Diary

This edition is being issued in conjunction with that for August 1979. Diary details will be found there.

FFn

FREE FLIGHT NEWS

Contents

Editorial Note	52
A/2 Design by D Siebenmann	52
WAKEFIELD No. 10 by J Kristensen	54
NFFS Ten Models of the Year - 1979	56
TADPOLE, fLH by G Xenakis	56
SMAE 2nd Area Centralised results	56
SMAE 3rd Area Centralised results	56
Teams for Taft	58
The Open Rubber Trophy	58
Books by Hoerner	58

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The last two editions of FFn were delayed due to litho-plate and printing department holidays! Once again, please accept our apologies; it was entirely due to the editors having to work for a living instead of devoting their time to editorial matters. Sinecures, pensions, annuities - all will be gratefully accepted by the deserving(?) few...

A/2 DESIGN by D Siebenmann

Part 3

Lateral Stability

As has already been indicated, the lateral stability of the model must be as good as possible. Stability of this type is achieved by dihedral in the wing, or by sweeping back the wing (as often used on tailless models for this and other reasons, such as longitudinal stability). The static balance effect of the CG being below the lateral centres of pressure is a small effect on any conventional aircraft, and it is particularly small on A/2s, since the moment arm is so short. What is the optimum form and amount of dihedral for our purposes? The idea that a lot of dihedral ensures good lateral stability is as false as the view that a large tailplane automatically ensures good longitudinal stability. We will now examine the action of dihedral.

Rolling and Yawing moments

Consider a model which has been disturbed into an inclined position about the longitudinal axis. There is a lateral component to the lift produced by a wing with dihedral when it rolls, and this produces a change of direction. The wing which is dropping has an increased angle of attack and thus produces more lift, while the rising wing has a reduced incidence less lift than it has in steady flight. See figure 12. The rolling moment about the longitudinal axis tends to restore the model to its normal horizontal flight. The same difference of lift occurs when the model is yawing (side slipping) in which case the leading wing is the one to develop more

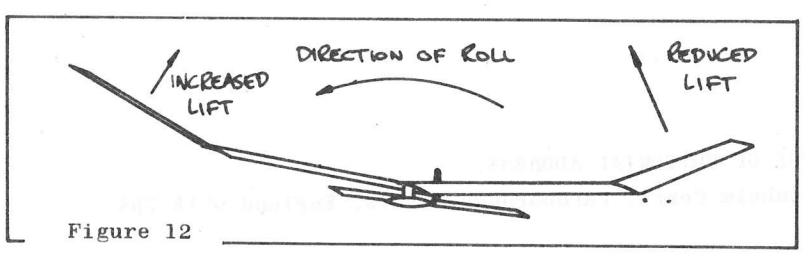


Figure 12

lift. In both cases the extra lift has associated with it increased drag and so there will be a tendency to turn, with that wing on the inside of the turn. On modern A/2s, with their small fuselage side area, the most significant lateral area is the fin, and as this is well behind the CG it is not possible for the model to yaw without turning; this reinforces the action of the dihedral.

Circling flight

When a symetrical model circles, the outer wing covers a greater distance than the inner wing. The speed difference depends on the radius of the circle. See figure 13.

