape - all concave and horrible, and you stand further forward and they all straighten out.

JC - You look a lot at waterlines then

SR - Well I've just got a computer program that churns millions of pictures out and you look at them and say "Ooh I like that" That is- but at the end of it you've got to make something that comes out fair, that seems to be the biggest thing hassle

AP - The old rules Cherubs had fixed mid-length section, so there was a start point. The current rules also have minimum chine width, so that's also a fixed start point. I used to use pencil & paper and do lots of drawings, then lots of square counting to check the centres of buoyancy, curves of areas etc. I then made models to visualise the design. Now using computer program, I can do all the calculations so much more easily, and then see the rendered design on screen, so I don't need the models.

The prismatic coefficient for me is an interesting end calculation.... I don't have a target or use it in the development of the design. I think the my Mk 7 Cherub prismatic is just .6. The main thing is fairness... I do it manually, and see what the program says, rather than using its fairing function. I've tried various shapes over the years... fine and full bows, wide narrow chines/transom, lots of curve/ flat, lots of rise of floor /flat, and am now developing the flat shape rather than trying something new. It seems the way to get lots of volume forward, fine entry, and flat planing surface. This hull shape needs to be sailed flat, but is best sailed heeled a bit in light winds. The fine entry gives low drag in a nosedive, so recovery is easy without much slowing or water over the deck. The light weight of the bows -with lots of lead near the back- make the boat very responsive and easy to sail in waves without much digging in or hull-steering.

Moth design is similar... but different in that they are non-planing, so fine entry and low wetted surface are important. The modern narrow Moths are easier to sail - high directional stability, no steering effect from heel, light rigs, and with the T-foil rudder holding the trim angle almost constant, nosedives are very rare, pitchpoles almost impossible. When I designed the first Axeman moth, I deliberately didn't measure the contemporary fastest Moth, as I didn't want to be influenced, and so ended up with a hard chine boat 6" narrower or about 70% of the previous designs, and with the daggerboard 6" further back. The reaching speed went up by a corresponding 25%, and the hull was easier to control at high speed and in waves. Now, after some experimenting with narrower hulls, all the Moths are about the same width, and are variations on the Axeman tall

narrow shape. For my latest design I've done lots of tweaks so that the slightly narrower hull has less wetted surface than the old hull, despite greater immersion depth.

JB - I go to bed with a problem and wake up with the answer. In terms of actual designing, I start with researching the hole in the market, then plug some well founded numbers into a Excel program. From there after a few preliminary free hand sketches, I draw it out full size. Do not, in fact, use to use a computer to do this part because, if you use a computer then you lose track of what you are trying to achieve. We only use computers to verify what we have already achieved. After that it is up to full size plugs and full size tow tests.In these days of Internet and travel, there is a huge amount of cross -fertilisation world wide. One of the most important things I do is travel and keep my eyes open and shut up. You never know where your next idea will come from and what will inspire you to it.

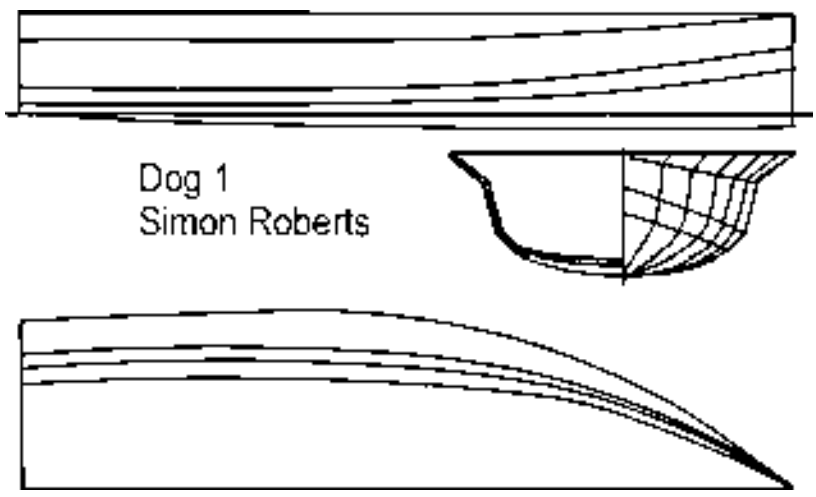
JC - What about section shapes, you know V sections U sections do you start off with some ideas about what things should look like or do you just look at buoyancy and waterlines, because what I've always found is you look at having a nice flat mid section, to get plenty of buoyancy there, but you also want a fairly V section bow and if you draw that you get horrible hollow waterlines

