AMATEUR YACHT RESEARCH SOCIETY

AYRS

HIGH SPEED SAILING

AYRS 105 OCTOBER 1989

AMATEUR YACHT RESEARCH SOCIETY

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INTRODUCTION

By the time this has been published, we will know whether the severe limitations of the Wirral speedweek course have made a difficult job impossible. I refer to the task of craft closing the speed gap viz a viz sailboards. The limitations of Wirral are the four feet water depth, the banning of kiteboats due to the proximity of power lines, the thirty yards in which to pull up after a run, and wind isovents which only reach Weymouth's average shore strength thirty miles out to sea (see New Scientist 27 May 1989 page 63).

One has to admit that there are many boat sailors who are not interested in sailboards, and vice versa. When this is coupled with a speed course that is loaded against craft there is a powerful argument for holding a speed event for non-boards only. That is, until craft can once again seriously rival the board's speeds, at which time the two can again compete together. There is no better place in Britain than Portland Harbour and I state this from local knowledge - and local prejudice. I live there.

Our grateful thanks are due to Graeme Ward for editing this publication, John Cadley, a new committe member, for designing the cover, preparing the artwork and layout, Sonja Sulzmann, Chris Norris and Norman Champ for the printing, Commander Chapman for assisting with the centrespread speedweek results, all those who contributed articles and especially to Mrs Ann Stock for typing the publication.

Report of the second AYRS Speed Sailing Symposium held at the Royal Dorset Yacht Club Weymouth September 1988

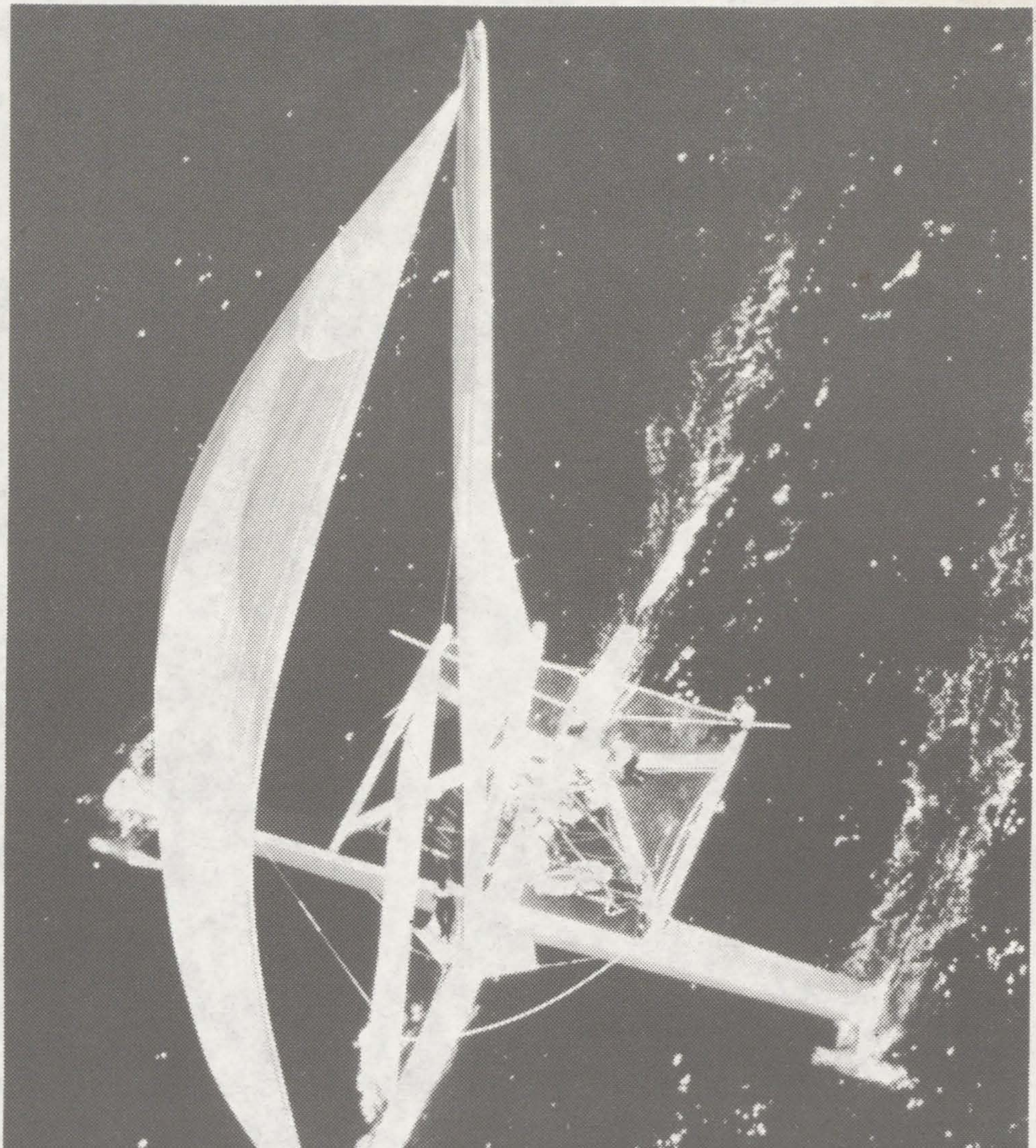
After a welcome to all present a plea to the speakers to try to keep within their ten minute time allowance, AYRS Chairman Sir Reginald Bennett called the first of fifteen speakers.

ERIK BEALE

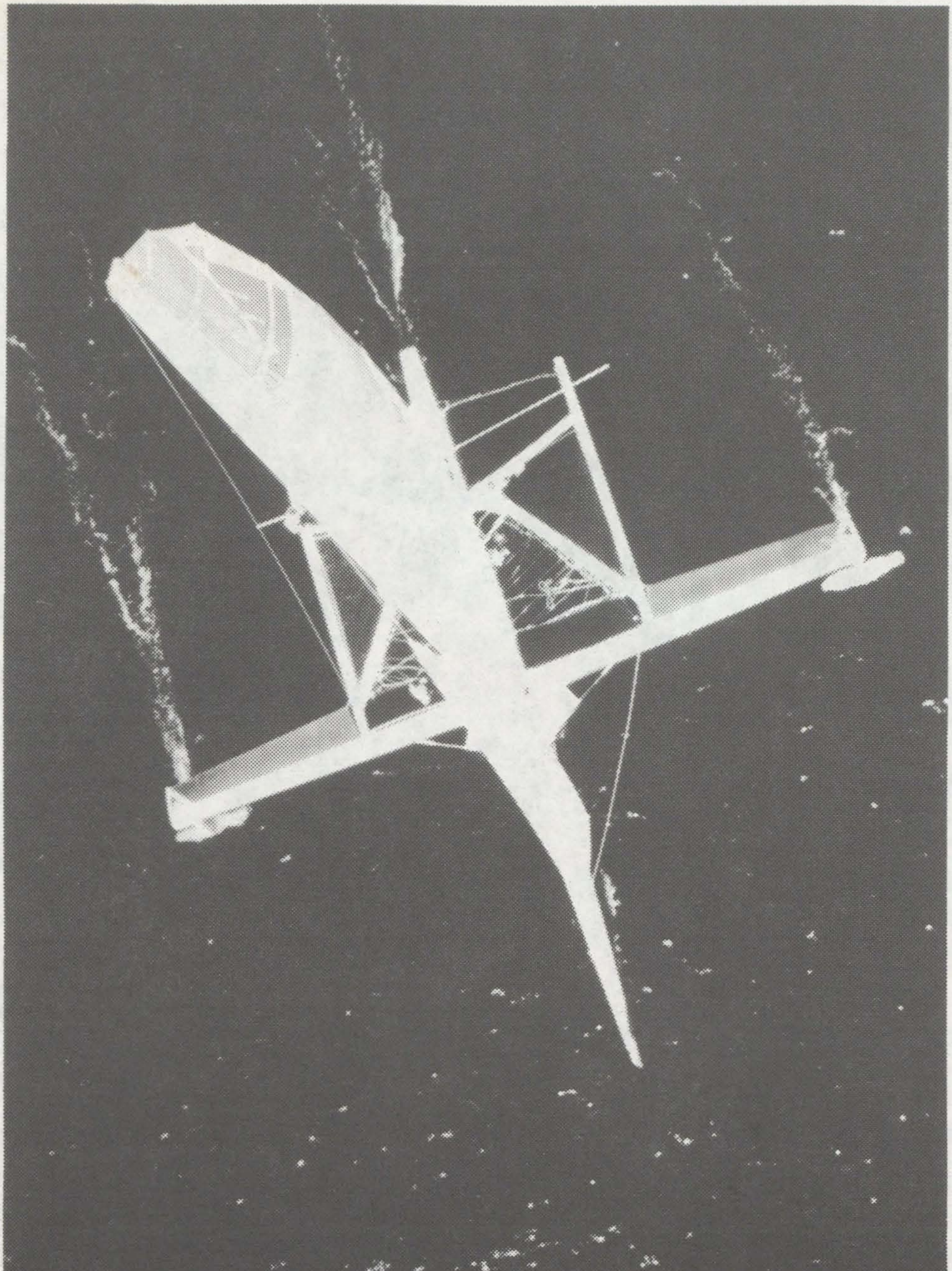
Erik Beale, one of the world's top speedsailors, outlined the main evolutionary trends in speed-board design in the years 1984 to the present. He emphasised the expotential curve of the rocker line and the point that 1-2mm change in rocker can be felt by an experienced speedboard sailor, flatter rocker lines being in general faster within the constraints that water is not normally flat! Other points of primary importance were: a flat tail profile allowed planing at low angles of attack; mininum wetted surface with a concave underside, to give an even pressure distribution across the board; a fin of about 1% of the sail area with a maximum thickness 10% of chord at the mid-chord position; concentration of the fin lift near the surface with low lift sections at the tip to mimimise rotational torque on the sailor's feet. The main question from the floor was "why was a sailboarder so fast compared to present boats? Eric's reply was that the sailor is a major integral part of the system and is thus as responsive to rapid changes as it is possible to be.

DAVID PELLY

Erik Beale was followed by yachting journalist David Pelly who had sailed on "Blue Arrow" the foil stabilised America's Cup challenger. He described its features and sailing characteristics in relation to the design constraints of the America's Cup Deed of Gift. The differential turning of the crossbeam and the electronic artificial horizon system displaying heeling angle as well as foil geometry was of particular interest. Whilst not new in concept it probably leads the way in execution aboard such a craft. David also said that the design was optimised for Force 2 and had exceeded 20 knots in 10 knots of wind, reaching and running being the best points of sailing. David was certain that a catamaran would have been superior to windward. In answer to a question David stated that "Blue Arrow" had no neutral state of balance and needed 5 knots of wind to stay upright. Whilst many useful lessons were learned, the cost of the exercise, £600,000, was high, it was probably good value for the sponsor in view of the publicity that it attracted.



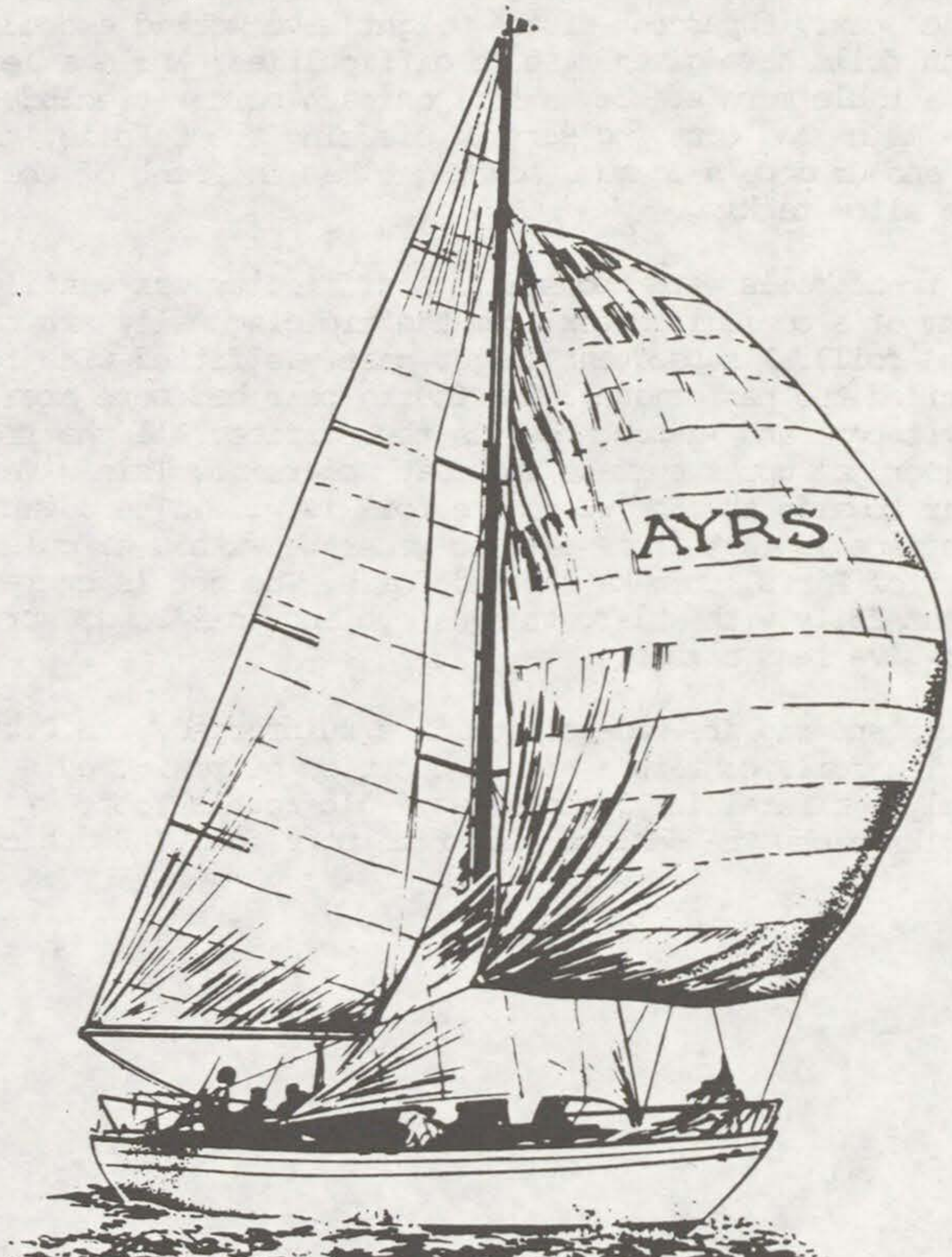
Blue Arrow Challenge Leo Mason Photo
courtesy of the Port Pendennes Americas Cup Challenge



Blue Arrow Challenge Leo Mason Photo
courtesy of the Port Pendennes Americas Cup Challenge

SIMON SANDERSON

Simon Sanderson was the third speaker. At the 1987 symposium he had spoken of his work on single tack solid sails with sections chosen for high coefficient of lift rather than high lift to drag ratio. This year his progression of thought and experimental results were most evident when he told of the problems encountered by lack of sailing time with single tack sails. He also experienced problems with distortion on structures built down to the very low weights required. To complete with soft sail rigs he has now chosen to work with Göttingen 628, a section from the 1920's, as a good compromise between aerodynamic and mechanical features. He is using this in a two-tack sail with the front 50% of chord built rigidly of foam sandwich GRP. The rear 50% is similarly constructed but is a flat plate hinged to the fore part with glass and carbon fibre hinges fitted with a shock absorber to restrict uncontroll-lable flopping about in choppy conditions. The trailing edge is sharply rectangular and is sheeted to the boom giving control over twist of the rig. The next step is slightly more tip length giving a higher aspect ratio without too much increase in the height of the centre of effort. This is expected to exceed 30 knots on the water. Göttingen 628 is <u>not</u> a laminar section and has a Reynolds Number of about 500,000.