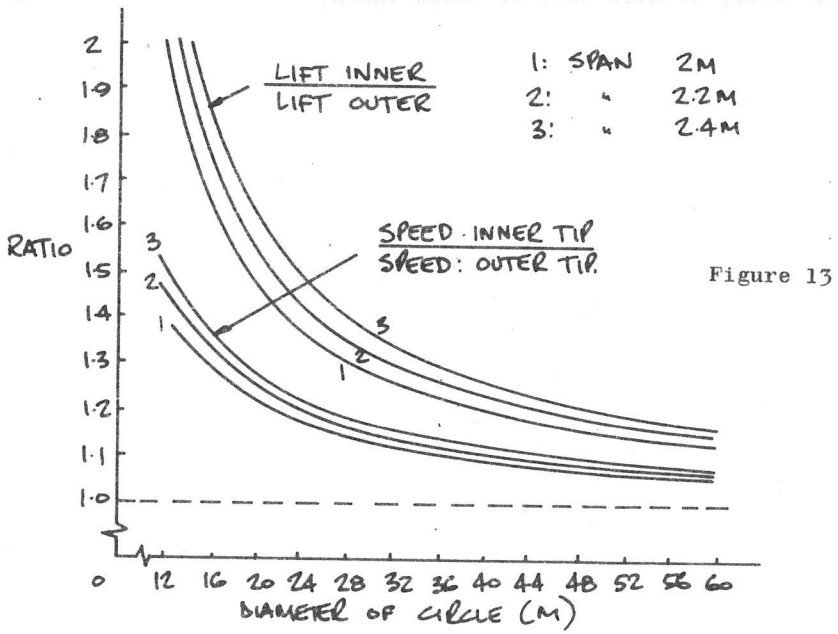


Figure 13

The speed variations across the span have associated with them changes of lift and drag, which depend on the speed to the power 2. This gives a rolling moment which raises the outer wing as well as a yawing moment dragging back the outer wing. Stable flight requires the forces and moments about all three axes to be balanced. On a wing without ailerons this may be attained only with the longitudinal axis rotated outwards by reference to the tangent of the circle. This side-slipping produces more lift on the inner wing to offset the lift lost by the reduced speed - and so equilibrium is reached. The increased drag of the inner wing at higher incidence provides a turning moment towards the centre of the circle. This is the same situation as that when the glider has been disturbed in yaw, such as by a gust, except that the circling situation is constant. If the force from the fin (which may be adjusted by trimming) is included, one may calculate the radius of the turn for equilibrium. It is necessary to balance the lateral force against the centrifugal force and to balance the lift against the weight of the model.

Dihedral

We have seen how dihedral enables the model to fly in a steady circle and also to recover from lateral disturbances. The requirements for dihedral are thus to achieve the corrective moments at the mini-

mum cost of performance; stability in circling flight is important, particularly when the model should be making best use of weak thermals at low altitude. What losses result from having dihedral on a wing?

1) The lift of a wing is proportional to its projected horizontal area, since the lift from lateral perts neutralise each other over the whole wing; by contrast, the drag is determined by the total surface area of the wing. We need to maximise the ratio of projected area to total area. Excessive dihedral means that excessive weight is being carried at the wing tips and this has a powerful effect in increasing the lateral inertias of the wing, with consequent detractions from lateral stability and the ability to thermal.

2) As shown in figure 6, the ratio C_L^3/C_D^2 of a section is only at its optimum over a small operating range, of which a larger part is below C_L max than above it. This implies an advantage for forms of dihedral which achieve their corrective moments with small changes of the local angle of attack. It is then that the performance losses will be smallest when the model is disturbed and also when it is circling. The reduction in still air time for a model flying in 15 metre radius circles is about 15 seconds compared with the same model flying straight. This loss could be worse for a less efficient model.

What is the best compromise to minimise these losses? Peter Soule wrote an article in the 1971 NFFS Symposium report (The dihedral effect for large dihedral angles) in which he showed that the normal calculations used in full-scale aeronautics are defficient if they are applied blindly to models with large dihedral angles. He presented appropriate theories for free flight models and in several graphs showed the results of numerous calculations for a variety of dihedral forms. The best solution was found to be a continuously curving wing, starting at zero angle at the root and increasing in angle towards the tip - figure 14A. This poses extreme construction problems and so we look for simpler ways of reaching results almost as good, in the same way that we wanted a simple dual taper planform in an approximation to an elliptical shape. Figure 14 shows different variations of dihedral, which have all been predicted to give the same corrective moments - and thus the same effect on stability. The ratio (S proj/S total) is a good measure of the efficiency of them as discussed under (1) above. The profile drag of the wing accounts for 60% of the total drag and so one can easily calculate the effect of variations in (S proj/S total). It is found to be a range of 5 seconds between the worst and best forms. In turbulent air, the difference could exceed this. The ratio h/b represents the height of the dihedral as a multiple of the span (b) for which the diverse forms have the same effect on stability. The short, steep tips, fashionable after Gerry Ritz's victory in 1959, are really poor and diminish flight time as well as increasing inertia.