SR - I always had a V bit at the front because I read in a book somewhere it was a good idea - whether it is or not… But also Bill Deeley's (UK Cherub Designer 70s,80s) U shaped ones never seemed to work all that well so I went for a V shaped one - it makes sense on a boat that pitches quite a lot. Also, the way the equations that I've used to generate my boat work I can change the angle at which effectively the axis set which swivels as you move up the boat and the program I wrote just effectively you tell it how much buoyancy you want and how deep you want the thing to go and it will customise it and you see if you like it or not, and if you don't you've got to change the amount of curvature but that's just the why my designs evolved and I do it probably a different way to a lot of the commercial programs, I don't know how they do it

DR - Yes similarly the way mine are drawn rather than draw it and fair it I see what a fair curve that fits my requirements - fit a couple of points and start with something that's fair in the first place, probably a strange way of going about it, but not using commercial packages that are B-spline things like that. And I quite like doing it that way because it gives you the opportunity to place curvature where you want it whereas you put a spline point in it will naturally curve most where your control points are

PB - Yes, well it depends on what kind of a surface fairing you're doing. I like programs where you can cut sections through the hull surface and visualise the curvature across those sections. That tells you a lot about the surface and is pretty critical to performance.

DR - I'm getting the feeling that there's probably quite a lot of commonality between



the parameters that we look at, but quite a lot of difference about the way we actually go about it, you know the nuts and bolts

PB - Yeah could be

DR - No great surprise I suppose

SR - The bit that I don't understand is really is the - Cherubs perhaps more than anything else are quite a dynamic - I don't really understand the trade-off between what s quite a classical hydrodynamic shape and the fact that you've actually got to sail it at the end... You know its got easier because the boats have got narrower so I think they're actually easier to sail in some ways, but the business of actually keeping control of them when its quite busy and the trade-off of shape - a round boat that's got quite a lot of curvature it's a piece of piss to sail when its blowing old boots but its quite slow, The flatter and thinner they get the more wobbly they get an it's an interesting trade off - I wouldn't say I've got that much of a handle on it, so I just hope that I can sail the ones I design

DR - But that's where you need an accurate database and practical experience in the boat - if you've sailed a few boats and know what they feel like and you've got the numbers for them then you can actually make a quantitative decision about how much rocker you want how much warpage, curvature

SR - The thing that makes a difference in a Cherub is like the back two or three feet so that when the rest of the boats out of the water whether you can actually control how easy it is to control the front of the boat when its about to meet the next wave, and you can have a huge effect on that with the way the chines bend in both plan and elevation

JC - So doing lots of rocker makes it stable, you know.

SR, Well I think the reason why the Slug is so easy to sail is that it really quite thin

DR - It's a lot got a bit of warpage in the chines, more than the centreline?

SR - The intention is to give it something so that you could control it when it was misbehaving

JC, So that by bringing the chine up a little bit more…

SR - Yes, seems to stabilise it and a lot of the really severe fore and aft problems that we used to get have gone away because its quite thin. Things like Eric that was 4 feet wide at the back was an absolute sod, the modern ones don't have that nasty...

JC - Yes because we've gone a lot narrower at the back than we used to be. You know its funny that it used to be the big thing that was different in the seventies was the boats went fat at the back, but now we've gone narrower but have got much less rocker of course than we used to have. Paul, how do you find that with the 14s, you know the business of sailability?

PB - Yes that's a big part of it, that the big thing about designing a short boat is that there are real trade-offs between being able to go in displacement mode and carry that weight, and being able to haul ass and keep it going in the right direction. I think that's the biggest thing, you know the longer skiffs like the 16s there's much less subtlety in the trade-offs in the hull, but I just figured that transversely I've always put a fair amount of curvature in my boats - I feel that helps carry their weight efficiently. An elliptical cross section for a given depth and waterline beam is the most efficient for carrying volume and for wetted surface so I haven't really felt that making the boat really flat transversely pays off planing wise. I think it's more important to really look at the rocker and curvature fore and aft. One thing I've learned is to try to avoid the silver bullets - one of the early boats I made was as straight as I could make it in the back which forced more curvature forward (the more flat you make it

aft the more curvy you end up making it in the bow). It was a funny boat, when it was up and flat it was great - riding on that flat back section, but the minute the bow would touch down in a wave it would be like a spoon in a faucet and it would suck down and try to cartwheel. It was a fast design (it won several American and Canadian championships) but you couldn't call it an all around good design.

JB - One of my big advantages is that I have my father. Between the two of us we can be very confident of what we are trying to achieve straight up. What has staggered us in the last 4-5 years is the very small differences that turn a good boat into a ground breaker. It is a chipping away on 10 different fronts of 2-3% to end up with a quantum lift in overall performance. You have to do the whole thing as a overall package as opposed to a bunch of bits thrown together. No point putting low drag rig with high lift foils, they cancel out the benefits.