AUSTER

By R.R.A. Bratt M.A.,C.Eng.,M.1.MechE

Auster is a 20ft x 8ft catamaran built in 1975. The 10square metre high boom rig which it carries was transferred from the 18ft modified Unicorn hulls of Boreas. Although the standard Unicorn carries 160square foot of sail and Boreas had only 105square foot it would bury its bow, and the deck would act as a negative hydrofoil. Furthermore since the wind always blows across the hulls the bows were perceived as having a high windage. Auster's bows are cut away in an ellipse down to the waterline in defiance of conventional shape, but in fact still having much greater righting moment and reserve buoyancy than Boreas. The bows have no deck and can shed water or cut freely out of a nose dive. The surface sensing 45degrees front foils are carried 2ft from the points of the bows, which can be seen alternatively as protracted bow bulbs which act as fairings for the front foil mountings. The hulls are each tilted 10degrees inwards to maximise the beam waterline, reduce the connecting structure and further assist the transverse airflow. A torsion box amidship controls transverse axis torque between hulls while fore and aft axis torsion is held by the tube across the stern.

The high boom rig was described in AYRS Journal No.61, and the foils follow from the 1960 experiment described in No.58. The principle feature of the latter is that the greater part of the weight is carried on the totally immersed rear foils, which can be of an appropriate high performance section. Auster's rear foils (each 3" x 27") are mounted on the bottom of the rudders, and 10degrees dihedral each side follows from the inward cant of the hulls. The rear foils which carry 60percent of the weight have worked exceedingly well, but the front foils have given rise to difficulties. While a leg on each corner makes a table more stable, a foil on each corner precludes tacking. The large main load carrying surface piercing front foils, used by Hansford's Mayfly and Grogono's Icarus, mounted close in front of the sail centre of pressure allow tacking.

Auster's original front foils were too small. A difficulty was ventilation which took the form of a conical vortex from the tip diagonally aft to the surface (not up the foil). A subsequent larger pair was fitted with fences, but the fences spoiled the performance. The fourth pair had more area, very high aspect ratio, taper, and washout towards the surface. All the front foils were of cylindrical upper surface and flat underside. This gives rise to excessive camber towards the top where the foil is wide. The advantage of the cylindrical surface is that it is easy to generate with a circular strickle in Plaster of Paris, to make tapered foils. Thought is currently being given to front foils with a large radius cyclindrical lower surface instead of flat to give less camber.

Auster's hulls foils and rig are made of Araldite reinforced with 0.009" one way glass fabric. The foils contain a high proportion of plain roving. The hulls are single ply periferal lay, each side of 6lbs/cubic foot, 1/4" thick foam, and weigh 60lbs each. The desired 12lb fine pore foam 1/8" thick was not available.

DIDIER COSTES

Didier Costes delighted his audience by setting out the reasoning behind his EXOPLANE series of boats seen over the years at Weymouth Speed Weeks. The main reason behind the angled sails was to generate lift to provide stability. He had the problem of choosing the angle before sailing as it had proven far too complex to arrange an adjustment whilst actually sailing. After defining the conditions for transverse equilibrium and stability, Didier explained that EXOPLANE 1 and 2 were both very fast close to the wind and in the extreme would luff up. This however made sailing on a conventional speed course very rarely rewarding as the other competitors needed the course set up as a broad reach. As a result every EXOPLANE run needed a major rearrangement of the course alignment. He had therefore abandoned the "EXOPLANE" formula for his current Trischape type. One of the major requirements of it was that the floats must be symmetrical.

GILLES DURAND

The sixth speaker and last before the interval was Gilles Durand speaking on behalf of his team at Weymouth of Thomas le Febure, Jean luc Givelet and Marc Fourgeot, and kite designer Bernard Bonin. The team's boat DANTO-ROGEAT is a closed loop controlled foiler powered by a static mode kite. The concept of a fully automatic foil control system is not new but this craft has an elegant way of combining floatation at low speed and planing at low speed with minimum drag from the foils with automatic transition to foil-borne mode. In each of these modes of operation the gain and damping of the system changes to suit the situation. In the final foil-borne condition the gain is non-linear. The dead-band of the system becomes somewhat narrower as the speed rises. The structure appears to exhibit no low frequency resonances within its operational envelope. The craft consists of a tubular triangle frame with two float-foils leading and a third steerable one astern. The craft has been tested in 1 metre waves up to a speed of 30 knots towed. Propulsion is by a large single static high lift to drag ratio kite, unlike the Jacob's Ladder arrangement. This has enabled kite stability problems to be attacked technically rather than by cut-and-try methods. The light weight of the boat (approximately 65kg) combined with the very low centre of effort possible with kite propulsion has made a very high power to weight ratio both possible and practical. Achieving 19.25 knots during the early part of Weymouth 1988 Speedweek proves it isn't too far wrong!

SPEEDBIRD 'AA'

My experimental boat is an articulated 'A' rigged catamaran, with the lee hull forward of the windward one (similar to Crossbow 11) and the masts are joined together at the top. This design is part of an investigation into alternative rigs and layouts for multihulls. The 'A' rig has structural and stability advantages, but there is no reliable information on the aerodynamics or handling problems so I set about trying to find out. Since it would not be possible to race such a craft in conventional races, the ideas were modified for speed sailing. This meant that it could be a one tack machine and accept limited performance on the wrong tack.

The construction is based on a pair of standard Tornado hulls and tube sections. The masts are inclined at 20 degrees and the angle of the crossbeams can be adjusted up to 45 degrees. The present sails have a total area of 27m2 and the weight is about 225 kgs. The distance between hull pivots is 4.8m. In order to reduce wetted area and spray, triangular spray strips have been fitted to the bottoms of each hull. These appear to work well at speeds over 15 kts. An alternative lee hull was made with a deep 'V' section, so as to act as a pure planing surface with the weather side fully ventilated at speeds of over 25 kts. But as we have not seen strong enough winds yet, we will have to wait and see if the idea can be made to work.

With one crew the maximum sail force is about 1.25 times the all-up weight at 30 kts. apparent wind and maximum stability. With three crew the ratio becomes 1.75 at 40 kts. On the principle of brute force it should be fast, but so far we have not sailed it in over 20 kts. of wind and never anywhere near the stability limit so recorded speeds have been modest. With the cross beams set nearly square, the craft is difficult to control and has a great tendency to lay head to wind. Increased control improves with the angle of the beams, since the distance between the lee daggerboard and the weather rudder is increased. It can be manoeuvred in most conditions. The cockpit was meant to reduce the windage of the crew, but it fills in rough water and so will be removed. Along with a few other minor modifications we will be ready to sail in over 30 kts. of wind next year.

So far the performance has about equalled wind speed and it appears that the advantages of the inclined rigs only come into their own when the taller or vertical rigs are overpowered and the additional drag from extra spars and struts is avoided.

Ian Hannay

<u>WINDMILL BOAT "REVELATION"</u>

This is the story of my experiments with windmill power as a means of boat propulsion. There does not seem to have been much interest of late in this subject, and I would be very interested to meet any members who have an interest in this subject.

I have for many years been intrigued by the proposition that a boat could be propelled directly into the wind by using a windmill coupled to a propeller. Like almost every other sailor I know, I felt that this must violate one of the intrinsic laws of nature and consequently I did nothing about it. Then one day an article appeared in 'Practical Boat Owner'. This article described Jim Bates' turbine powered boat. At this time I had just acquired a computer and was looking for an interesting project to practise programming. Proving Jim Bates' system did not work seemed like an interesting, though rather negative, subject to attack.

The first problem that I hit was an almost complete absence of recent published information on propellers. I discovered that the early workers on the subject had taken about 60 years and several different basic theories before they had got anywhere near being able to predict the real performance of a propeller. Being clever fellows their theories stretched my mathematical abilities to the limit and beyond. The result of all this was that I failed in every method that I used to prove the impossibility of sailing straight into the wind.

The previous work left me no option but to build a turbine powered boat. Prouts sold me one of their small cruising cat hulls, the Scirroco and this has proven a good choice, being very strong and having a very strong cabin roof to carry the mast stress. The turbine is 8 metres diameter driving a 1 metre propeller. Power is transmitted by two bevel gears and a drive shaft which is inside the mast. A power take-off is provided to drive an alternator, and a torque limiter is fitted in the main drive shaft to protect the gear boxes from excessive power, or a fouled propeller.

The turbine has a variable pitch control mechanism. This enables power to be controlled, an essential feature because power generated is proportional to the cube of apparent wind speed. Since this power is being used to drive the boat into the wind it will also increase the apparent wind. Therefore when sailing straight into the wind the power generated is even greater than a cube law. The only other controls are helm and mast rotation, which interact according to the desired course and wind direction. I have called my windmill boat "Revelation".

"Revelation" has been on the water for four years. It is now possible to give an assessment of the system based on a good deal of practical experience in which she has done extensive estuary cruising and a trip to Holland in far from ideal conditions. She turns out to be an ideal cruising boat, placing very few demands on the crew either for physical effort or skill, although I must admit I seem to keep learning. She is directionally very stable but if the helmsman's attention wanders and she goes off the wind we do not suffer the tantrums of a thrashing lethal boom. She just stops and lies beam onto the sea. To start all that is needed is to put the mast so that the turbine faces the wind and adjust the pitch until rotation starts and off we go.

cont/d

The convenience of rigid sails is a great boon. Switch on the power and the boat is ready to sail, reverse the process for docking. This makes very short periods of sailing attractive, ideal for an evening's sail after a harassing day at work.

The boat also has the comfort and convenience of the catamaran without many of the traditional drawbacks. Tacking is no problem. It is eliminated. Simply point the boat the way you want to go. The polar diagram is almost circular with a slight increase in the downwind direction.

With regard to performance, tow tests indicated a hull speed of 6KN at which point 4HP was being absorbed. We can achieve speeds of 4.5KN in a 15KN true wind speed. Attempts to better this caused the torque limiter to trip at about 120RPM and 640lbs ft. Down wind speeds up to 8KN have been achieved in winds up to 30KN. The design was optimised for 15 knots. Useful performance can be obtained in winds as low as 6KN.

J. Wilkinson

This seems an ideal point to interrupt the flow of speakers to present Jim Wilkinson's paper on............................

The Ideal Performance of the Wind Turbine Propelled Boat

Very little has been published on the theory of the wind turbine propelled boat. This article is intended to make good some of this omission and show that this fascinating subject can be subjected to analysis as a whole system in order to predict the performance.

This preliminary paper develops a theory to predict boat speed and wake velocity of the propeller using the Rankine and Froude momentum theory.Theoretical actuator disks for turbine and propeller are used.

This theory gives the ideal maximum performance for any given set of parameters, it is therefore very useful to those engaged in this form of activity as it gives a measurement of the efficiency of the practical design.

The method cannot be used to produce an actual design since it tells us nothing about the physical configuration of turbine and propeller. It is hoped to produce a further paper dealing with these aspects at a later date.

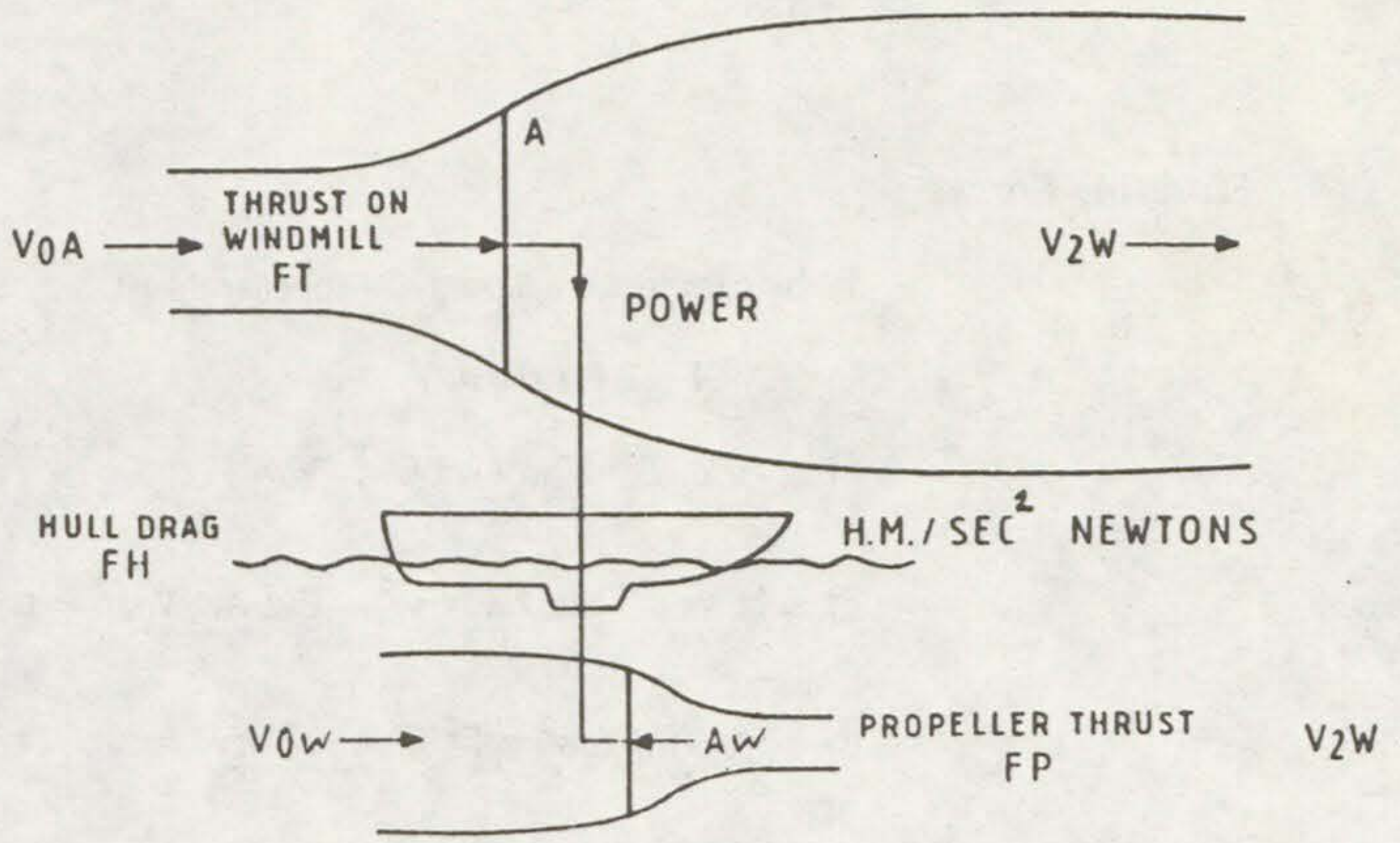


Fig. 3 Schematic of Windmill Propelled Boat

We can now use the formulae developed to predict the ideal performance of a boat propelled by the system as shown in fig. 3. The power generated by the turbine is equal to that absorbed by the propeller assuming 100% transmission efficiency. Also since the whole system is afloat it is free to move in any direction and the forces are in equilibrium. If we consider motion in the direction of the wind we can say that propeller thrust FP = Windmill thrust FT and drag FH.