The data used to produce figure 14 does not take account of the polars of the airfoil section. As these section characteristics near C_L max can be quite dissimilar, it is not possible to make general calculations on item (2) above. The approximate formula:

$$\Delta\alpha = \sin\beta \sin\theta$$

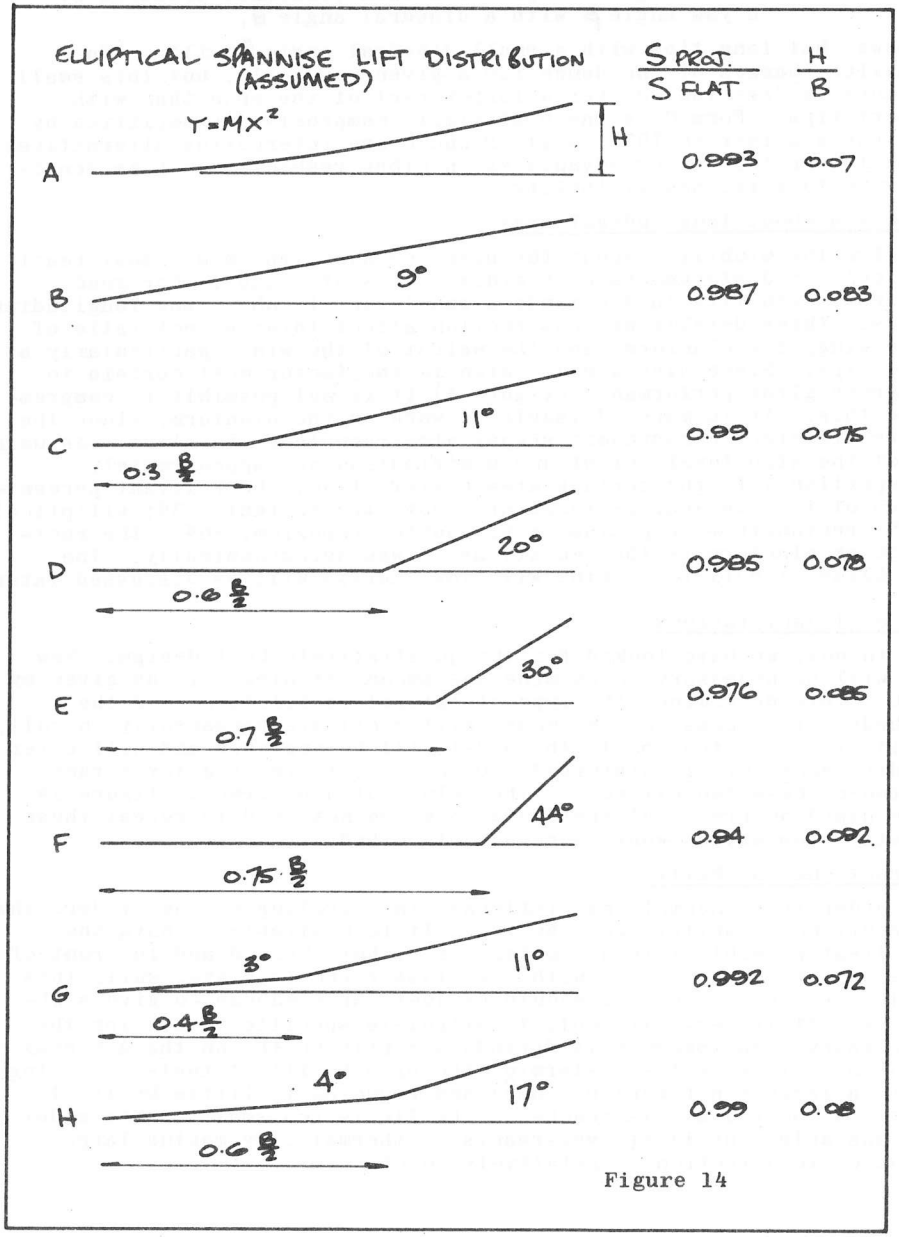


Figure 14

where $\Delta\alpha$ = the change of angle of attack (radians) produced by a yaw angle β with a dihedral angle θ,

shows that long tips with a small dihedral angle θ will produce smaller changes of incidence for a given yaw angle, but this small change is distributed over a larger part of the span than with short tips. Form C is the best simple compromise, exemplified by Dvorak's glider in 1971, while D and H are interesting alternatives - the latter two having advantages in other respects, such as sensitivity to lift, and visibility.