The sport is in a wave of gear shift. Does not matter who what or where, but over the next 5-10 years what used to be good will be totally overhauled. You can blame me or Paul or Ian or whomever you wish, but that is pointless and only offering us too much praise. This was going to happen, it had been stalled for to long so you are seeing it with a rush.

JC - Something I've observed is that you seem to have designs of boats that are bolt upright boats, and designs of boats that are tolerant - like the Cherubs are bolt upright boats...

PB - Yeah looks like it...

JC - ...5 degrees you're dead but the twelve footers on the other hand are totally curved they sail them - even the top people sail them 15 degrees up the beats as far as I can see

SR - Yeah with that much rag and two people on the wire on a twelve-foot boat [laughter]

JC - Well that too, but its quite striking, what they've got is a hull shape that works effectively like that.

SR - I would have thought a lot of that comes down to two people on the wire on a twelve foot boat its not the most stable platform

PB - You're just jealous [laughter]

SR - But the latest ones you know things like Woof, they're not hard chine but they're not far off the same waterline beam as us, they're really quite narrow,

JC - They're interesting; they go really flat then really a quite tight turn of bilge

SR - They go out, then they go up like that [gestures]

JC - It's almost like a little bit National 12 sort of section - obviously a lot different on Rocker

PB - Have Twelve Footers have gone skinnier lately?

SR - The latest ones are quite thin at the waterline

PB - And they seem fast?

SR - From what I've seen of them they're horrendously quick

PB - Compared to the older ones?

SR - Yeah, all the ones that are winning at the moment are thin. But then I think the guys sailing them have got better too, they can probably put up with something that's a bit less forgiving

JC - The Woofs seem to be totally dominant in the Twelves now, even the Kiwis are building them in preference to their own designs - in fact one of the top Kiwi sailors has cut the bottom off his boat he designed and put a Woof bottom section on it.

DR - That's a historical thing. - The Twelve foot skiffs were always round hulls and had no rig rules, and shoot the rigs. So they've got this design problem - "right we've got these huge rigs, how the hell do we sail with it?" Whereas we've come from completely the other direction - hard chine hulls, little rigs. How on earth do we get this little rig to drive a twelve foot hull and we've evolved down a different avenue.

JC - And I suppose that's why playing the twin trapezes was apparently unsuccessful in the Cherubs?

DR - Bit of a hassle

PB - Why was that, rigs not big enough?

DR - I have sailed a Cherub twin wire and we could have changed the rigs to suit, but actually the decision we made at the time was more of marketing one in a sense in that we found that perhaps 50% of the boat owners didn't stick with it because they couldn't do it, and so adding an extra wire would at least double that figure, so that there was nobody left. Basically there was not the skills base in the UK to support a twelve-foot twin wire boat.

SR - Some of it was the boats - I had Rebel at the time which was a very round loads of rocker [Howlett design] and I think you could have twin wired that one, and it would probably have been more successful than the ones they were putting twin wires on which were relatively narrow at the front and fairly flat anyway - you certainly had to sail them upright to go. Its not that easy to sail a boat that's a bit wobbly front to back with two on the wire - you have a nasty habit of pitchpoling. So in some ways the hull designs were...

JC - The wrong ones. Yeah that was always my feeling. You evolve the hulls for a job, and if you change the job radically - and two trapezes was radical…

PB – Yes, in the 14 when they went to twin trapezes and said that the big thing was "It will be a cheap modification to go faster" And then everybody got to chuck their hulls.

DR - Yes, I said this at the time with the Cherubs, when everyone said it would be a cheap modification and I said it would be cheaper just to add a foot to the boat cause you could modify the existing hulls and everyone laughed at me

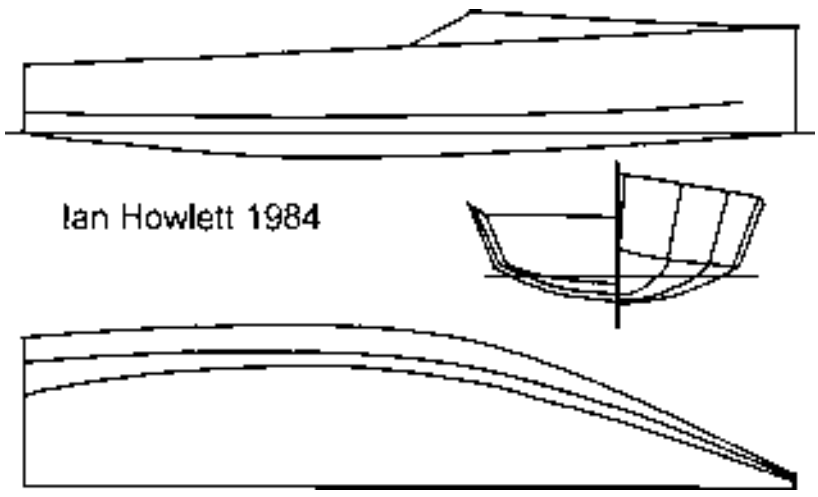
JC - They can't have laughed at you that much because they didn't do it

DR - So then they tried to go sail them and realised what the problem was.