Using this model the boat speed and induced water speed can be calculated, all the turbine variables are given. Thrust and power can be calculated using e.g. (1) and (2).

Equating Power

$$W_T = \frac{P_W . A_W}{4} (-V_{OW}^3 - V_{OW}^2 . V_{2W} + V_{OW} . V_{2W}^2 + V_{2W}^3) \quad (5)$$

$$0 = - V_{OW}^3 - V_{OW}^2 . V_{2W} + V_{OW} . V_{2W}^2 + V_{2W}^3 - \frac{4W_T}{P_W . A_W}$$

$$F(V_{2W}) = V_{2W}^3 + V_{OW} . V_{2W}^2 - V_{OW}^2 . V_{2W} - V_{OW}^3 - \frac{4W_T}{P_W . A_W} \quad (6)$$

$$F'(V_{2W}) = 3V_{2W}^2 + 2V_{OW} . V_{2W} - V_{OW}^2 \quad (7)$$

Equating Forces

Turbine force + Hull drag = Propeller thrust

$$F_T + F_H = F_P \qquad (8)$$

$$F_T + H, V_{ow}^2 = \frac{P_w, A_w}{2} (V_{2w}^2 - V_{ow}^2) \qquad (9)$$

$$F_T + H, V_{ow}^2 - \frac{P_w, A_w, V_{2w}^2}{2} + \frac{P_w, A_w, V_{ow}^2}{2} = 0$$

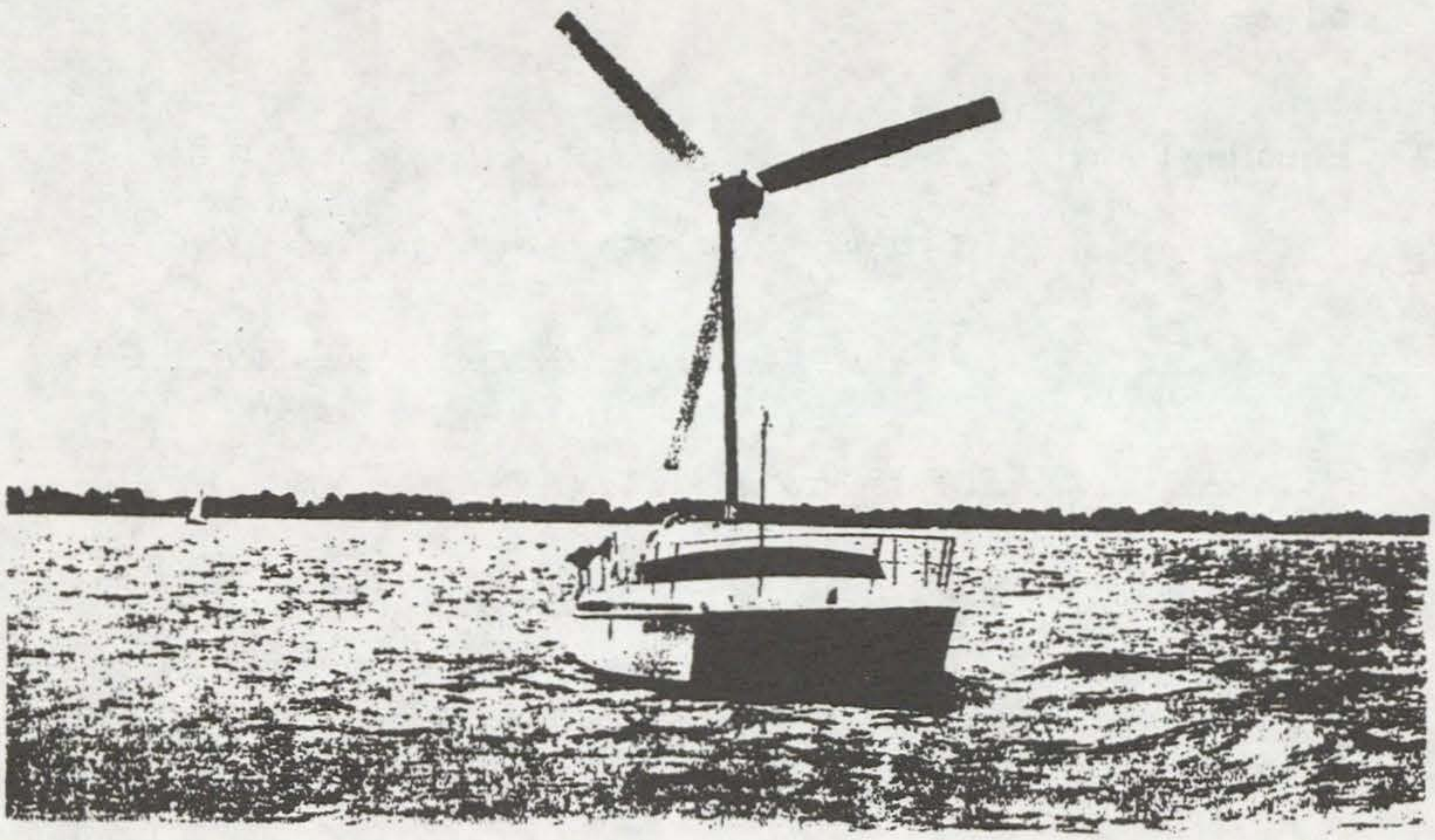
$$\left(H + \frac{P_w, A_w}{2}\right) V_{ow}^2 = F_T - \frac{P_w, A_w, V_{2w}^2}{2} = 0 \qquad (10)$$

$$\left(H + \frac{P_w, A_w}{2}\right) V_{ow}^2 = \frac{P_w, A_w, V_{2w}^2}{2} - F_T \qquad (11)$$

Let $a = H + \frac{P_w, A_w}{2}$ $\qquad b = \frac{P_w, A_w, V_{2w}^2}{2}$ (12) (13)