Inertia about longitudinal axes

As for the stability about the pitching axis, the model must react quickly to disturbances with minimum loss of height. For good lateral stability this demands a small inertia about the longitudinal axis. Three details of construction affect this: aspect ratio of the wing; the planform; and the weight of the wing, particularly at the tips. Since high aspect ratio is the factor most certain to improve glide performance (figure 1) it is not possible to compromise this. It is more advisable to work on the planform, since the more efficient aerodynamic shapes also show lower inertias. Assuming that the structural weight and distribution are approximately proportional to the surface area distribution, the relevant percentages of inertia are: rectangular, 100%; trapezoidal, 85%; elliptical, 77%; rectangle + trapezium, 88%; double trapezium, 86%. The rectangular planform is thus worst, as it was aerodynamically. The problems of building a wing with low inertia will be discussed later.

Lateral oscillations

Up to now, we have looked for the qualitatively best design. Now it will be necessary to examine the amount of dihedral, as given by h/b. This determines the type of lateral oscillation - if the dihedral is excessive, the model will oscillate permanently in roll, while if it is too small, the model will be unstable and will enter a divergent turn if disturbed. Of course, there is a large range between these two extremes. The values of h/b given in figure 14 are based on practical tests and so we do not need to repeat these tests to establish what is reasonable dihedral.

Directional stability

In order that thermals may influence the circling of the glider, the directional stability must be low. It is desirable to have the smallest possible lateral surface area, both behind and in front of the CG. The modern A/2, with its glass fibre fuselage, suits this objective well. The fin should be just large enough to give stability. It is very difficult to stipulate specific values for the necessary area, because it depends strongly on the on the dihedral chosen. It is best to determine the area by flight tests, starting with a large fin (about 0.8 dm^2) and reducing it little by little until a lower limit is reached. The fin is too small if the model is unstable , or if it over-reacts to thermals, by making large changes in direction in relatively smooth air.

WAKEFIELD, F1B by J Kristensen

Jens writes:

Per Grunnet has mentioned to me that you would like details of my Wakefield models. A drawing of one of my latest, together with a description of the design appeared in the Danish magazine 'Modelflyve Nyt, nr 2/79, so I have translated part of this article into English - the part which describes the flight pattern and the method I use for trimming the climb, using VIT and auto-rudder...

The model is equipped with a variable-incidence tailplane and a three-position auto-rudder. The flight pattern is as follows: immediately after launch, the rudder is to the left, while the tailplane is held approximately 2mm below the glide setting (at the trailing edge, that is). The climb is steep and fast.

After three seconds, the rudder is released by the timer and goes to the neutral position. The model begins to turn right because of the propeller sidethrust.

One second later, the VIT is released. The one second delay between the rudder movement and VIT release is intended to smooth out the transition from the steep initial climb into the low-powered cruise.

The rest of the climb is normal. At the end of the motor run, the rudder is released to its glide setting by the propeller stop mechanism. The glide path is to the right.

The model will make between $2\frac{1}{4}$ and $2\frac{1}{2}$ full turns during the climb.

Trimming technique

I have developed a method of trimming which I believe is right for Wakefields with VIT, etcetera.