JB - What is sailing? In its simplest terms, it is the exploitation of the velocity differences in to mediums. You have a wing in the air and a wing in the water through which you exploit this phenomena.

Wings are most efficient perpendicular to the plane of reference, hence then will be most effective bolt upright (or down).

To be continued . . .



Models - A Cheap, Quick, and Effective Learning-Curve toward Full-Size Construction.

As a recent member of AYRS, and...over many years...a staunch believer in the importance of model-making, I offer the following conclusions:-

Many of us in this exclusive group are forward-thinkers, longing to put our theories of 'the ultimate sailing vessel' into practice, but lacking the essential funds to fulfil our dreams. We all know that the full-scale realisation of any advanced concept can be ruinously expensive, and the likelihood of failure is enough to kill one's enthusiasm, as well as one's bank-balance. Thus, many excellent and exciting projects are put permanently on the back-burner when...with minimum effort, and minimum expense...they could blossom in model-form, and demonstrate their potential for full-size construction.

To those of you who either abhor the prospect of fiddly, microscopic, and detailed construction, lack the patience and manual dexterity to produce a satisfactory shape, I say that, with modern materials and adhesives easily and cheaply available, it is no longer a hassle to achieve swift, and gratifying results.

I look at model-making as a means of understanding the practical working concept of a new design which can be scaled up to full-size and, en route quickly iron out the structural and engineering problems that could so easily become insurmountable on a full-size project.

SIZE MATTERS:-

Because of 'scale-effect', I have found that it is generally fruitless to construct working models of less than 2ft in length.

Most commercial test-tank facilities use models of at least 6ft in order to gain any degree of accuracy in their readings.

I therefore strongly advocate construction of models of 6ft and more, with the following advantages:-

1) They are less subject to 'scale-effect'.
2) They can easily be transported on a car roof-rack.
3) They can be more easily fitted with batteries and radio-control equipment.
4) Weight distribution is less of a problem.
5) Components and accessories are larger, and less complicated to install.

WEIGHT:-

This is an important consideration which, in small models, can seriously affect performance. In large models the combined weight of various components can be absorbed with little or no counter-effects but, particularly with multihull models, it is wise to keep them as light as possible, consistent with adequate structural strength. Also with multihulls, it is essential to keep the weight distribution as close to the centre of gravity as possible. Avoid loading the ends!!

CONSTRUCTION MATERIALS:-

Having tried many permutations of model-construction materials...including an exotic 'papier-mâché' skin of old newspapers and polyester resin over a wire-framed hull, I finally opted for sculpting my hulls from rigid polyurethane foam block, and skinned them with 2-3 layers of fibreglass tissue and polyester resin, which conforms easily to compound curvatures.

The outstanding advantage of rigid polyurethane foam is that, not only is it extremely easy to cut, sand, and generally shape to a smooth finish, but polyester resins will NOT dissolve the surface so it can be applied direct. Resulting in a strong, lightweight hull with minimum effort.

Used as insulation board in the building industry , it can be obtained from builders yards, and comes in sheets 8ft x 4ft with thickness from 2ins to 4ins.

If required , it is easy to strip off the aluminium paper backing, and build up to your relevant thickness by glueing the foam together with contact adhesive .

Although not cheap, this foam pays for itself easily with its versatility, and speed of construction.