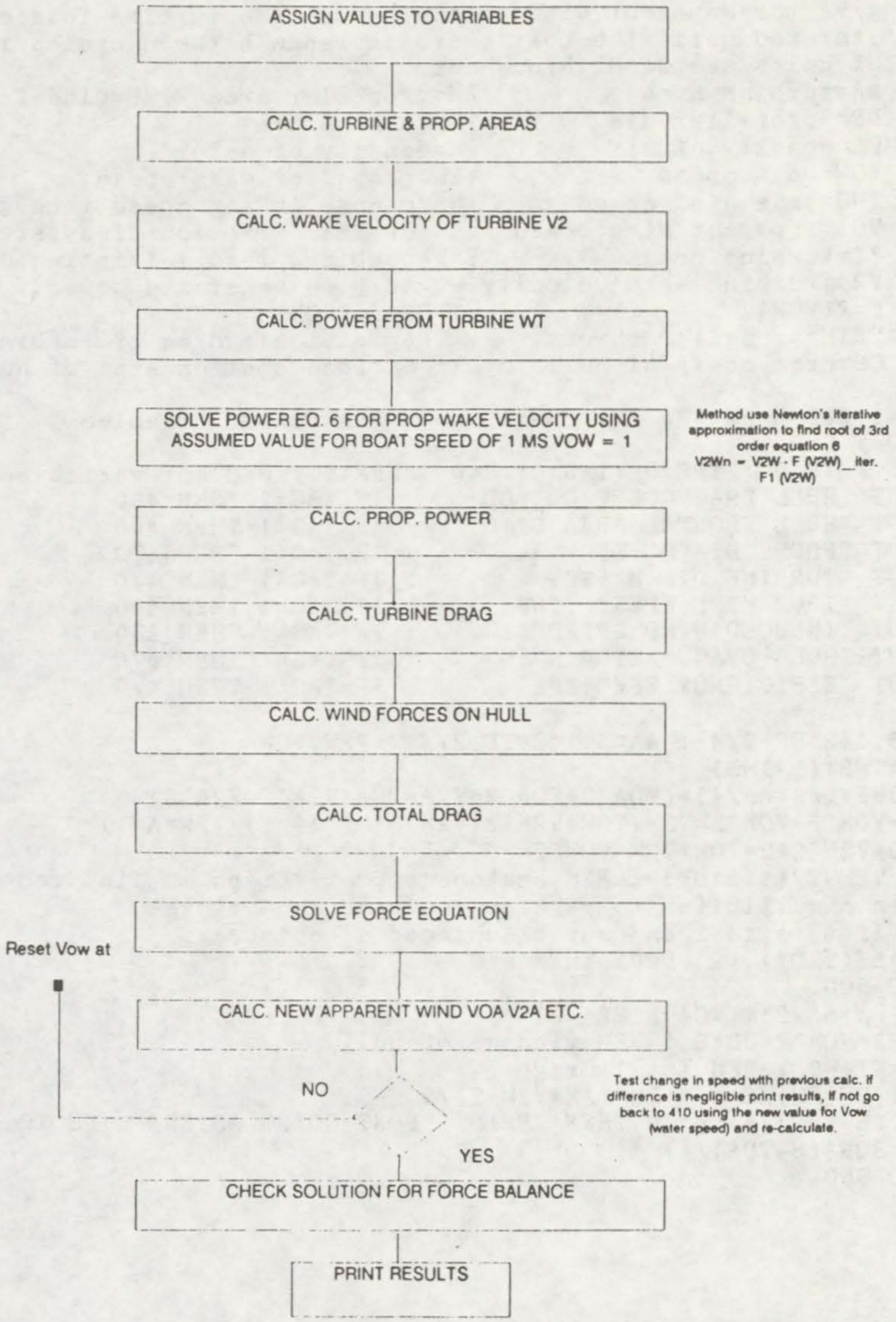
then $aV_{ow}^2 = b - F_T$

$$V_{ow} = \sqrt{\frac{b - F_T}{a}} \qquad (14)$$



Revelation Frank Martin Photo 15 August 1985

A computer program can now be written to carry out the task of determining the simultaneous solution of equations 6 and 14. There are two unknowns, the boat speed and the wake velocity of the propeller. The technique adopted to solve these equations is illustrated in the flow chart.



```
100 REM Program MAXSPD
110 REM This program calculates the ideal speed of a wind turbine boat sailing
120 REM directly into the wind.Rankine and Froude momentum theory is used
130 REM using the concept of an actuator disk,which either adds or extracts
140 REM energy.
150 REM  The program simultaneously solves two conditions.The first part solves
160 REM the power balance by equating turbine power and propeller power
170 REM This produces a value for the propeller wake velocity which is used
180 REM to calculate the boat velocity that is, the free stream velocity of
190 REM the propeller.The calculation is carried out by creating a force
200 REM balance in which the propeller thrust is equal to the hull drag and
210 REM turbine drag.Finally the boat speed is added to the wind speed to
220 REM give the apparent wind speed through the turbine.This operation is
230 REM iterated until the boat speed increase between cycles is negligble
240 REM SI units are used throughout.
250 REM AA=turbine area            AW=propeller area   WF=wind force on hull
260 REM DP= propeller dia.         TD=turbine dia.
270 REM PA=density of air          PW=density of water
280 REM VOW=boat speed             V2W=propeller wake speed
290 REM TWS=true wind speed        IWS=change in air speed through turbine as a
300 REM VOA=apparent wind speed        decimal fraction of apparent wind speed
310 REM FT=turbine drag            EFF=combined form + friction drag turb.,prop
320 REM V2A=turbine wake velocity WT=turbine generated power
330 REM Y=f(VOW)                     DY=f´(VOW)
340 REM PRTH=propeller thrust      TDA=total air drag of turbine and hull
350 REM CD=drag coeff of hull to air S=cross section area of hull
355 TAG=0
360  PA=1.293 : PW=998.3 : VOW=1       : REM fixed variables
370 CD=0 : S=0
380 DP=0 : TD=0 : TWS=0 :IWS=0: H=0 : EFF=0 : REM set variables to zero
390 INPUT "HULL DRAG COEFF CD";CD     : IF TAG=1 THEN 480
400 INPUT "HULL FRONTAL AREA S";S     : IF TAG=1 THEN 480
410 INPUT "PROP. DIA M";DP            : IF TAG=1 THEN 470
420 INPUT "TURBINE DIA M";TD          : IF TAG=1 THEN 470
430 INPUT "TRUE WIND SPEED";TWS       : IF TAG=1 THEN 470
440 INPUT "INDUCED WIND SPEED";IWS    : IF TAG=1 THEN 470
450 INPUT "HULL DRAG FACTOR H";H      : IF TAG=1 THEN 470
460 INPUT "EFFICIENCY EFF";EFF        : IF TAG=1 THEN 470
465 TAG=0
470 AW=3.142*DP^2/4 : AA=3.142*TD^2/4 : V2W=VOW
480 V2A=TWS*(1-IWS)
490 WT=EFF*(PA*AA/4)*(VOA^3+VOA^2*V2A-VOA*V2A^2-V2A^3)
500 Y=(-VOW^3-VOW^2*V2W+VOW*V2W^2+V2W^3)-((4*WT)/(PW*AW))
510 DY=3*V2W^2+2*VOW*V2W-VOW^2
530 V2W=V2W-Y/(1.5*DY) : REM Newtons approximation to find roots of pwr bal.DY
is given a multiplier to make approach to root slower
540 REM if this is 1 and may be changed if necessary
550 IF ABS(Y/DY) < .00001 THEN 570
560 GOTO 500
570 FT=(PA*AA/2)*(VOA^2-V2A^2)
580 WF=PA*VOA^2*CD*S : REM windage of hull
590 TDA=FT+WF : REM total drag
600 A=H+(PW*AW)/2 : B=PW*(AW*V2W^2)/2
610 IF ((B-TDA)/A) <= 0 THEN  PRINT "BOAT GOING ASTERN" : GOTO 740
620 VOW=SQR((B-TDA)/A)
630 GOTO 650
```

```
640 PRINT "VOW=";VOW;"VOWN-VOW=";VOWN-VOW
650 IF ABS(VOWN-VOW) <.0001 THEN 680
660 VOA=VOW+TWS : V2A=VOA*(1-IWS) : VOWN=VOW : GOTO 490
670 GOTO 500
680 PRTH=PW*AW/2*(V2W^2-VOW^2)
690 PRINT "WT=";WT;
700 PRINT "V2W-VOW=";V2W-VOW;"prop eff=";VOW*PRTH/WT;
705 GOTO 720
710 PRINT "CHECK=";TDA+(H*(VOW^2))-((PW*AW*V2W^2)/2)+((PW*AW*VOW^2)/2)
720 PRINT "VOW="VOW;"FT=";FT;"DRAG="H*VOW^2+WF;"THRUST="PW*AW/2*(V2W^2-VOW^2)
740 PRINT "Which variable do you wish to change ?"
750 PRINT "1 hull drag coeff.                2 hull frontal area"
760 PRINT "3 prop dia                        4 turbine dia"
770 PRINT "5 true wind speed                 6 induced wind speed dec. fraction of tw

780 PRINT "7 hull drag factor                8 efficiency"
785 PRINT "9 START AGAIN"
790 INPUT "function";FUNC
800 IF FUNC <1 OR  FUNC >9 THEN PRINT "BAD FUNCTION" : GOTO 790
805 TAG=1
810 ON FUNC GOSUB 390,400,410,420,430,440,450,460,100
820 END
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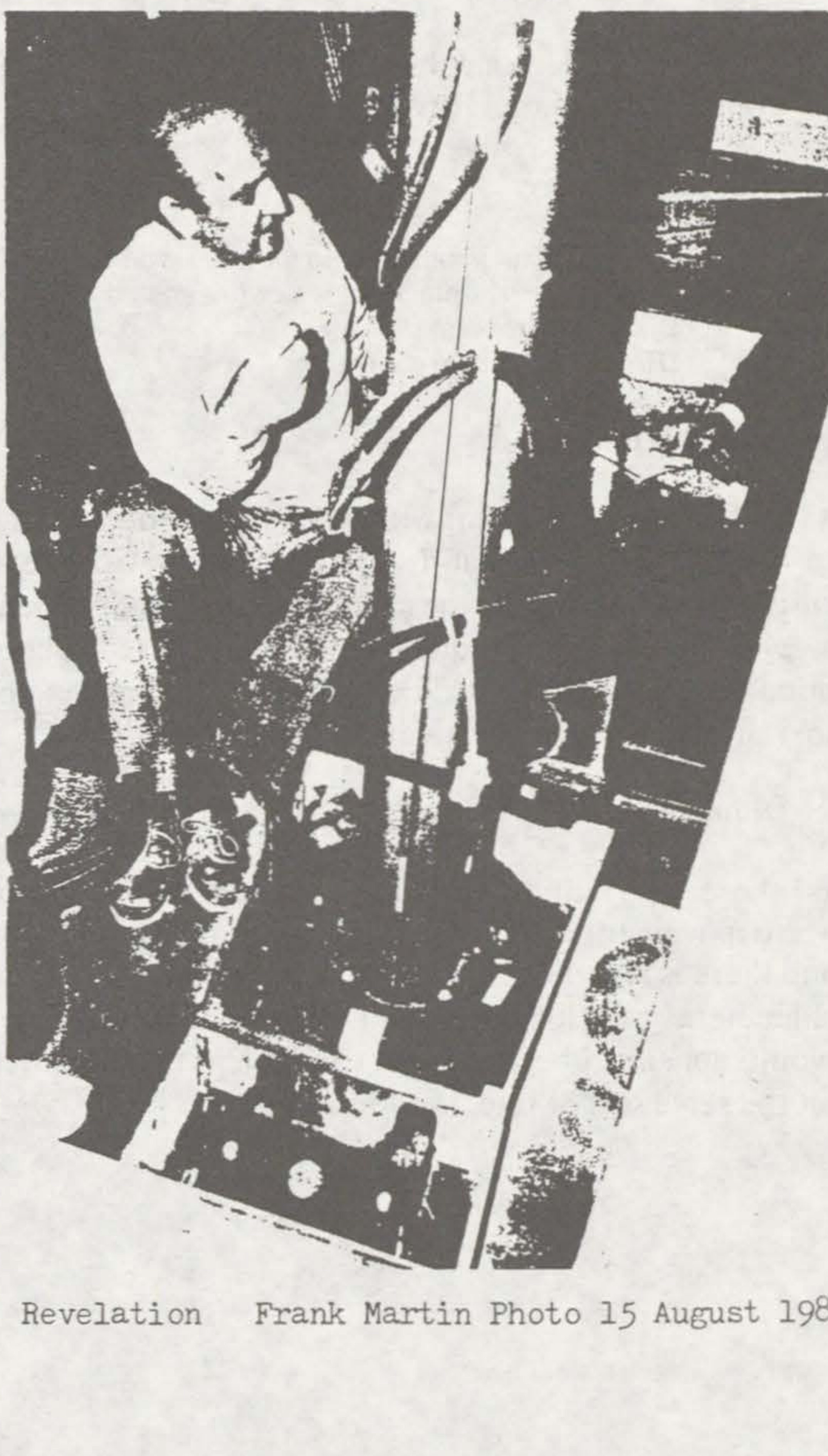


Revelation   Frank Martin Photo 15 August 1985

The program can now be used to examine the performance of any configuration and will give the projected ideal performance i.e. the maximum achievable speed assuming zero friction of turbine and propeller. The result can therefore be used to judge the success of a practical design and give a figure of merit according to how close the practical performance approaches the ideal performance.

In order to obtain an idea of the effect of friction, an efficiency factor has been included which is the power loss due to friction and it is simply applied to the power generated by the turbine, it therefore takes account of the skin friction and form drag of both turbine and propeller.

This program covers only one course i.e. the boat is sailing straight into the wind but it can be modified to take account of different wind directions and the lifting force generated by an inclined turbine, consequently allowing for a reduction in the hull drag factor H. In fact it opens the way for investigating the theoretical performance of a number of different configurations.

The program has been used to calculate a number of curves based on the author's wind turbine propelled catamaran Revelation.

The values of the variables are:

CD = .6 Hull windage drag factor (assumed)
H = 120 Hull water drag factor (measured by tow test)
DP = 1 Propeller diameter
DT = 7.48 Turbine diameter

1. Boat Speed/True Wind Speed

This shows that boat speed is linear with wind speed both under ideal conditions and with an efficiency factor less than 1. A few points showing measurements taken on Revelation are given, these show the usual scatter of results when practical results are used, however, statistical techniques could be used to calculate the slope of the line over a number of readings thus allowing the performance to be averaged over a large number of readings to produce an accurate result.

2. Propeller Diameter/Boat Speed and Propeller Froude Efficiency

As expected there is a minimum diameter below which the propeller cannot produce forward movement and this provides one limit for propeller diameter. On the other hand there is no point in having too large a propeller and it appears that the 1 metre diameter chosen for Revelation is at a point where the curve is flattening out and so would appear to be about right for the job. The efficiency curve also flattens out at the same sort of rate.

3. Boat Speed/Hull Drag Factor

This is the most interesting result, it shows that boat speed is inversely proportional to the hull drag and that speeds considerably in excess of the wind speed are possible providing that drag can be reduced. This could be by means of hydrofoils combined with an inclined turbine to produce lift. The approximate drag factor of Revelation is marked. Revelation is a heavy cruising catamaran with poor WL/beam ratio and low aspect ratio keels, so obviously a boat designed for speed and lightness would have quite a sparkling performance.

The above curves show the performance assuming there are no physical limitations and propeller thrusts. In real life these effects have to be taken into account and they produce the real limitations. Revelation weighs about 2 tons on a beam of 12′ and length of 26′ the force required to fly a hull at the centre of the turbine is easily calculated. There is also a limit to the maximum power that can be transmitted because power generated is proportional to the cube of wind speed, power builds up very rapidly with wind speed and the whole rig exhibits a surprising sensitivity to it. This power is controlled by varying the pitch of the turbine blades. In addition a torque limiter is used which disconnects the drive shaft when a given torque is reached. This normally happens at a given RPM of the turbine and so there is an effective limitation of power.

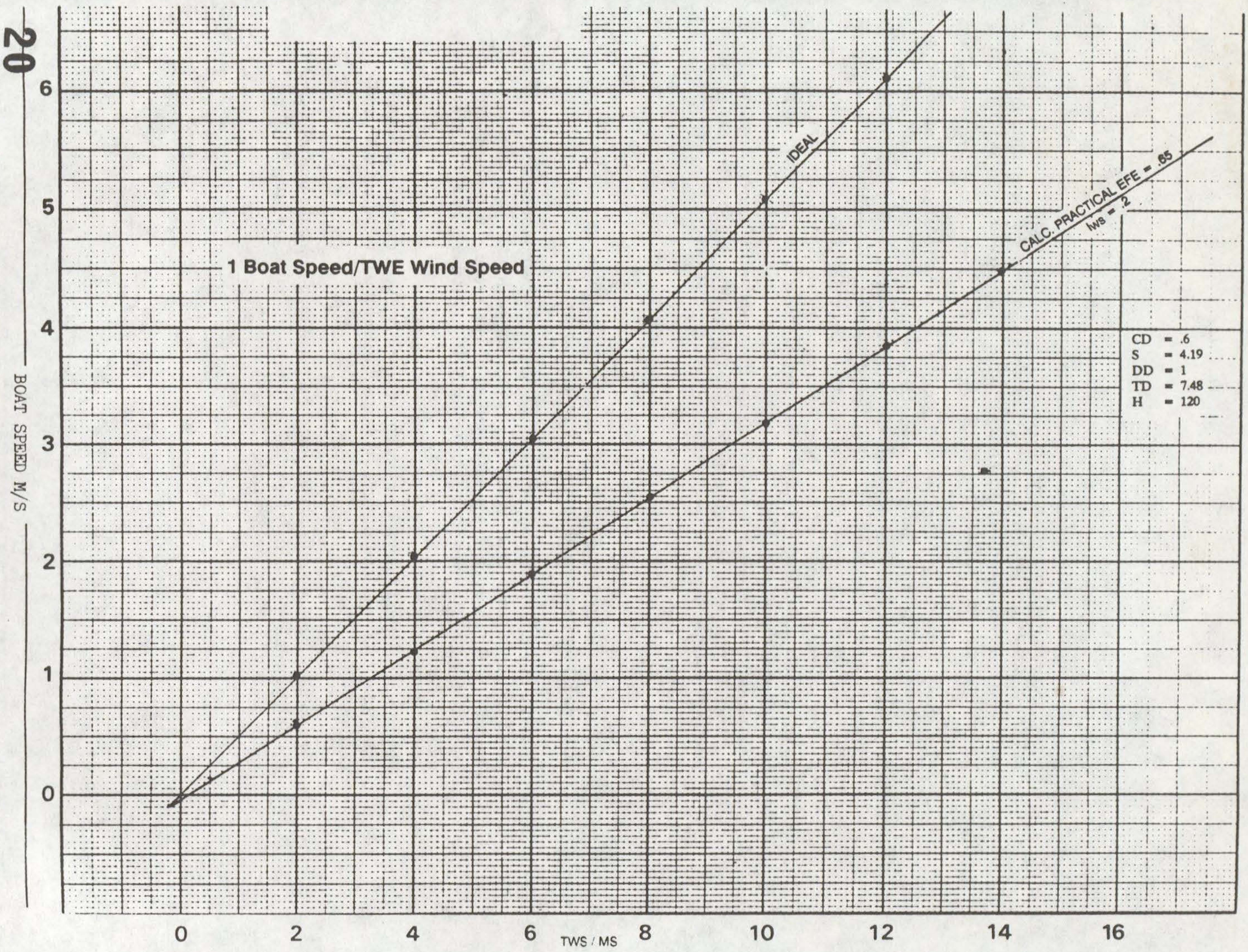
4.

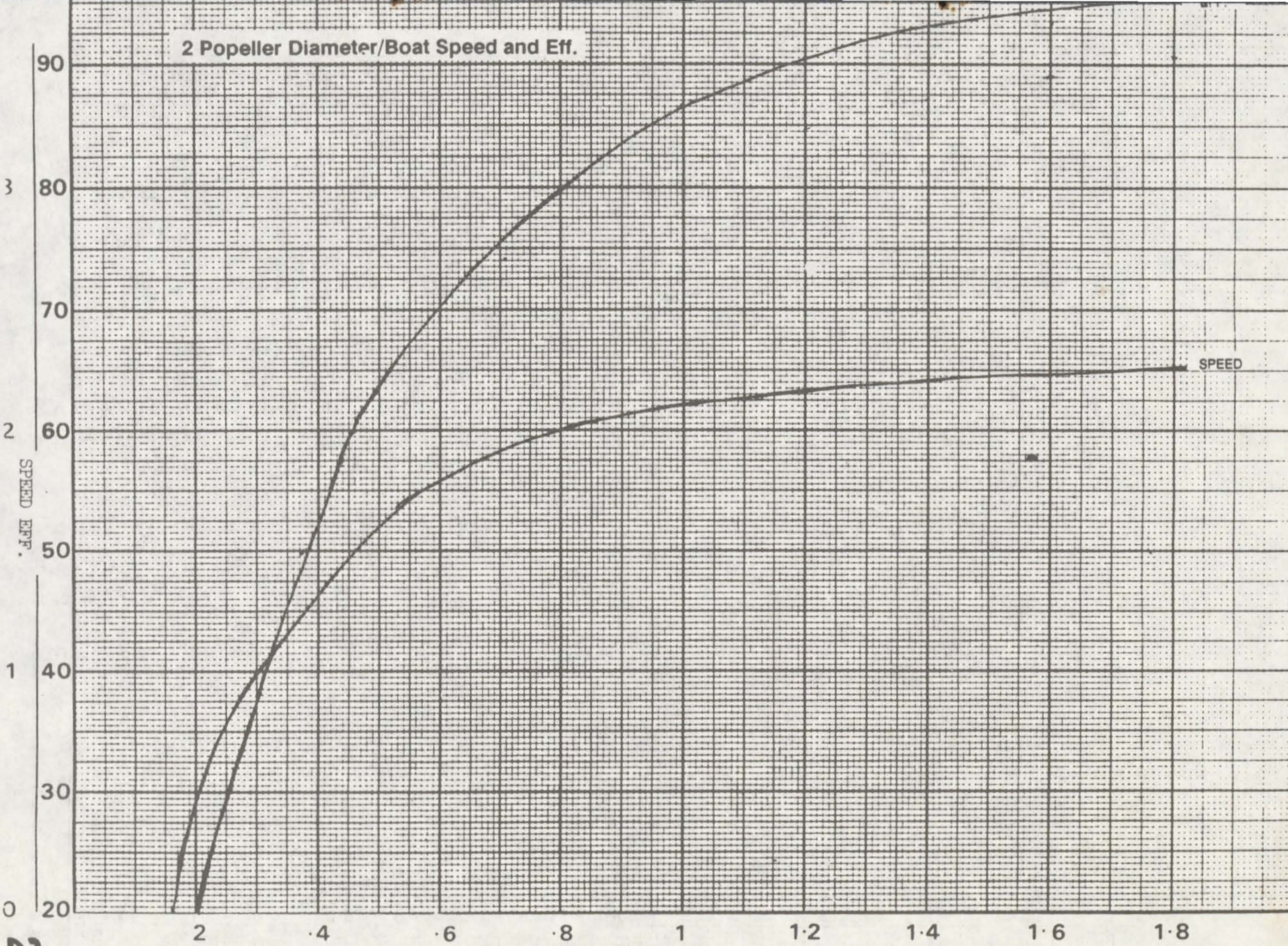
This shows the boat speed plotted against wind speed when V_2 is adjusted to maintain (a) constant wind drag, and (b) constant power.

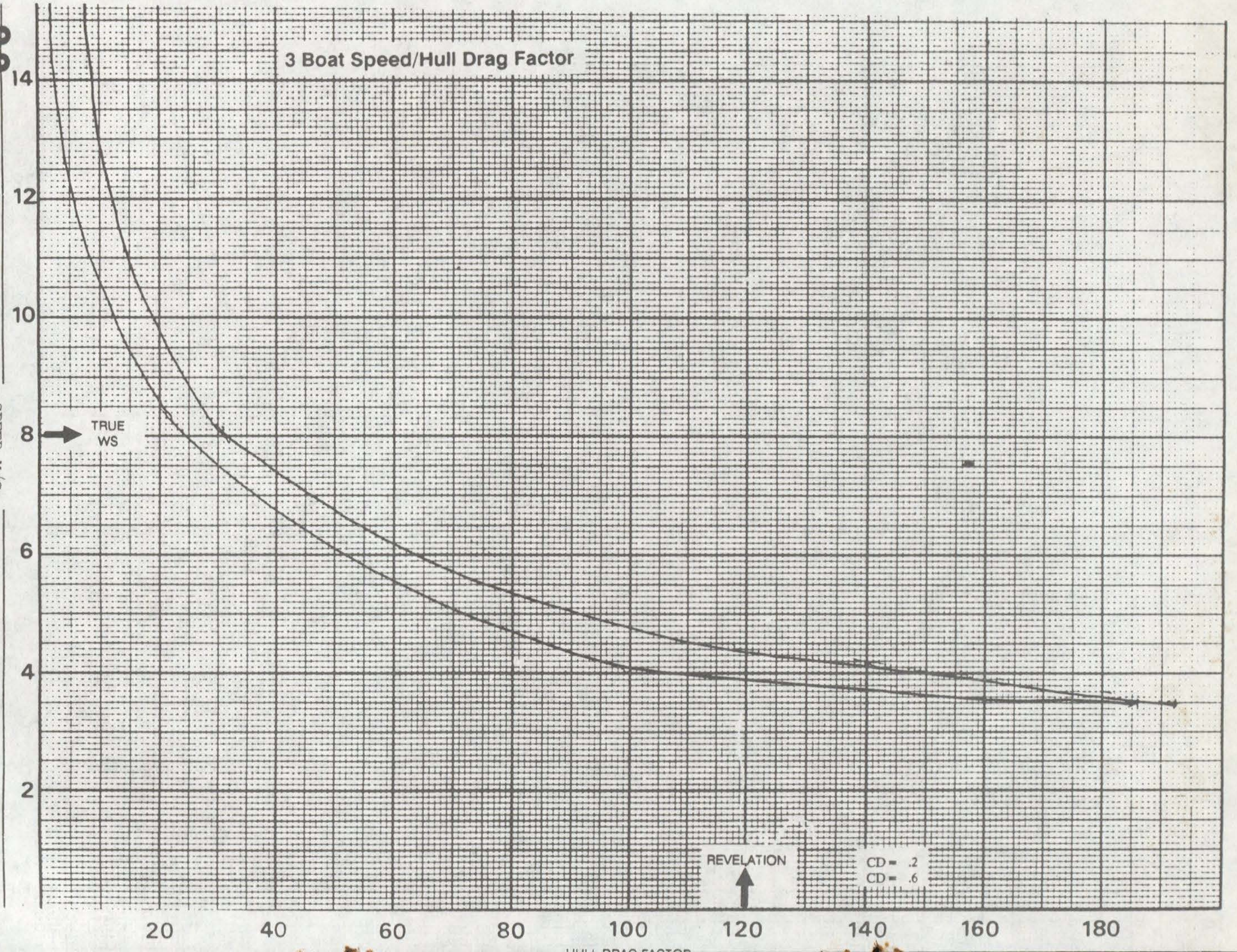
The curves are remarkably flat considering the range of wind speeds and this is also born out by experience on the water as the torque limiter always seems to operate at about the same boat speed regardless of wind speed. The torque limiter also of course, acts at a given power, given constant RPM it is therefore a valid power measurement.

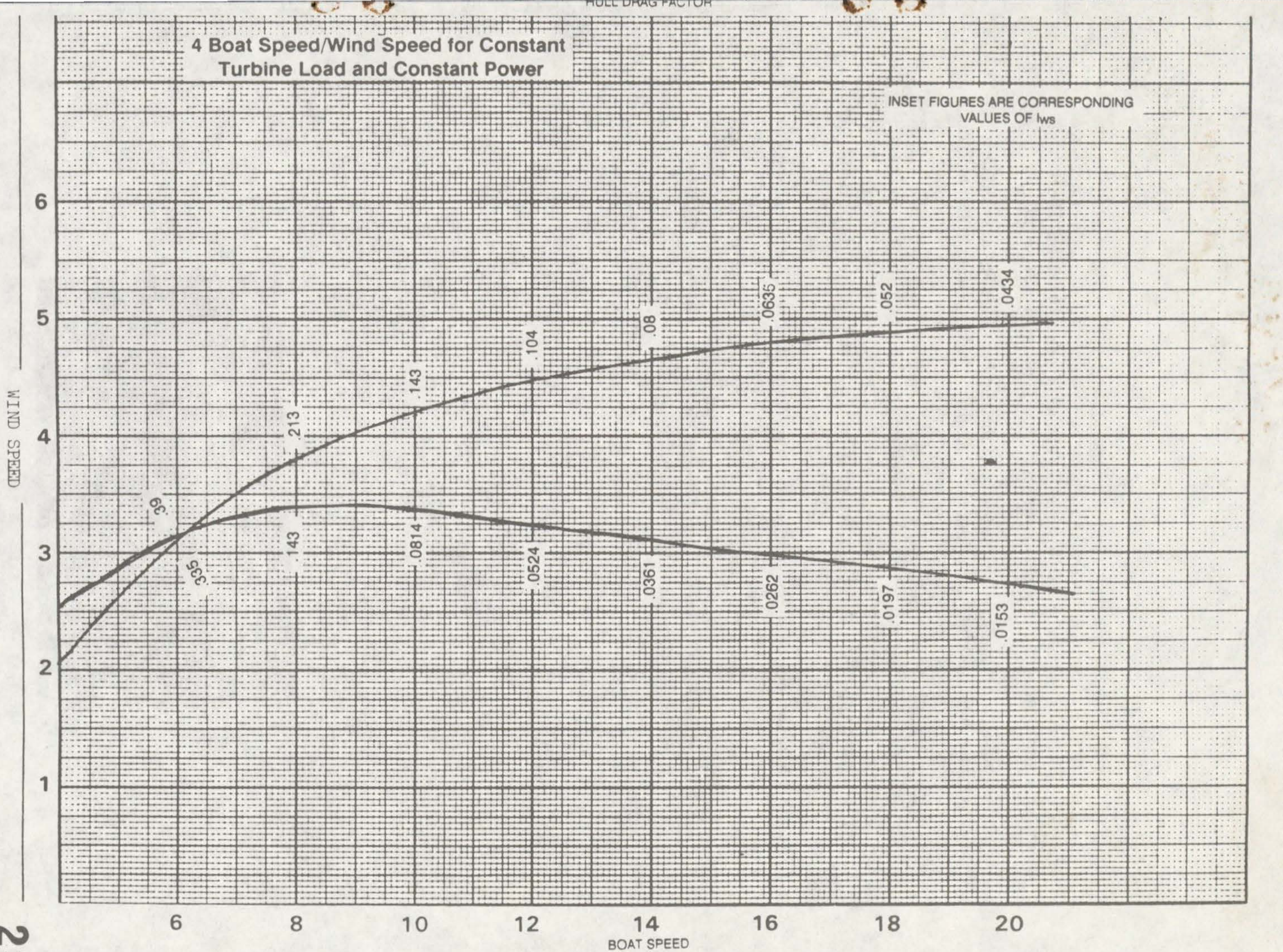
In the case of Revelation it appears that power is the most critical limitation rather than strength of mast and it might be better to strengthen the drive shaft and gearbox.