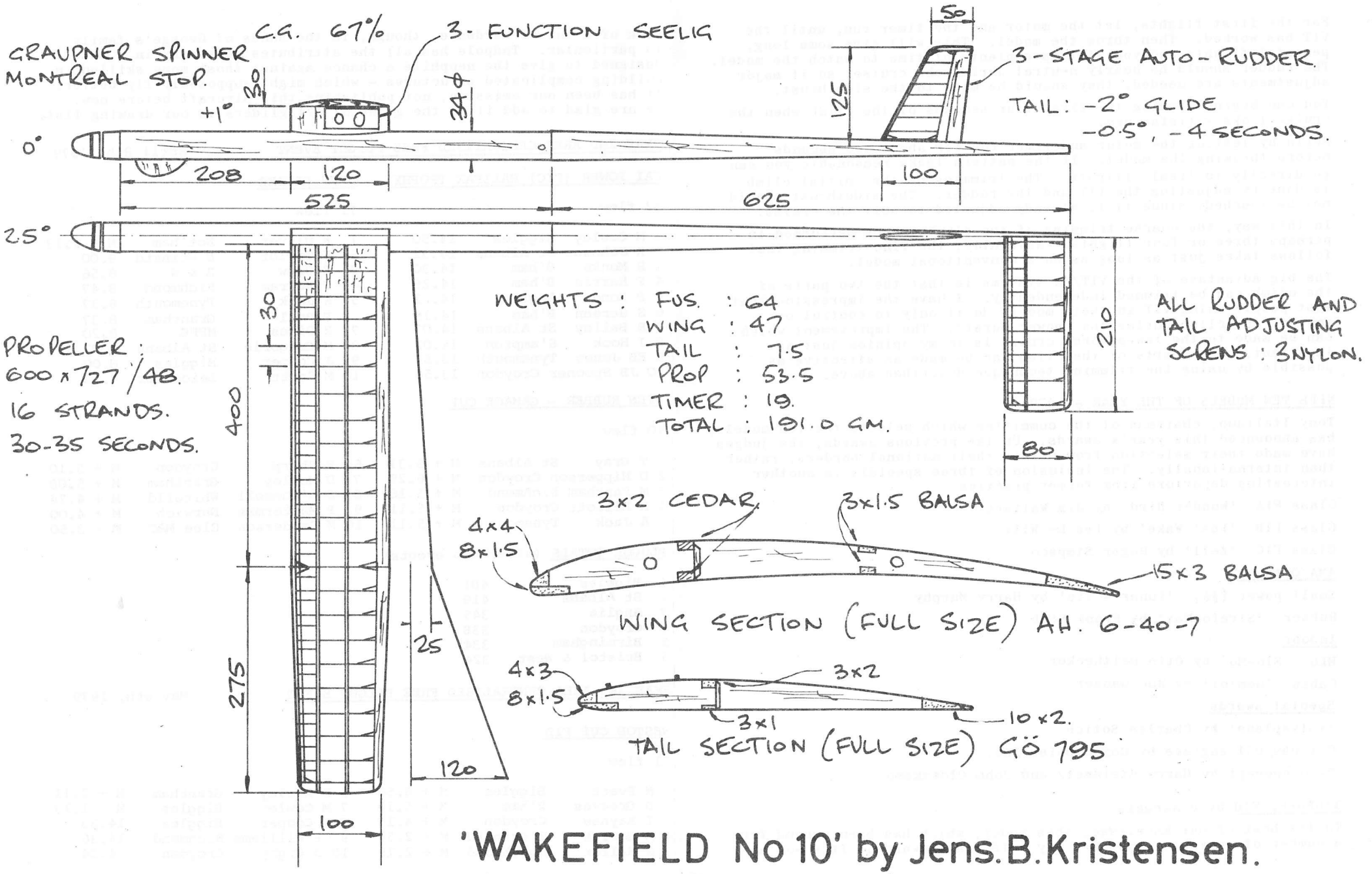
Ordinarily, the climb of a Wakefield model is trimmed by making gradual increases in the number of turns applied to the motor. The sidethrust and auto rudder (if used) are adjusted as the power increases. This is a good method, because the conventional Wakefield must use the same trim throughout the climb, so this trim must be able to handle high and low power equally well.

The situation is completely different when the model is equipped with VIT. After the first three seconds or so - during which the climb is controlled by the VIT, and, in my case, by the rudder - the power from the motor will be very low. So the trim used for the rest of the climb will never have to cope with high power. This means that a trim flight with, say 75% turns, has little meaning. The model will be put on a test that it will never be subject to on a 'real' flight - and you will be tempted to make unnecessary, perhaps even harmful, changes of trim.

So the principle is that after some flights with 100 to 150 motor turns, where the glide is trimmed and you check the sidethrust to make sure it's not wildly wrong, you give the model full turns on all trim flights.

The trimming of the climb is done in two stages. First the cruise, and then the high-powered initial climb.

SCALE 1:6 ALL DIMENSIONS IN MILLIMETRES



'WAKEFIELD No 10' by Jens.B.Kristensen.

For the first flights, let the motor and the timer run, until the VIT has worked. Then throw the model. This will give some long, peaceful flights and you will have plenty of time to watch the model. The rudder should be nearly neutral during the cruise. so if major adjustments are needed, they should be made to the sidethrust.

You can begin trimming the first four seconds of the climb when the cruise looks satisfactory.