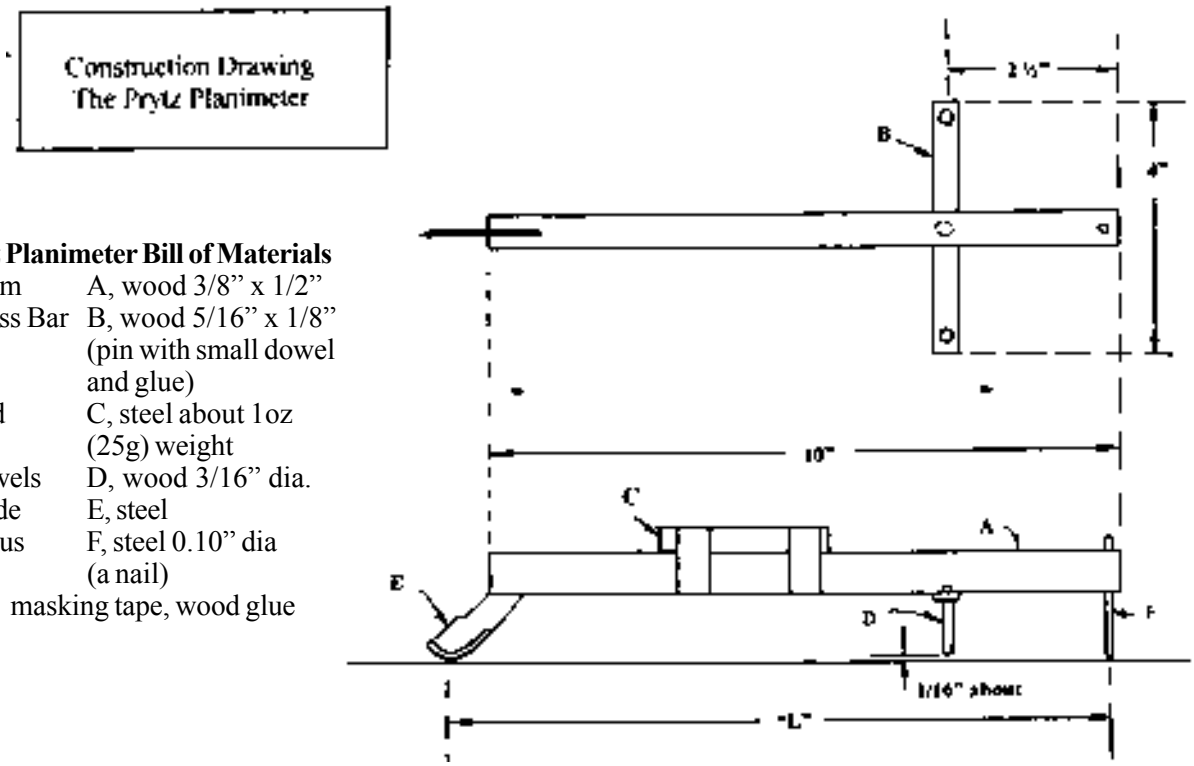
Not only model hulls, but also components, such as spars, wing-masts, and rigid wingsails, can be constructed this way.

James Crafer <jcrafer@yahoo.co.uk>

Frank Bailey

A Practical Look at the Prytz Planimeter

The planimeter is a device for measuring plane areas such as might be needed for ship or boat hull design in figuring displacements, waterline areas, centers of buoyancy, sail areas, etc. The commonest and most accurate, generally accepted planimeter is probably the Amsler Polar Planimeter but they are a bit expensive. Another planimeter which costs practically nothing to make yourself and gives reasonably accurate results is the Prytz planimeter named after a Captain *Prytz*. Once you have been introduced to this device, you will form a love/hate relationship with it as you will see. Let us start by making the device.



Prytz Planimeter Bill of Materials

1 Beam	A, wood 3/8" x 1/2"
1 Cross Bar	B, wood 5/16" x 1/8" (pin with small dowel and glue)
1 Rod	C, steel about 1oz (25g) weight
2 Dowels	D, wood 3/16" dia.
1 Blade	E, steel
1 Stylus	F, steel 0.10" dia (a nail)

Misc: masking tape, wood glue

Referring to the construction drawing, you will see how simple it is to construct. I made mine using some 100 year old oak stolen from the basement of a local church. The wood was very dry and stable. The cross bar was doweled and glued for strength. The weight on top of the beam was cut from a steel curtain rod and weighs about 1 oz. which seems about right. If the weight is too light, the blade won't track properly. If it is too heavy, you will cut the drawing paper. The blade I used was a surgeon's scalpel, used about 50 years ago in a delicate appendectomy surgery. It is held at the proper angle in a slot sawn in the main oak beam. The two side dowels are merely to keep the device from falling over while not being towed about. The stylus is a finishing nail with the head cut sawed off and the bottom filed to a nice smooth roundness. A bit of wood glue here and there will make a rigid assembly.