The value of V_2 is controlled by varying the pitch of the turbine the sensitivity of this adjustment is indicated by the small increment of V_2 that are needed at high wind speeds to maintain the constants.


1 Boat Speed/TWE Wind Speed
BOAT SPEED M/S
0
1
2
3
4
5
6
TWS / MS
0
2
4
6
8
10
12
14
16
IDEAL
CALC. PRACTICAL EFE = .65
hws = .2
CD = .6
S = 4.19
DD = 1
TD = 7.48
H = 120


2 Popeller Diameter/Boat Speed and Eff.
SPEED EFF.
0
1
2
3
20
30
40
50
60
70
80
90
2
·4
·6
·8
1
1·2
1·4
1·6
1·8
SPEED


3 Boat Speed/Hull Drag Factor
SPEED M/S
14
12
10
8
6
4
2
TRUE WS
REVELATION
CD = .2
CD = .6
20
40
60
80
100
120
140
160
180
HULL DRAG FACTOR

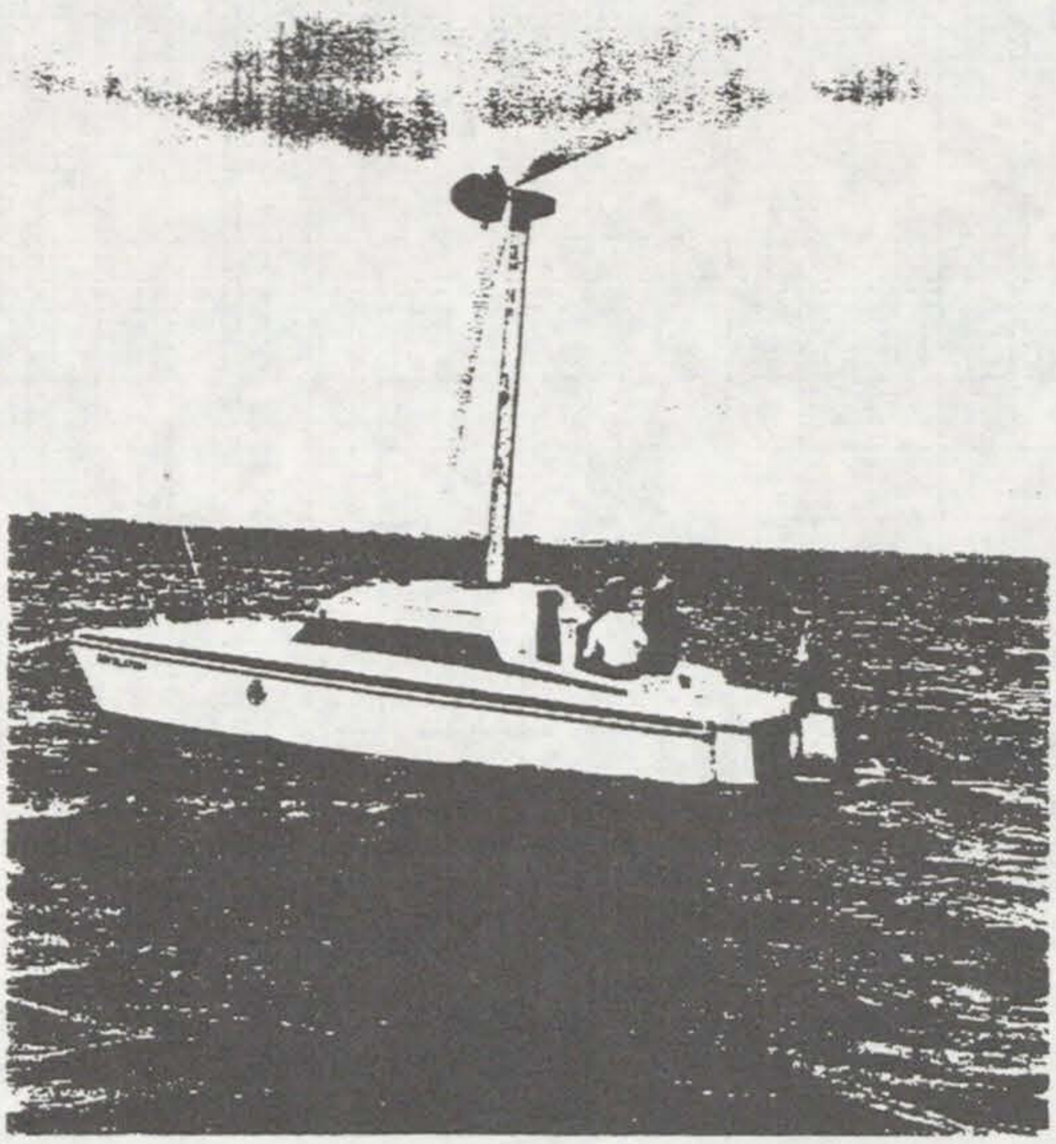

HULL DRAG FACTOR
4 Boat Speed/Wind Speed for Constant Turbine Load and Constant Power
INSET FIGURES ARE CORRESPONDING VALUES OF lws
WIND SPEED
BOAT SPEED
1
2
3
4
5
6
6
8
10
12
14
16
18
20
.39
.213
.143
.104
.08
.0635
.052
.0434
.335
.143
.0814
.0524
.0361
.0262
.0197
.0153

Conclusions

The method produces good results that appear to be in line with those obtained in practice a useful comparison between theoretical maximum and actual performance is obtained. This can be used to judge the quality of an actual design. The method can also be used to give a feel for the starting point of a practical design.

A practical design demands the choice of the number of blades and their airfoil sections, twist, solidity etc. none of these are provided by the (moments) method which enormously complicate the amount of calculation work necessary and therefore, it is difficult to visualise the effect of changing the main parameters. It is hoped this article will help to give a feel for the subject and that it will stimulate interest in this means of propulsion. Revelation has now been on the water for 3 years and apart from minor changes to the engineering she remains pretty well as originally designed.

During that period she has cruised extensively on the East Coast including the direct crossing to Holland and she proves to be a very satisfactory, easily managed and safe boat. The performance offthe wind is roughly equivalent to the same hull using canvas sails, but to windward she is very fast since VMG is the same as speed through the water. Very few vessels under 35ft can beat her in a 15KN breeze. When going to windward she is dry since spray does not blow over the deck.



Revelation   Frank Martin Photo 15 August 1985

After Jim Wilkinson had spoken, Reg Frank announced his intention of compiling a list of members of AYRS who are particularly interested in using kites, masthead rigs, line tethered rigs and swivelling pole attached rigs. The following is the list that he has at present:

Reg Frank, 87, Staincross Common, Barnesley., S75 6NA.
Yorkshire. Tel. (0226) 382272.

Ian Day, 19, Carisbrooke Court, New Milton, Hampshire BH25 5US

Josef T Dusek, (builder of foiler yacht 'DALIBOR') P.O Box 404,
Potts Point, Sydney 2011, Australia

George Floyd, SVL Box 7005, Victorville, CA92392, USA.
Tel. (619) 245-7545.

Roger Glencross, 6 Melville Avenue, West Wimbledon, London SW20 ONS.
Tel. 01-946-3254.
also, 7 Sudan Road, Rodwell, Weymouth,Dorset, Tel. 0305-785013.

Lasse Jamsa, A-Elementti, DY Rakennusmies, Ristopellontie 16, 00390,
Helsinki 39. Finland 2.

James Labouchere, 'Hydrosled Challenge', Kington St Michael, Chippenham,
Wiltshire SN14 6JR. Tel. (0249) 75222.

R.H. Maggs. c/o 156, Bedminster Down Road, Bristol BS13 7AF.

Dr. Enrique G. Petrovich, Advanced Sailing Inc,
620 SE. 18th. Avenue, Pompano Beach, Florida 33060, USA.
Tel. 305-941-1324 and 305-941-3549.

Dag. Romell, Angarna, PL386. Harbackshult, S286 00, Orkelljunge, Sweden.
Tel. KLIPPAN 0435-51455 and 0435-52355.

Walker Wingsail Systems Plc, Devonport Royal Dockyard, Plymouth PL1 4SG

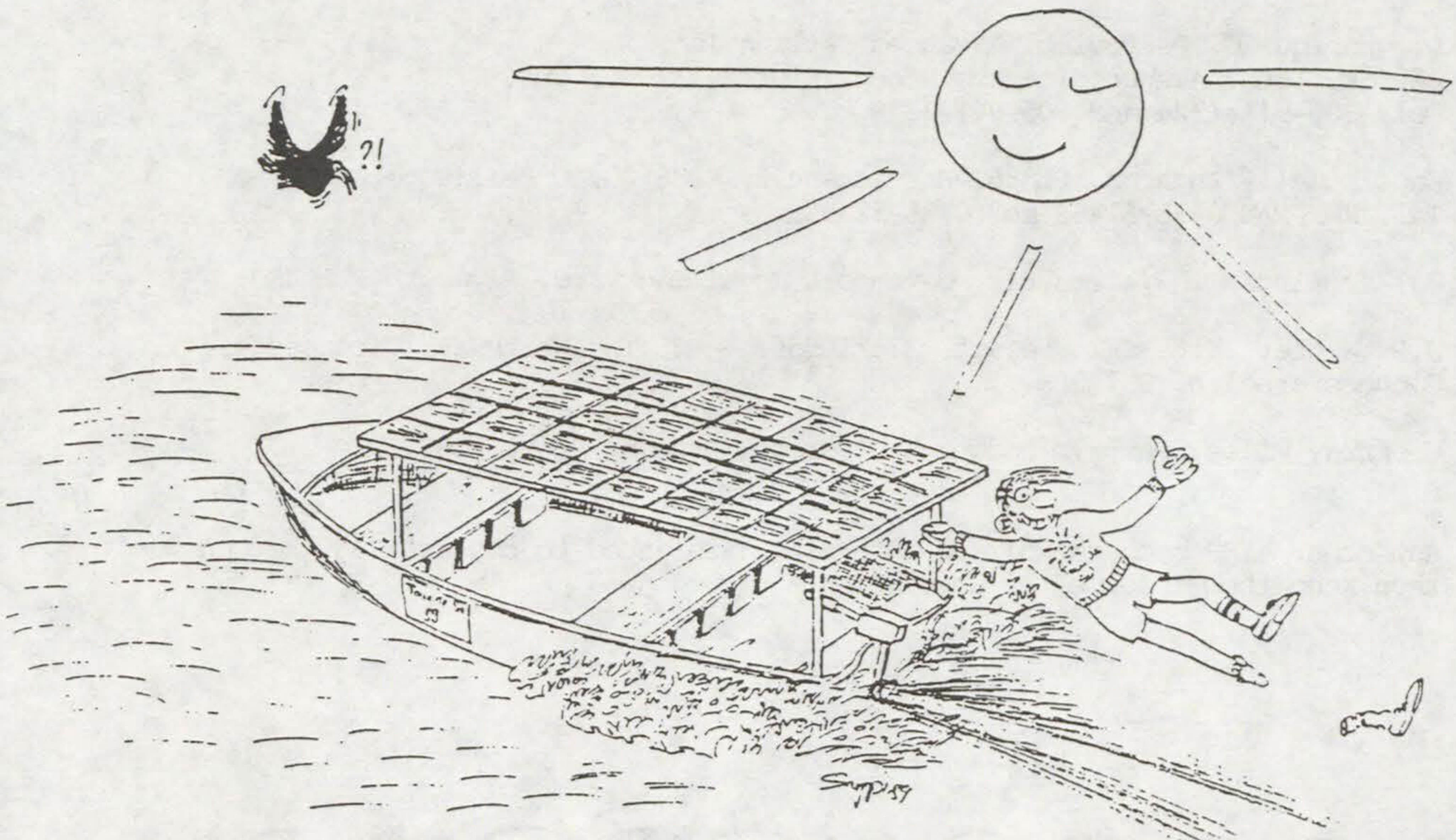
J.P. Winter, Kite-Ski Project, Mickledore, 25 The Whiteway, Cirencester,
Gloucestershire, GL7 2ER.

Geoffrey Miles, Penbryn Lodge, The Street, Brecon, Powys LD3 7SR.

Any other AYRS members who are interested are asked to contact Reg. He can then keep them informed of developments.

THEO SCHMIDT

Reg Frank was followed by Theo Schmidt who spoke entertainingly and enthusiastically on Solar Power and his work thereon in Switzerland. He had attended several Solar Power events in 1988, one with seventeen powered boats entered, another with nine. Theo told of his own attempt to cross the English Channel by Solar Power which highlighted one problem of solar power. When the sun is at a low angle the power falls. The array of solar cells is tilted to compensate and this can become a problem in windy conditions. Electric boats with the solar arrays charging batteries are heavier but are often more practical. All such craft must be very efficient. This encourages great ingenuity in design but gives in return almost total autonomy and reliability even in quite substantial adverse winds. The cost of arrays of solar cells was approximately £3.20 per watt at 1988 prices.



ADDRESS BY NED SNEAD

More than 20 Years ago I read Barney Smith's book "The 40-Knot Sailboat". The idea of combining a lifting sail to reduce displacement and hydrofoils to reduce wetted area was fascinating to me, and in the last ten years I have spent more time and money than I care to admit trying to build a practical boat this way.

In 1980 I contacted Barney Smith and sailed his monomaran, which we both thought was almost ready for sale to the public. I paid him several thousand dollars for a licence and kept his prototype at Lake Buchanan for three years. After many minor changes I decided that his steering system could not be perfected, the sail frame could not be scaled up, and there could not be enough displacement in the foils to sustain a back wind without capsizing.

About the same time I bought a windsurfer and learned to handle it in light winds. In strong winds I was frequently picked up and thrown in front of the board, proving to me that a very small sail could carry the weight of the boat and crew and make good speed at the same time, provided the crew was skilful enough.

By the time I got to Weymouth in 1983, the board sailors had mastered the skill well enough to outrun any sailboat except Crossbow, including well-developed foil riders like Icarus, Mayfly and NF2. It seemed as if the hydrofoils had found their own speed limit at just under 30 knots, although I would not bet against Philip Hansford's next generation of hydrofoils.

Last year I realised that Malcolm Barnsley with his "Alien" was working in the same direction that I was. I also saw the high quality of craftmanship in his boat and learned that Nick Barlow was the man with the magic hands. This year the three of us have pooled our resources and come up with "Delta".

This boat is a proa with the man-carrying hull always to windward. Two smaller planing hulls carry the leeward corners of the sail frame. They are free to pitch over waves and yaw, controlled only by their skegs. The main hull is also free to pitch, but it is held at a fixed angle to the sail frame by steering lines. It has two rudders, but only one is used at a time. A daggerboard is moved between tacks to a well in the leading end of the cockpit.

We are experimenting with a radio controlled model with a swinging centreboard on ball bearings which might replace both rudders and the daggerboard. If it works, it will improve the appearance and allow the boat to run up on a beach easily.

There are two roller furling sails of about 150 square feet, one of which is used on each tack. All four of the spars are elliptical to reduce drag and they add enough to the sail area to put the craft into class B.

Our goal this year was to be on the water every day and to make a lot of timed runs, hopefully over 20 knots. Our longer range goal is to come up with a seaworthy design which can be scaled up to beat Michael Fay and Dennis Connor around the buoys.

DAVE CULP

After Ned Sneed, Dave Culp spoke of the Skysail kite waterski projects with which he is heavily involved. Dave amazed many present by asserting that 40 knots had been achieved as had runs of one and a half hours without falling or dropping the kite!

Dave described in detail the use of large specially designed and made skis which were used to get up quickly and aid control. They were stable to 70 knots behind a powerboat and were predictable and repeatable in handling. Control of the skis was by "edging" since the use of a skeg produced vertiliation (or cavitation?) at 35 knots and higher. The kite working in a controlled stall improves its lift to drag ratio at 35-40 knots. When kites stop oscillating at high speed some not clearly understood things happen. But the presence of the human mechanism in the system allows fast improvements to control and development.

In reply to questions Dave stated that the faster the man goes the closer to the wind he can sail. He also made the point that lateral resistance and closeness to wind were in some conditions a trade-off.

ROY PACE