Begin by letting the motor and timer run for about two seconds before throwing the model. If the pattern looks reasonable you can go directly to 'real' flights. The trimming of the initial climb is done by adjusting the VIT and the rudder. The sidethrust should not be touched, since it is already adjusted to suit the cruise.

In this way, the coarse trimming of the climb can be performed in perhaps three or four flights. Naturally, the fine trimming that follows takes just as long as on a conventional model.

The big advantage of the VIT/AR systems is that the two parts of the climb can be trimmed independently. I have the impression that most people using VIT in their models do it only to control or improve the climb during the "power burst". The improvement which can be made to the low-powered cruise is in my opinion just as important. Both parts of the climb can be made as effective as possible by using the trimming technique described above.

NFFS TEN MODELS OF THE YEAR - 1979

Tony Italiano, chairman of the committee which selects the ten models, has announced this year's awards. Unlike previous awards, the judges have made their selection from within their national borders, rather than internationally. The inclusion of three specials is another interesting departure from former practice.

Class F1A 'Wonder Bird' by Jim Walters

Class F1B 'Les' Wake' by Les De Witt

Class F1C 'Zell' by Roger Simpson

AMA/Outdoor

Small power (½A) 'Lunar - Tic' by Harry Murphy

Rubber 'Strato-Max' by Frank Heeb

Indoor

HLG 'Slo-Mo' by Otto Heithecker

Cabin 'Gemini' by Ron Ganser

Special Awards

'Volksplane' by Charles Sotich

Cox 049/051 engines by Cox Hobbies Inc.

P-30 concept by Harry Steinmetz and John Oldenkamp

TADPOLE, F1H by G Xenakis

To the best of our knowledge, this model, which has been around for a number of years, has not won any 'official' awards. It's won a heck of a lot of hardware, though, in the hands of George's family in particular. Tadpole has all the attributes necessary in a model designed to give the neophite a chance against those more skilled in building complicated structures - which might supposedly fly better. It has been our omission, not publishing this aircraft before now. We are glad to add it to the genus of A/1 gliders in our drawing list.

SMAE 2ND AREA CENTRALISED FREE FLIGHT EVENT — April 8th, 1979

FAI POWER (FIC) HALIFAX TROPHY

32 flew

1	M Cowley	Biggles	14.50
2	R Johnson	St Albans	14.32
3	R Monks	B'ham	14.30
4	P Harris	B'ham	14.29
5	P Bond	Anglia	14.21
6	S Screen	B'ham	14.19
7	R Bailey	St Albans	14.03
8	J Hook	S'ampton	14.02
9	EB Jones	Tynemouth	13.57
10	JB Spooner	Croydon	13.56

OPEN GLIDER

71 flew

1	K Oliver	Not'ham	M + 2.13
2	K Taylor	E Grinstd	9.00
3	E Drew	B & W	8.56
4	P Bayram	Richmond	8.47
5	A Jack	Tynemouth	8.37
	P Ball	Grantham	8.37
7	R Dines	MFFG	8.20
8	M Gregorie	St Albans	8.02
9	J Cooper	Biggles	8.00
10	M Scott	Leicester	7.59

OPEN RUBBER - GAMAGE CUP

40 flew

1	T Gray	St Albans	M + 6.31
2	D Hipperson	Croydon	M + 6.25
3	M Fantham	Richmond	M + 5.16
4	R Elliott	Croydon	M + 5.11
	A Jack	Tynemouth	M + 5.11
6	F Sharp	Croydon	M + 5.10
7	D Morley	Grantham	M + 5.08
8	J O'Donnell	Whitefld	M + 4.24
9	P Masterman	Norwich	M + 4.00
10	M Sanderson	Clee MAC	M + 3.50

PLUGGE TOTALS (after two events)