Since this is mostly a practical look at this device we will not go into any mathematical theory of how the device measures areas but basically when you move the stylus from a starting point around the perimeter of the area to be measured, then measure the length of the arc (see Main Test Diagram) that the blade has moved and then multiply this by the length "U' of the device, then you arrive at an approximate value for the area measured. Referring to "The Main Test Diagram", you will see the diagrams whose areas we wish and the arc length drawn from the center of the circles and squares. The

arc length is the length L' of the planimeter. This is a critical length and should be measured carefully or else we have a constant (systematic?) error. With practice, one should not be unwilling to zero in on this length. The zig zag lines are the approximate path the stylus takes as it leaves the center of the large square, travels left to the left side and then around the square clockwise and then back to the center of the square again. The stylus will have ended a distance above the original horizontal line. The distance is measured as accurately as possible considering you are measuring an arc length. Length "L" times this distance is a measure of the area of the square;. In my sample calculations I have used centimeters and it is quite easy to estimate a value between the millimeter marks on a small plastic scale. Now here is where you will love/hate Prytz. You will notice there are two triangles to the left of the main radius and one larger triangle to the right of the main radius. The "correction factor" to add to your reading is the difference in the areas of the triangles on either side of the radius line. This article will ignore these correction triangles. We will assume they cancel themselves out which is of course not strictly true. Further, we actually have no easy way to record on the paper the trace of these triangles. They are not constructed of straight lines, either. You can see that the blade can translate and rotate separately or both at the same time. The proper name for the shape of these lines is a tractrix which is an awful thing., So let us be content with just measuring the arc length.*

It appears, as far as I am familiar with this device, that one should generally start from about the center of your area, go to the outside edge, go around the perimeter (I chose clockwise) and then back to the center again. I have tried some different approaches which we will examine but let us say you get what you pay for. A small problem with using the center of the area is that you have that much more line to trace with a shaky hand and of course with irregular areas, you can estimate the center only approximately. Let us look at some results.

The data I took for the test figure is shown in Table A. The percent differences are calculated from dividing the measured area by the actual area. The actual areas were figured from carefully inked drawings and measured with a small but accurate centimeter scale. Table A has also been augmented from data from the other tables for areas taken from starting in the center of the drawing. In total the areas are extremely precise. As stated above, I did not pay any attention to the correction triangles.

Table B shows the results from marking on a horizontal radius four points plus the center and a tangent point, thus calculating 6 areas to the left of center and 5 areas to the right of center, and not counting the area based on the center twice. Here again, individual readings are a bit off but the average is very good.

Table C shows the data collected for a vertical diameter. I took fewer points due to ennui and it appeared quite early on that the arc length measured was quite consistent but each reading was about 5% less than actual. It has been suggested in the literature that one should take the areas twice, the second one at right angles to the first. Why don't you think about this? To facilitate experimenting, it is convenient to draw on your paper the area to be measured and a center point and then lay off the main radii "L" from the various starting point you wish to use, labeling each and drawing the "zero" horizontal line upon which the blade starts initially. Notice that as you start from points on the vertical line, you will have less distance to travel as you approach the tangent or perimeter.

Table D shows the results from starting at the quarter points around a circle.

If you are statistically minded you might wonder about two other things. It has been stated that longer arms are more accurate which may be so but if the arm is too long compared to your areas, the blade will move a very small distance on the arc which will be difficult to read accurately. I listed by decreasing areas (not included here) the percent error of all my readings and there was no correlation of error by size of area measured. A fertile mind might think of some more ways to optimize precision (or accuracy).

So there you have it. If you construct this device, you will have to decide how to use it yourself. It appears there is no 100% easy answer but if you take enough readings at different points, you will arrive at a half way decent answer for very little cost. So now you may appreciate the love/hate relationship statement mentioned above.

I am indebted to one Weston Farmer, who ranks right up there with (now) old time boat designers. In his delightful book, (all of them were.) "From My Old Boat Shop", he introduced me to the Prytz. My construction drawing is of course very similar to his. From there I researched it in the Britannica Encyclopedia, I 1th edition. There is also a website describing the Prytz: <http://persweb.wabash.edu/facstaff/footer/Planimeter/Prytz/Prytz.htm>

From this site you will see the other configuration of the Prytz which is its hatchet shape. This type is also easily made.

It might be appropriate to mention here another very convenient way to measure areas. If you can draw your area on a piece of cardboard of uniform square centimeter weight and then cut it out and then weigh it on a laboratory balance for instance, you will have a very accurate area if you have beforehand figured out the grams per square centimeter for instance of the cardboard. Stacking these areas can also yield other interesting numbers dealing with centers of gravity of volume, etc.