The thirteenth speaker Roy Pace spoke briefly about his new boat which with some humour he described as having "organic outriggers" which were of insufficient length. (His arms were too short!) He said that no development of this craft was planned as it did not work at all. This highlighted to all present that sometimes it is best to admit you have made a total mess of your theory, calculations, design or constrution and to laugh it off and go back to square one. (It is nice to know that others too have this problem!)

MALCOLM BARNSLEY

Next Malcolm Barnsley spoke about the design and philosphy behind "Delta", Ned Snead's craft at this year's Weymouth Speedweek. He spoke of the choice and problems with angled sails, their low efficiency in low wind speeds and their great advantages when designed and exploited correctly.

A questioner asked how the freely pivoting floats of "Delta" were designed. He was not entirely displeased to be told that the approach was purely intuitive. Despite all the mathematics deployed to solve such problems, guesswork and empiricism are alive and well!

PHILIP HANSFORD

The fifteenth speaker was Philip Hansford who answered questions about his boat "Philfly". He was asked whether is was possible to set the control foils to zero angle of attack, get foilborne and then link in the "feeler" control system rather than having it permanently engaged. Philip replied that it would work that way if so required. Asked why he did not use surface piercing foils to "get-up" and submerged foils to "stay-up", Philip cited weight and complexity to militate against such an arrangement.

David Chinery asked the final question. "When designing Philfly you used a rearwind trailing sensor system instead of the classic forwards facing "Hook" type. How did you arrive at this arrangement?" Philip answered that it "seemed more practical". (Yes it is, but not obvious until you have seen it done! GGWW). All present agreed that it was one of the most elegant ideas around.

The free discussion continued until 10.15pm. all agreeing that at next Speedweek there should be another AYRS Speedsailing symposium.

CANAL COURSES FOR SPEED SAILING

GRAEME G W WARD

As sailing speeds have risen and the required true wind direction has become broader, similarly the required wind speed has become greater. This has caused wind-induced waves to become a major factor in the choice of suitable locations for speed events. After promising results from some "ready-made" very sheltered courses, a course carefully orientated to suit the likely wind was excavated after the manner of a short length of canal in a flat beach at Les Saintes Maries de la Mer in the Camargue. This area is blessed with a local wind, the Mistral, which blows with some predictability in both direction and speed.

This course, on a line 60degrees/240degrees true, initially in March 1988 of 830m and lengthened in January 1989 to 1200m has opened up new vistas in speed sailing. Although really only suitable for sailboards and perhaps the smallest craft it has changed the very approach to speed sailing of all involved, from the sailors and spectators through to the organisers and sponsors. The sailors have had to find new ways of seeing a gust coming, over land rather than over water, before starting, often by pushing their board into the end of the canal or along the side before jumping on, hopefully, straight into the toestraps! Returning to the start necessitates a whole new system of disciplines to avoid causing wind shadow for following competitors, walking through electronic timing beams, treading on delicate cables at the side of the course, obscuring video camera sight lines, even not getting your return transport hopelessly stuck in very wet sand near the course.

This latter problem is largely due to the course water level being above the surrounding beach level as the banks are shaped to minimise wind turbulence and the "canal" is pumped to within centimetres of the bank top. The seepage thus caused can make the adjacent beach hydraulically soft.

The organisers have even more problems. Aside from choosing the location and bearing of the course and the depth (too shallow and it is dangerous, too deep and it is expensive to build and keep full,) they have to keep the spectators and Press close by but not on the windward side, and again not on the cables, in timing beams or video transits. Also the canal must be kept full and the windward bank which slowly erodes into the canal must be reconstructed every few weeks if the winds are very strong.

With such a course it is necessary to have the wind within a very narrow angle for good sailing. In the event that it is not, patience is a great virtue, as also is a sympathetic sponsor! Even with all the wind at the ideal angle to the course, starting in high winds can be difficult and it is helpful if the course is wider in this area so that the competitors can curve in to the optimum course, starting on the leeward side and rather more square to the wind before speeding up in a curve to the weather side.

When everything goes right the results are quite amazing; personal best times flow thick and fast from the timing computer print-out. The next time the wind blows everyone is complaining about the "hole" in the wind caused by some small bush or similar feature barely visible upwind and previously unremarked! All are certain that they could improve their speeds greatly if such were to be removed! Nevertheless to achieve the full potential of such courses attention to detail is most important and there is yet some mileage in "fine tuning" both the physical courses and the techniques of sailing them.

Even at this early stage small wavelets, driven diagonally across the canal, cause interference effects and cause somewhat larger waves to run down the length of the course. As the techniques improve and the wind requirements increase the optimum wind will be rather more along the course and such waves are expected to cause problems. Already possible methods of preventing the propagation of waves along the length of such a course are being sought. I feel AYRS members could have much to contribute in the form of ideas and experiment in such an endeavour.

In January 1989 a second "rival" canal was opened in the Zone Industriel de Fos just north of Port St. Louis and about 40 minutes drive east from the first one. Called the "H_2O Speed Canal" it is rather more than 800m. long and slightly wider at 28m that the Sts. Maries Canal at 25m. In January/February 1989 it was about 1.3 - 1.7m deep but not yet quite full enough to prevent bank turbulence with the water about 80cm. below the bank top. Its location is clear of obstructions, taller than 20cm high for at least one kilometre to windward, so the wind is clean. On a bearing of 20degrees/200degrees for a wind of around 330degrees it is probably potentially even better that the Sts. Maries canal. It should be noted that the two canals are at differing angles because the Mistral wind spreads out as it reaches the area of the Rhone delta and both canals are optimum for the winds expected at their respective locations.

Doubtless there will be other courses of this type constructed at appropriate locations around the world, places where the wind vectors are reasonably predictable and the required concentration of enthusiasm, effort and money can be brought together. Some interesting problems have been solved or attempted such as timing at night and reflective bar code sail numbers on the video camera system. Doubtless other problems will arise and hopefully be solved.

In less than 15 months many of the major speed records have been broken on these two "Canal" couses including the first sailing record at over 40 knots, and the Ladies record is now closer to the outright record than ever before. It is reasonable to expect the outright speed record to reach 43 - 45 knots within a short time given the right wind conditions. Expectations beyond that are somewhat speculative and most likely require the evolution of techniques and equipment to suit; weight jackets, offset mast steps, asymmetric boards, vortex sails are some ideas that are being tried or considered. Perhaps special boats for canal courses are possible. Perhaps catapult and kite ski launching systems can be devised. Whatever happens AYRS members must be to the fore.

HARNESS THE HEATWAVE, SAIL BY SUNPOWER

Report by Theodor Schmidt

Why Solar Boats?

Ordinary petrol or diesel boats have several disadvantages:

On lakes, rivers and canals, pollution caused by exhaust and lubricating oils does much damage and several countries have banned 2-stroke engines or require bio-degradable oils to be used.

Noise frightens wildlife and annoys other waterway users.

Because high power is readily available and is cheap, hull design has deteriorated and most modern motor boats are not only driven at inappropriate speeds much of the time, but waste most of the motor's power by creating large washes, which not only annoy and sometimes endanger other sailors, but also erode banks.

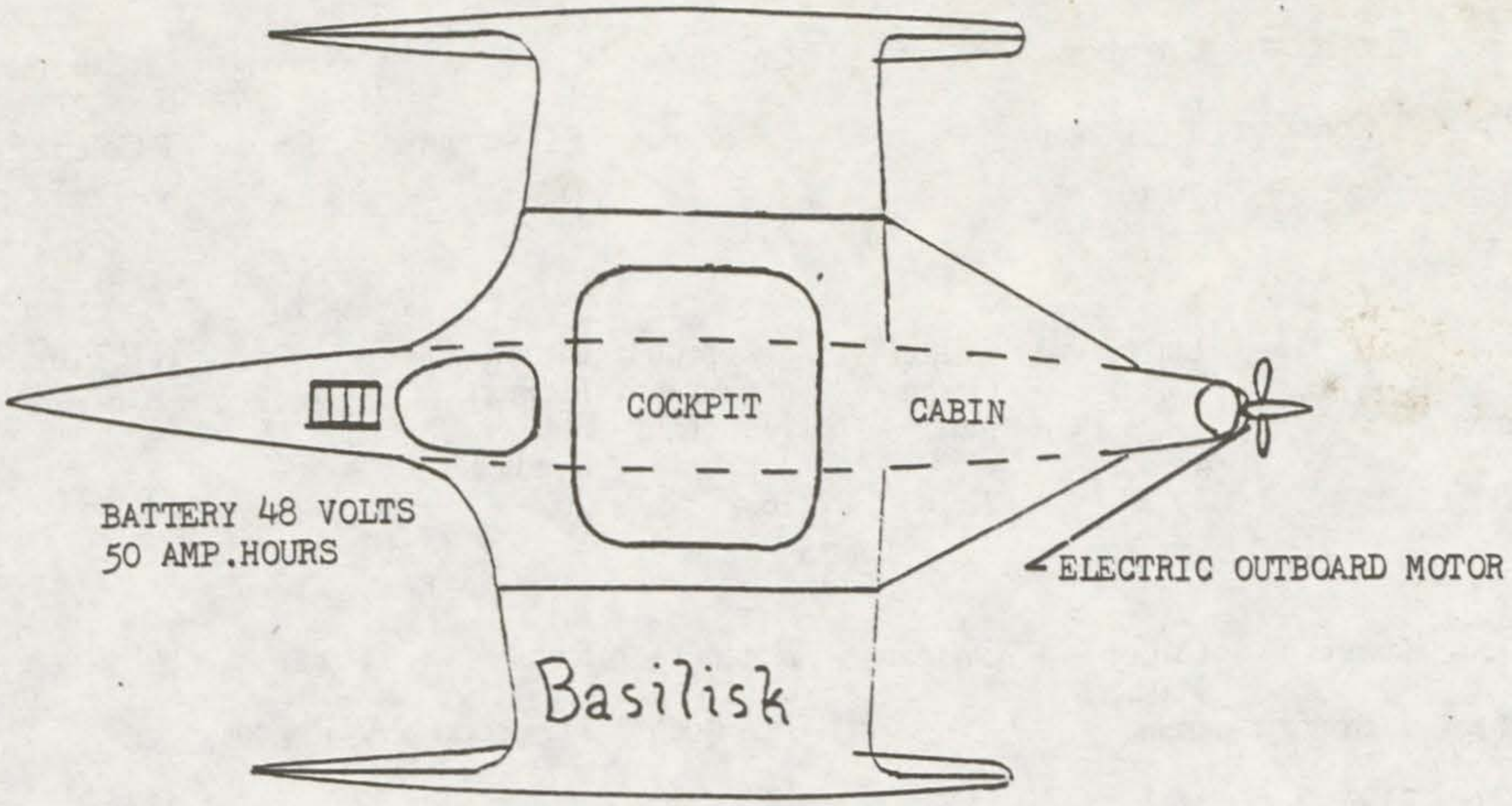