1	Biggles	481
2	St Albans	419
3	Anglia	345
4	Croydon	338
5	Birmingham	334
6	Bristol & West	324

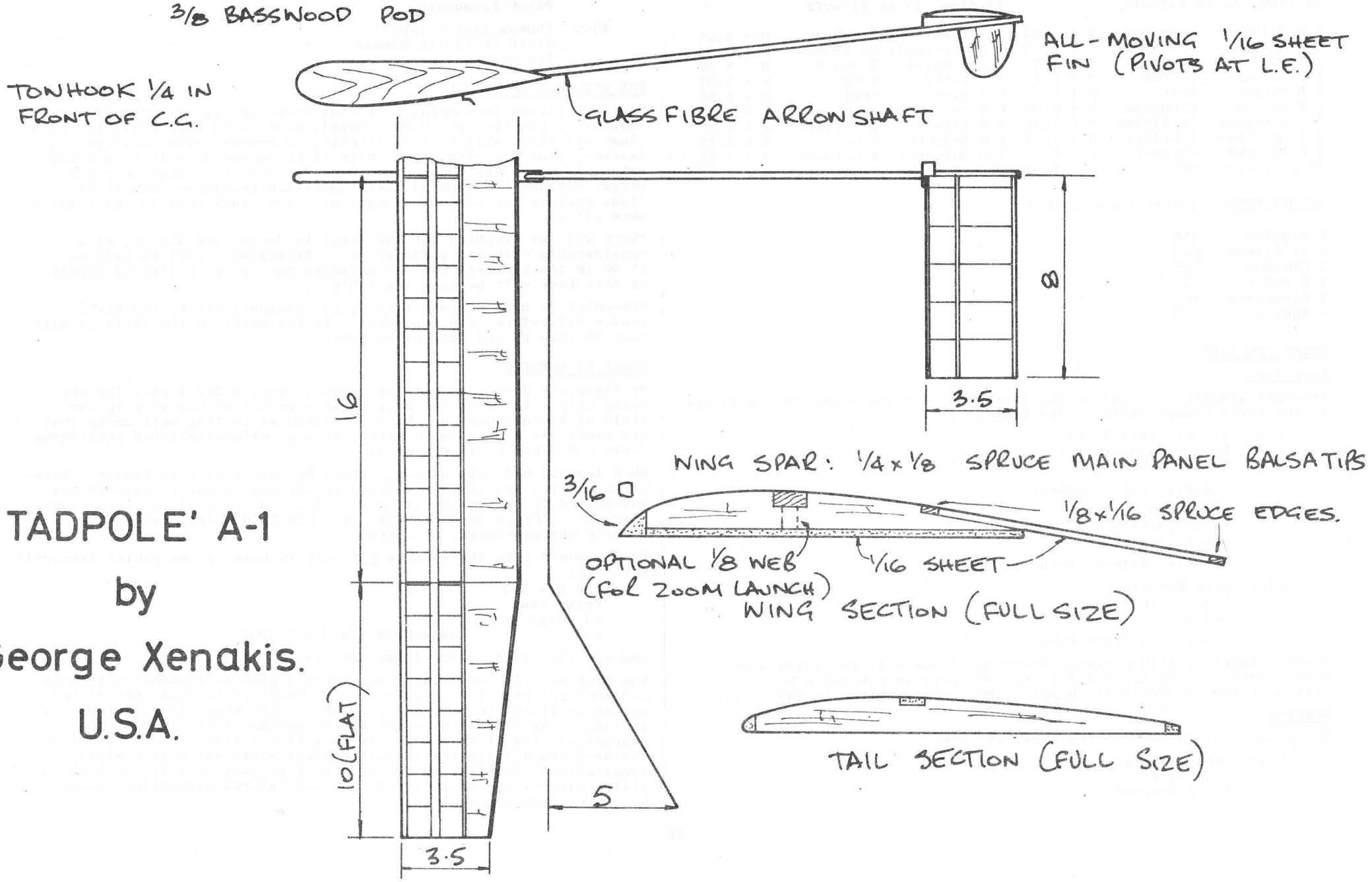
SMAE 3RD AREA CENTRALISED FREE FLIGHT EVENT — May 6th, 1979

WESTON CUP F1B

51 flew

1	M Evatt	Biggles	M + 6.50	6	D Morley	Grantham	M + 2.11
2	D Greaves	B'ham	M + 5.18	7	M Cowley	Biggles	M + 1.13
3	I Kaynes	Croydon	M + 4.17	8	J Cooper	Biggles	14.53
4	M Howick	E Grinstd	M + 2.51	9	CP Williams	Richmond	14.36
5	R Miller	Northwood	M + 2.18	10	D Digby	Croydon	14.34

SCALE 1:5 ALL DIMENSION IN INCHES



'TADPOLE' A-1

by

George Xenakis.

U.S.A.