∗ From the website mentioned above, here is how to handle the error triangles: Note that the blade traces one of the triangles in the clockwise direction and one in the counter-clockwise direction, while tracing counter-clockwise around the area to be measured. The correction is to add the counter-clockwise triangle area and subtract the clockwise triangle area. If we had a trace of the triangles, the area of each is still an approximation due to the slightly curved lines

Table A: Data for Area Basis Center of Test Figure

Actual Area	Measured Area	% Error	
106.1	102.2	-4	Square A
51.0	52.4	+3	Square B
25.6	26.2	+2	Square C
82.5	82.9	-	Circle D
40.7	41.9	+3	Circle E
12.8	11.0	-14	Triangle F
25.9	25.7	-1	Triangle G
53.0	50.6	-5	Triangle H
77.9	76.0	-2	From Horizontal Diameter Circle
96.8	98.9	+2	From Vertical Diameter Circle
97.3	100.9	+4	From ABCD Circle

Total actual 669.6
Total measured = 668.7 negligible error in total

Table B: Data for Horizontal Diameter Circle
Actual Area = 77.9

0	76.0	0	——
+1	81.2	-1	69.4
+2	83.8	-2	69.7
+3	87.9	-3	66.8
+4	91.7	-4	64.2
+T	95.6	-T	62.9

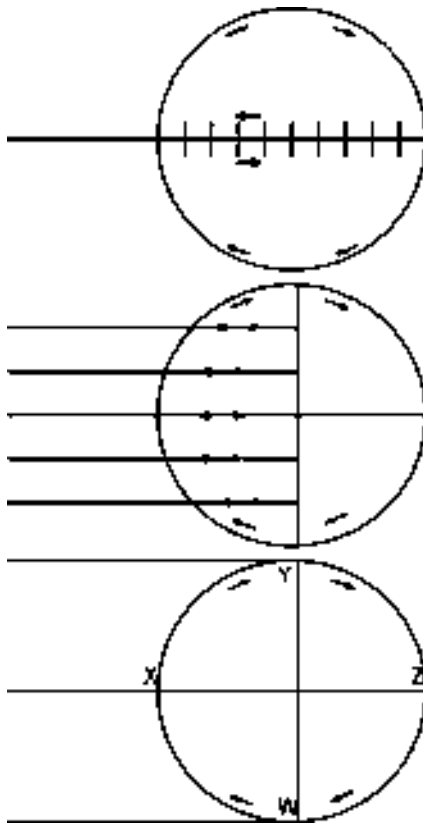
Average of 11 readings = 77.2, error -1%

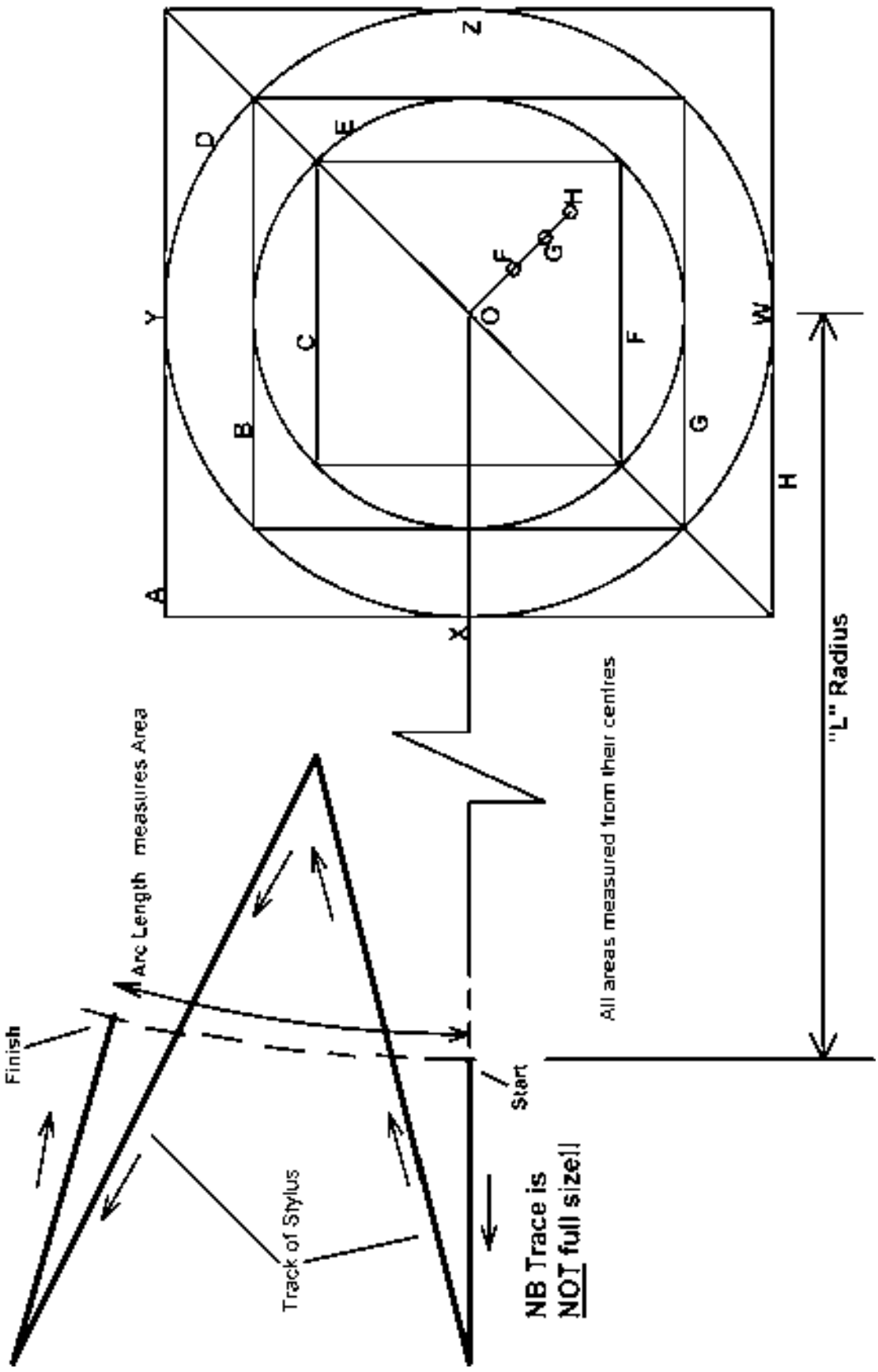
Table C: Data for Vertical Diameter Circle
Actual Area = 96.8
Nine runs across vertical diameter
almost the same measurement of 102.1
Most consistent readings but +5% error!