Steam engines offer a partial solution, but unless especially clean fuels like LPG are used, the pollution problem remains.

Electric drives are well known and especially suitable for displacement boats, where weight of the batteries does not matter much or is even useful as ballast for sailing. The main disadvantage is the need for charging facilities and the cost of replacing the batteries after five or ten years.

Both these disadvantages can be greatly reduced if solar panels can be fitted to the boat: not only is the need for shore-based charging reduced or dispensed with altogether, but also the amount of batteries can be reduced, in extreme cases to zero, and their lifetime is prolonged even while the cruising range is extended.

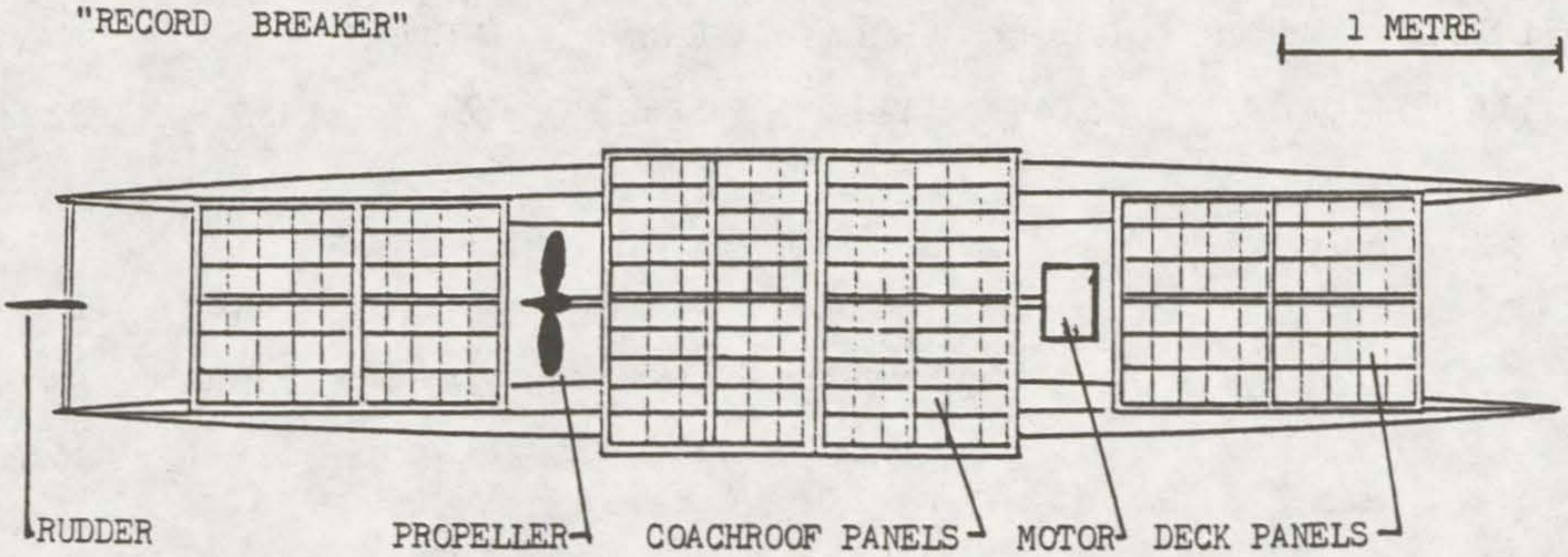
Users of efficient electric boats soon realise that the power required is a fraction of that of equivalent petrol installations and that energy consumption is suprisingly low. Distance record holder is a standard Frolic 21 (built by Steam & Electric Launch Co.) driven by Rupert Latham: over 100 miles on a single charge.

Solar boats of course have even greater ranges and many can cruise indefinitely, in Summer, anyway. Pleasure boats are often used infrequently, at weekends, for example, so a relatively small solar panel can be fitted, which will charge the batteries up during the week. Many traditional boats have suitable coachroofs, sunroofs or decks, so that installation of panels need not be difficult. The high initial cost of the solar panels may sometimes be recuperated eventually by the savings on batteries, but more important is the "image" value to hire operators, companies, etc., and the personal satisfaction to individuals, not unlike the fascination of sailing, and also the sheer convenience.



NOT SHOWN : COACHROOF AND SIDE SOLAR PANELS

"RECORD BREAKER"



WEYMOUTH SPEEDWEEK

	1972	1973	1974	1975	1976	1977	1978	1979
Sponsor	Players			Players	Players	Players	Smirnoff	
Open Class								
Boat/Craft	Crossbow	Crossbow		Crossbow	Crossbow II	Crossbow II	Crossbow II	Slingshot
Helmsman	T Coleman	T Coleman		T Coleman	T Coleman	T Coleman	T Coleman	K Thomas
Speed (kts)	26.3	29.3		31.24	31.8	33.8	27.7	22.6
C Class								
Boat/Craft		Lady B	Clifton Flasher	Stampede of Cowes	Clifton Flasher		N F 2 (b)	Smoothy
Helmsman			Irens	J Pritchard	Flasher Syndicate			J Vigurs
Speed (kts)		17.7	22.14	16.4	20.4		24.4	14.1
B Class								
Boat/Craft	Icarus	Clifton Flasher	Orlando	Hobie Cat 16	Icarus	Icarus	N F 2	Icarus
Helmsman	J Grogono	Irens		J Dinsdale	J Grogono	A Grogono		A Grogono
Speed (kts)	21.6 (a)	16.2	16.31	16.9	20.7	22.2	23.0	18.9
A Class								
Boat/Craft	Mayfly	Mayfly	Mayfly	Mayfly	Mayfly	Mayfly	Mayfly	Mayfly
Helmsman	P Hansford				B Wynn	B Wynn	B Wynn	B Wynn
Speed (kts)	16.4	12.0	19.38	19.4	21.1	23.0	18.7	22.0
10 sq m								
Boat/Craft	Kotaha	Shooting Star	Boreas	Boreas	Auster	Wind-glider	Seafly 10	Olympic Gold
Helmsman	L Smith	R Bratt	R Bratt	R Bratt	R Bratt	D Thys		C Colenso
Speed (kts)	13.6	9.1	15.04	14.1	14.6	19.1	15.7	22.9 (c)
Design/ Prize								
Boat/Craft				Mayfly	Exoplane	Sisi	Force 8	Dice
Helmsman				P Hansford	D Costes	J Montgomery	P Pattison	J Montgomery
Speed (kts)				19.4	13.2	13.5	12.8	15.6
AYRS Prize								
Boat/Craft								
Helmsman								
Speed (kts)								

Notes
(a) Icarus at Burnham 25.5 knots December 1972
(b) N F 2 in United States 1978
(c) A couple of days after "week" ended 1979
(d) Yap Van de Rest in Hawaii 24.6 knots 1980
(e) Yap Van de Rest at Lac de Veere, Holland, 25.1 knots November 1981 with 7.8 square metres

SIGNIFICANT RESULTS

1980 Ten Cate	1981 Ten Cate	1982	1983 J Walker	1984 J Walker	1985 J Walker	1986 J Walker	1987 J Walker	1988 J Walker
Crossbow II 36.0								
Formula Supercat 19.5	Jacobs Ladder I Day M Rayment 23.8	Jacobs Ladder I Day M Rayment 25.03	Jacobs Ladder 24.48	Loisiers 3000 Galiagnou 22.32	Loisiers 3000/ OK Shape Galiagnou 3.49	YEAR OF GREAT CALM	YEAR OF GREAT STORM	Loisiers 3000 J-B Cunin 26.44
Icarus A Grogono 23.8	Icarus 24.47	Icarus A Grogono 18.01	Icarus Grogono/ Fowler 26.59	Icarus 25.0	Icarus A Grogono 28.15			Icarus J Grogono 21.32
Force 8/ Seafly14 17.5	Seafly 16.45	Loisiers 3000 J-B J-B Cunin 16.83	2 man Board Way/ McKinley 25.39	2 man Board Way/ Griessman 24.73	2 man Board Way/ McKinley 25.58			2 man Board Tuckman/ Coe 24.80
T C 2 23.8 (d)	Board Hauschied 24.75 (e)	Board P Maka 27.82	Board Haywood 30.82	Board Siret 29.68	Board P Maka 30.27			Board Bertin/ Maka 28.80
Jacobs Ladder I Day M Rayment 18.6			Gama 24.58					
	Seafly/O 21.39		Gama 24.58	Inter-media 13.12	Inter-media G Shine M Handley 16.71	M Spindler 179% VT		

THE 1988 JOHNNIE WALKER SPEEDWEEK

PORTLAND, ENGLAND

RESULTS

10 SQUARE METRE-MEN

			KNOTS
1.	Manuel Bertin	France	28.80
2.	Pascal Maka	France	28.80
3.	Jean-Pierre Siret	France	28.64
4.	Erik Beale	Great Britain	28.55
5.	Olivier Auge	France	27.91
6.	Julian Kendall	Great Britain	27.66
7.	Stephan Pavcovich	Italy	27.55
8.	Mac Taylor	Great Britain	27.28
9.	Yves Salaun	France	27.19
10.	Peter Bridgman	Great Britain	27.12

10 SQUARE METRE-WOMEN

1.	Elizabeth Coquelle	France	26.07
2.	Susie Miles	Great Britain	25.85
3.	Paula Wickens	Great Britain	25.50
4.	Sylvie Renart	France	25.07
5.	Samantha Harrison	Great Britain	23.79

10 SQUARE METRE CRAFT SAIL AREA

1.	Cory Roseler Sky Sail	USA	19.89
2.	Greg Warner Harris Rebel Yell	Great Britain	17.63
3.	Philip Hansford Philfly	Great Britain	17.49

A CLASS TANDEM SAILBOARDS

1.	Mark Tuckwood/Rod Coe	Great Britain	24.08
2.	Steve Coombs/Tony Bartho	Great Britain	23.75
3.	Paddy Payne	Great Britain	23.51

A CLASS CRAFT

1.	Yves Salaun Deltamaran	France	7.71

			KNOTS
B CLASS			
1.	James Grogono Icarus	Great Britain	21.32
2.	Gilles-Loic Durand Danto Rogeat	France	19.24
3.	Robert Date Taal 3	Great Britain	15.75
C CLASS			
1.	Jean-Bernard Cunin Loisirs 3000	France	26.44
2.	James Grogono Icarus	Great Britain	23.30
3.	Ian Hannay Speedbird	Great Britain	15.84
OPEN CLASS			
1.	Robert Downhill Crusader	Great Britain	10.44

IDEAS FROM MEMBERS

In attempting to produce a publication worthy of our Society, a task taking about six times longer and requiring vastly more effort than I expected, I have unashamedly tried to emulate our late founder Dr. John Morwood. In an effort to scatter the fertile ground of our members minds with the seeds of good ideas, I telephoned a selection of members that I know to be especially interested in high speed sailing, and begged to be party to their latest thoughts on or around the subject. Similarly I approached some non-members whom I believed to be possessed of relevant expertise and/or the facility of original thought. Apart from a few blank looks (how do you get a blank look over the phone?), most were suprised to be asked and gave freely of their thoughts, some expanding at great lengths, others with great brevity. The result, apart from sending my telephone bill into orbit, is a sort of mini-symposium of ideas, thoughts, suggestions and odd bits of information. Dr. Morwood did it without doubt more elegantly and precisely by letter, notwithstanding which I hope you may find it as stimulating reading it as I did getting it.

A great deal of time and effort has been put into drag reduction by injecting lubricating fluids into the boundary layer water round the hulls of displacement craft. This is mostly military work and therefore is seldom easy to find in libraries, but a great deal of information can be obtained on the subject of increasing the flow in pipes, such as storm water drains, the same problem inside out! Several people have sent me various scientific papers on this subject and I have now quite a good bibliography available to any members interested in this.

Several of the boardsailing competitors are experimenting with air-entrainment drag reduction ideas. As yet nobody admits to other than inconclusive results, but they acknowledge that very little real effort has been put in, or priority given, and such only on an intuitive basis.

One suggestion that needs a try is soft foam under a flexible smooth coating, rather like a wet suit, for use round struts. One member thinks it will work but admits to not having tried it. He does admit to being about to start building a foil boat with the flying weight controlled by deliberatly venting air into sections of the foil thus destroying lift. He stops the venting to increase the lift and thereby controls the flying height as required. Control of venting is by "Hook" type sensor arms.

Australian Boardsailor Malcolm Wright was very pleased to talk at length and show me his assymetric sailboards, all one-tack speedboards, but apparently quite controllable on the non-optimum tack.

Weight jackets for boardsailors was a subject arousing such passion that it should be banned outright (mostly the opinion of the non-speedsailors). But the speedsailors mostly realise that the inertia provides a great steadying effect, especially beneficial for the lighter sailors. That the jacket should be positively bouyant was generally agreed, provided that the point was universally enforced! Masthead ballast or water ballast for sailboards was not mentioned by anyone except Owen Lewis (see his article in this publication). The filling and emptying rates may be a problem. Maybe the sailor should carry a filling and emptying ballast tank on his weight jacket.