OPEN GLIDER

72 flew, 32 in fly-off

1	M Gilmore	Grantham	M + 9.04
2	G Bunney	S Bristol	M + 8.20
3	P Ball	Grantham	M + 7.42
4	B Baines	RAFMAA	M + 6.42
5	M Stones	Louth	M + 6.20
6	P Stewart	Crookham	M + 6.00
7	J Fletcher	St Albans	M + 5.38
8	A Granthan	E Grinstd	M + 5.33
9	S Philpot	Whitefld	M + 4.49
10	J Foster	MFFG	M + 4.47

OPEN POWER - WHITE CUP

33 flew, 13 in fly-off

1	J West	Brighton	M + 8.05
2	D Perrerall	St Albans	M + 6.35
3	R Cummins	B and W	M + 5.50
4	R Monks	B'ham	M + 5.01
5	P Bond	Anglia	M + 4.56
6	R Peers	Falcons	M + 4.38
7	R Alford	E Grinstd	M + 4.20
8	R Baggott	B'ham	M + 4.18
9	H Hutchins	E Grinstd	M + 3.22
10	S Goodwin	Crookham	M + 2.07

PLUGGE TOTALS (after three events)

1	Biggles	756
2	St Albans	603
3	Croydon	599
4	B and W	510
5	Birmingham	443
6	Anglia	439

TEAMS FOR TAFT

Argentina

Arcangel Armesto has sent us the team lists for the Argentine challenge to the World Championships. The members are:

F1A: Antonio Tarzibachi
Walter Palmieri
Carlos Minolli

reserve: Emilio Romero

F1B: Rudecindo Marquez
Eliseo Scotto
Oscar Viggiano

reserve: Alfredo Herbon

F1C: Jose Bonetto
Domingo Intieri
Mauricio Zito

reserve: Alfredo Baños.

Readers familiar with previous Argentine teams will recognise some names, while others are totally new. We hope to publish a Wake design of the '79 National Champion, Marquez, sometime in the future.

Denmark

Per Grunnet tells us that the Danes will be:

F1A: Jørn Rasmussen
Finn Bjerre
Peter Buchwald

F1B: Jens Kristensen
Poul Kristensen
Peter Rasmussen

F1C: Thomas Køster (who?)
Niels Christian Hammer
Tom Oxager

THE OPEN RUBBER TROPHY

David Hipperson is running a special event on 21st October at Bassingbourne, starting at 10.00. Models must be to SMAE rules for this class and there will be four flights, in rounds, with an increasing maximum, plus fly-offs. Pre-entry is recommended, with fees being set at 50 pence for Seniors and free for Juniors. With your pre-entry, enclose two stamped, self-addressed envelopes with first class postage for acknowledgement of entry, full details and results soon after.

There will be trophies for the first in Senior and Junior, with considerable cash and goods prizes. Prizegiving will be held at 19.00 in the airfield pub - downstairs bar, where a limited supply of free beer will be made available...

Pre-enter to D Hipperson, Flat 2, 29 Alexandra Grove, Finchley, London N12 before 20th September. If you enter on the field it will cost Seniors £1 and Juniors 50 pence.

BOOKS BY HOERNER

Dr Sighard F Hoerner's name is known to many model flyers for one thing only - the wing tip devised as a result of his work in the field of fluid dynamics. We are certain it is less well known that his books are available in print, from a self-established publishing house - Hoerner Fluid Dynamics.

When last we had information, 'Fluid Dynamic Lift', providing information on lift and its derivatives in air and in water, co-authored and edited by Henry V Borst, cost US$ 28.00, plus $1.50 for postage overseas. 'Fluid Dynamic Drag' cost US$ 23.00 plus postage and packing charges again, of course.

If you would like these books (if only to have in the public library!) write to:

P O Box 342
Brick Town
NJ 08723
USA telephone (201) 458 3242

and you can obtain a pro-forma invoice.

The book on lift has twenty-one chapters plus an alphabetical index and contains over 700 illustrations. Chapters include general information on fluid dynamics and airplanes; lift characteristics of foil sections; the lift of straight wings; maximum lift and stalling; characteristics of trailing edge wing flaps; leading edge high lift devices; characteristics of tail control surfaces; roll control; longitudinal stability characteristics; propulsion lift and stability; directional characteristics; and lateral stability. Should keep you going for a while...