Table Data for Circle WXYZ
Actual Area = 97.3

A	104.8	+8% error
B	120.5	+23%
C	99.0	+2%
D	81.2	-17%

Average 101.3, error +4% average





Main Test Diagram

Catalyst Calendar

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

June, July

TBA Informal Sailing Meetings
Weather & other committments permitting! Portland Sailing Academy, (old RNAS helicopter base) Portland Harbour, Dorset UK. Contact Slade Penoyre, Tel: +44 (1364) 472 208; email: slade@penoyre.freeserve.co.uk to find out what is happenning!

June

23rd Rond om Texel
The World's biggest catamaran race! 750 multihulls racing around the island of Texel, near Den Helder, Netherlands. http://www.roundtexel.com

August

17th-19th Winds of Change Rally
Royal Harwich Yacht Club Orwell River, Suffolk, UK (See News & Views for details and map how to get there) Contact Bob Quinton; email Bobgen@boatek.demon.co.uk http://www.boatek.demon.co.uk

September

29th-5th Oct Weymouth Speed Week
Portland Sailing Academy, (old RNAS helicopter base) Portland Harbour, Dorset UK. Contact: Bob Downhill, 40 Collingwood Close, Eastbourne, UK; tel: +44 (1323) 644 879 email: robert@speedweek.demon.co.uk; http://www.speedsailing.com

October

3rd "Speedsailing"
AYRS meeting 19.00 for 20.00hrs at the Royal Dorset Yacht Club, Weymouth, UK. Contact: AYRS Secretary, BCM AYRS London WC1N 3XX; tel: +44 (1727) 862 268; email: ayrs@fishwick.demon.co.uk

November

6th AYRS London meeting
Subject to be announced. 19.30 for 20.00hrs at the London Corinthian Sailing Club, Upper Mall, London W6. Contact: AYRS Secretary, BCM AYRS, London WC1N 3XX, UK; tel: +44 (1727) 862 268; email: ayrs@fishwick.demon.co.uk

December

4th Proas: A panel discussion
(Speakers to be announced.) AYRS London meeting 19.30 for 20.00hrs at the London Corinthian Sailing Club, Upper Mall, London W6. Contact: AYRS Secretary, BCM AYRS, London WC1N 3XX; tel: +44 (1727) 862 268; email: ayrs@fishwick.demon.co.uk

January 2002

3rd - 13th London International Boat Show
Earls Court Exhibition Hall. Those who can, from 16th December onwards, give a day or two to help build/staff the AYRS stand (**reward - free entry**!) should contact Sheila Fishwick tel: +44 (1727) 862 268; email: ayrs@fishwick.demon.co.uk

January 2002 (contd)

12th AYRS Annual General Meeting
19.30 for 20.00hrs at the London Corinthian Sailing Club, Upper Mall, London W6. Contact: AYRS Secretary, BCM AYRS, London WC1N 3XX; tel: +44 (1727) 862 268; email: ayrs@fishwick.demon.co.uk

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

On the Horizon . . .

Low Reynolds Number Aerodynamics — Tom Speer
From Hulls to Boards to Foils — Rich Boehmer
The Maximum Speed of Yachts — Bob Dill
Electric Propulsion Design — Theo Schmidt
Alerion Electric Auxiliary Conversion — Charles Houghton
Wind Direction and Sails —Mike Brettle
More sources and resources: reviews, publications and Internet sites

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