Several suggestions were made about decoupling the sailors' weight from the board, sort of making the sailor part of the "sprung" weight allowing the board to follow the rapid wavelet buffetting of a highspeed sailing run on less than mirror smooth water. I too had been thinking about this after watching the World Records of Brigitte Gimenez and Erik Beale at Les Saintes Maries de la Mer in November 1988. Both being relatively short they sailed with much less "shock-absorbing" movement of the knees and seemed thereby to create rather more wash than Pascal Maka who is much taller and heavier. He appears steadier at the top of his body with considerable movement of the knee and hip joints, giving less wash.

After the AYRS symposium the angled sail generating some upwards lift seems to be an ever more popular a source of thought. The cataramaran Gamma which appeared at Weymouth Speedweek several years ago is still regarded as a stepping-off point by several. The high off-wind drive of a low aspect ratio sail combined with the foot at deck level on a flat solid decked cat combining with a low centre of effort sail with swallow-wing tip to lessen the size of the tip vortex was one idea being tried in model form; smoke-streaming tests look good I am told. The position of the seams or lack of seams in board sails is still an area of almost hand-to-hand conflict amongst several non-members. I think that seams are important especially after listening to members Ian Hannay and Simon Sanderson talking about board sails and how they work at two AYRS symposia (see elsewhere in this publication). However, looking at the results of good sailors with good and bad performances, and then looking at the seams in their sails is less conclusive, at least in my eyes!

The idea of a normal leading edge followed by a sharp edge to produce separation of flow followed by a transversly corrugated surface on the low pressure side of the sail with pitch of corrugations to match the vortices shed from the sharp edge is suggested by looking at British Patent Application BP 2,129,908A assigned to Rolls-Royce.

The new UK Patent law changes came into force on 1st August 1989 and will be sure to provoke some re-examination of the inventors approach to patents and patenting.

In the way of useful technical "tools" the use of acoustic noise recordings from inside a streamlined body in water to assess the turbulence caused (and thus the drag) seems, in this period of ever more powerful home computers, to be put on the verge of becoming a technique available to the amateur experimenter,(Watch this space!).

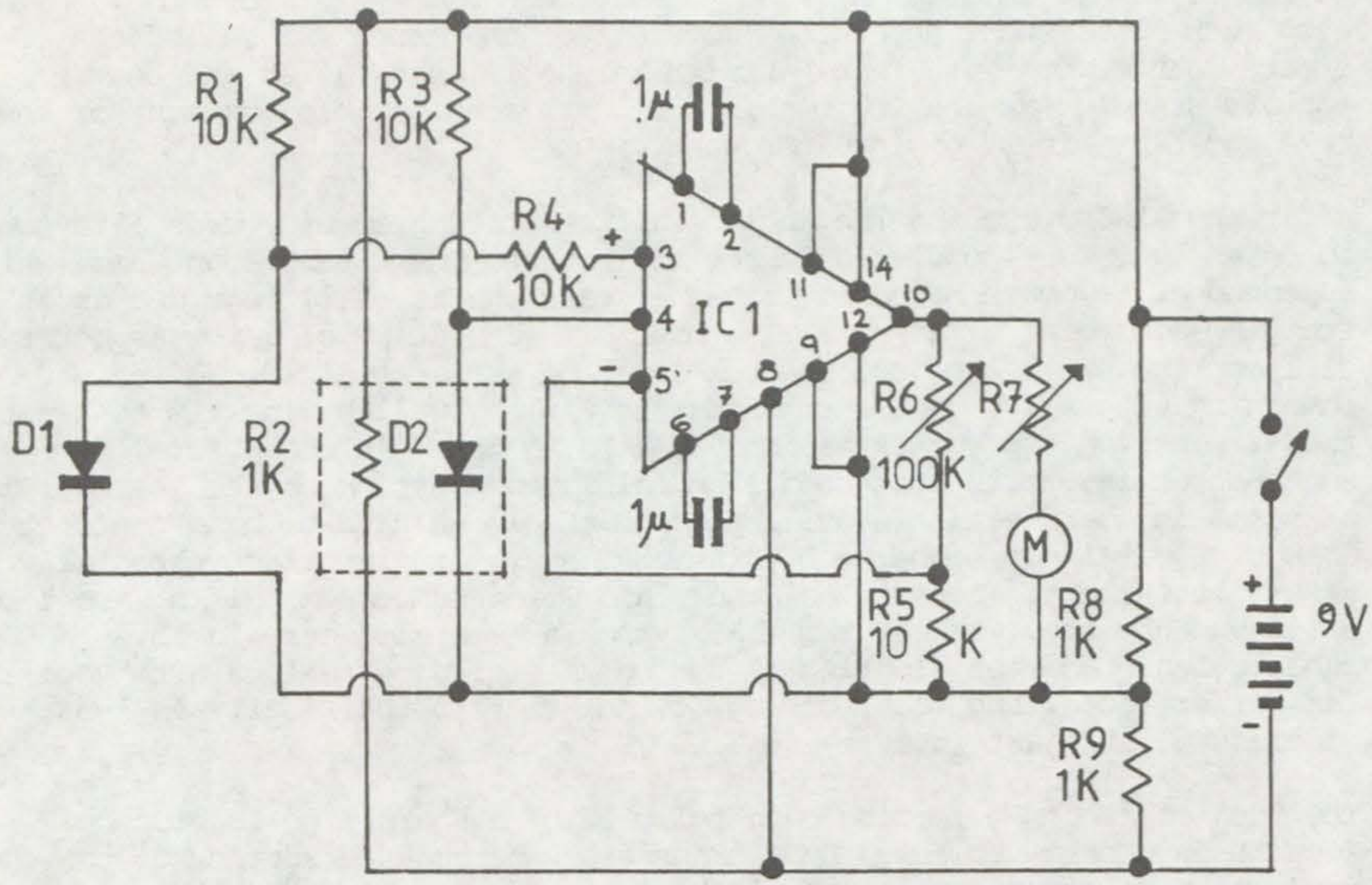
One electronically minded member asked me about Cain encoders as used in over-the-telephone line electricity meter reading systems. I had heard of them, and have promised to follow them up. (Why does he want to know?).

The tufting of sails or even hulls can be improved by the use of a more stable "tuft" devised by a non-member - perhaps he would like to join?

GRAEME WARD

CUPLESS ELECTRONIC ANEMOMETER BY GRAEME WARD

Developed from a differential voltmeter circuit this instrument measures the wind speed by measuring the



differences in junction voltage between two forward biased diodes. One diode D2 is enclosed, with a resistor, R2 in a small aluminium block. The resistor R2 heats the junction of D2 to a substantially fixed temperature, the precise temperature being of little importance. It will be a function of the power supplied to the block by R2 and its heat transfer characteristics. The temperature of the junction of diode D2 is used to reference the temperature of the junction of sensor diode D1 situated in the airstream to be monitored. A small change in temperature of D1 produced by changes in airspeed is amplified by the intergrated circuit amplifier IO1 and registers on the meter M. The output of the amplifier will be proportional to the temperature difference. The meter reading will vary linearly with temperature. However, the relationship between the cooling effect of the wind and temperature is not linear. Also the current with zero wind speed is a function of the reference temperature of D2. Therefore the calibration is unlikely to be the same for any two individual units.

Calibration can be effected by placing the sensor unit D1 in the clear airstream at the front of a car on a day with very little or no wind and noting the current for various car (hence wind) speeds. Should the response be too rapid for your requirements enclose the sensor diode D1 in a small aluminium block the mass of which can be best be determined by "cut and try" methods. The amplifier is a Type 7600 Commutating Auto-Zero Operational amplifier available from most electronic hobbies sources. The meter and the value of R7 are selected to suit each other from what you may find available. The circuit seems to work without recalibration between 5V and 16V, a PP9 battery (9 volts) being found a convenient choice.

SAILBOARD AERODYNAMICS

At speed, board sailors control the rig by allowing flow separation to take place ahead of the trailing edge, giving a separation "bubble" on the "top" or low pressure side of the sail, using this to control drive, and by angling the sail to get a component of vertical lift. The total effect of this is to give control of both speed and direction. Some element of self-adjustment for rapid changes of wind (sharp gusting) is obtained with mast and sail tip flexibility, batten arrangement and trailing edge shape.

The vortex or so-called "crab claw" rig appears to offer among its other advantages some "mileage" as a self-adjusting rig for boats. Whilst it has flaws in its controllability in its present form, it promises great things both in drive power and "docility". As regards use of separated flow schemes to make a self-adjusting sail for high speed craft it can be helpful to consider an extreme case.

It is possible to visualise a sail similar to a "crab claw" where flow separation occurs below the tip and moves down the leading edge. The separation line may run along the leading edge, causing a gradual loss of drive over the rear parts of the sail and hence an increasing tendency to force the sail and craft to an increasing angle of attack, causing part-span vorticity to be shed from the sail. It is expected that somewhere in the middle of this process the greatest drive would occur. Whilst this cannot be regarded as stalling in the normal sense it could if uncontrolled lead to a phugoid type of oscillation.

In the event of the shape and form of the leading edge spar and sweepback angles being exactly right (or exactly wrong from our point of view!) it is possible to imagine an attachment line (the place were separated flow starts) which divides the air drawn into rolled-up vortex "sheets", coming from the leading edge, from air which flows predominantly rearwards across the sail. Such an attachment line must intersect the trailing edge. Differing flow directions on either side of the sail each arriving at the trailing edge points of intersection would give a shear to the vortex sheets which would divide and roll up into new vortex sheet swirls. It is difficult enough to visualise without trying to guess how such conditions might vary with changing angles of attack. Calculation of such effects would be totally out of the question since forces would be liable to change in a most spectacular and uncontrollable way.

It is interesting to speculate that (especially with a rounded edge) with an attachment line along part or most of the leading edge, a separation "buble" might effectively change the shape of the initial camber of sail, giving a lift or drive at that angle of attack rather different than expected.

All this is to suggest a few ways in which we might progress in speed sailing with boats. I hope others will be inclined to think along even more radical lines.

GRAEME WARD

NOTES

P U B L I C A T I O N S

1	CATAMARANS	1955
4	OUTRIGGERS	1955
5	SAILING HULL DESIGN	1956
6	OUTRIGGED CRAFT	1956
13	SELF STEERING book Principles and practice.	1957
19	HYDROFOIL CRAFT	1958
30	TUNNEL AND TANK	1960
32	SAILBOAT TESTING	1960
34	OCEAN TRIMARANS	1961
38	CATAMARANS 1961	1962
42	CATAMARANS 1962	1963
46	CATAMARANS 1963	1964
47	OUTRIGGERS 1963	1964
50	CATAMARANS 1964	1965
53	SOLO CRUISING	1965
66	FOILS ICE YACHTS & SAILS	1968
67	CATAMARANS 1969	1969
68	OUTRIGGERS 1969	1969
70	RETIREMENT YACHTS & POLARS	1969
72	CATAMARANS 1970	1970
75	DEEPWATER SEAMANSHIP	1971
76	SAIL TRIMMING,TEST & THEORY	1971
77	TRIMARAN SELECTION	1971
78	CRUISING CATAMARANS book History of Design & Development.	1971
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79	RUDDER DESIGNS book Shapes,Areas and calculations	1974
80	ROUND BRITAIN RACE 1974	1974
82	DESIGN FOR FAST SAILING book Performance,factors & speeds.	1976
86	OSTAR 76 & SAFETY	1977
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