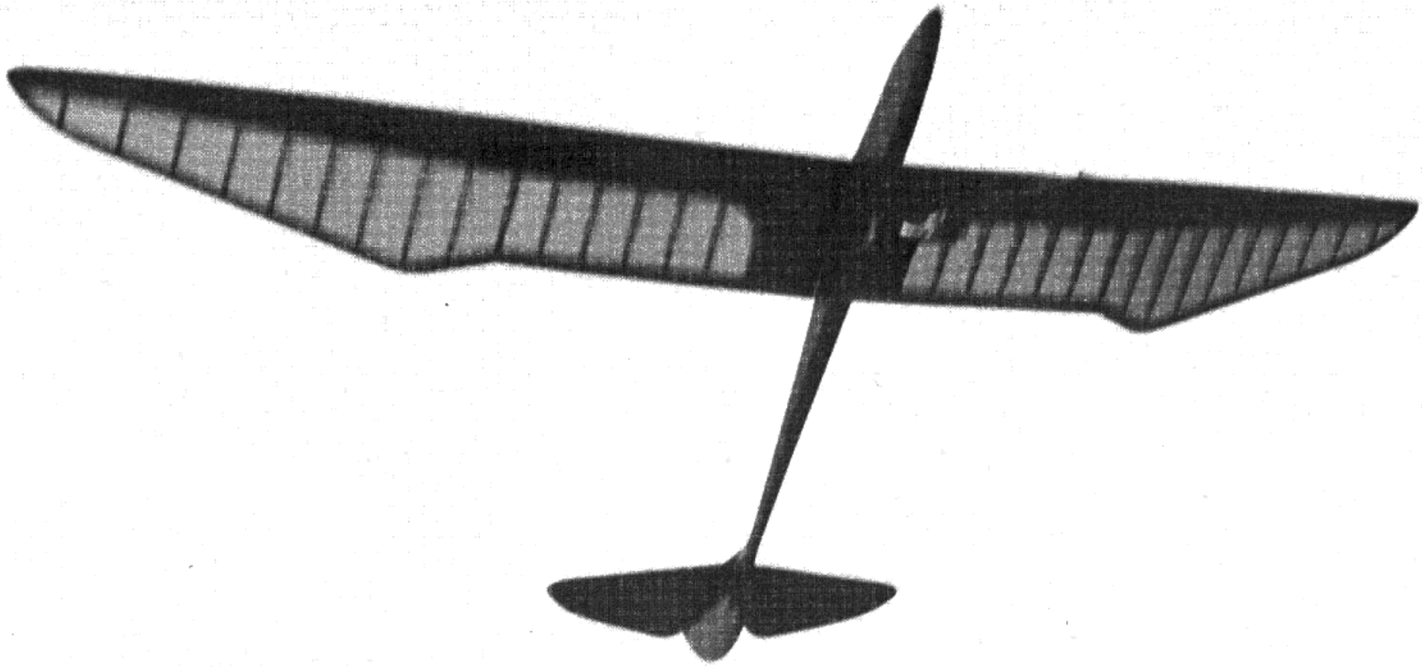
BIRD OF TIME



The indomitable and intrepid Dave Thornburg strikes again with the final version of a competition sailplane that has made its mark in contest circles. Despite Dave, the Bird of Time helped put Steve Work in the number one slot on the American FAI team - - -

Here's the "final" version of a sailplane that's done fairly well on the west coast contest circuit for over three years, and helped put Steve Work, of New Mexico, in the number one slot on the new American FAI team. Steve flew his Bird just one-tenth of a second slower than the fastest time recorded at the team Finals, and did it at only 9.4 ounces per square foot, while the other competitors were having to ballast up to over twelve just to stay in the race.

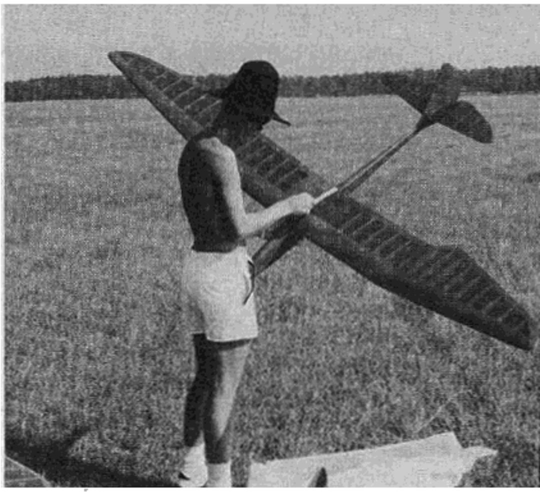
What was his secret? Besides very smooth flying, which Steve is master of, it took a few simple tricks of aerodynamics: a thin airfoil (9%) with a lot of Phillips' Entry, a rearward CG, and a clean machine. All these characteristics (except the piloting skill) are built into the Bird of Time. The design is based on the simple principle that full scale glider folk stumbled onto way back in the fifties: **the only thing more important than minimum sink is maximum go**.

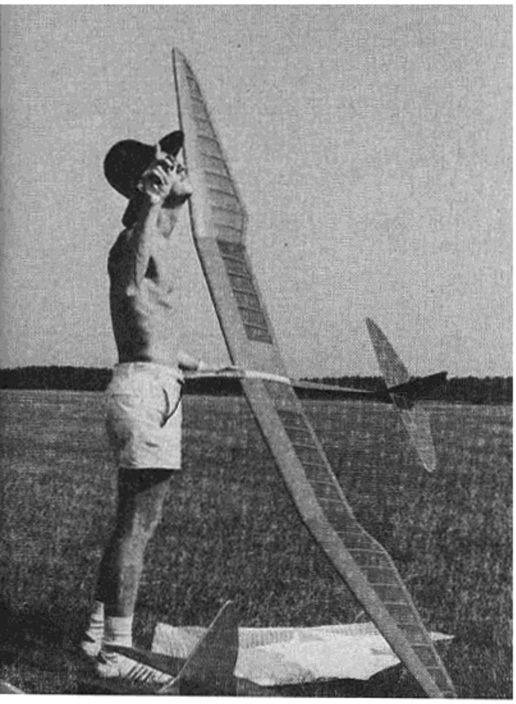
The reasoning behind this principle is that virtually anything - - - hang gliders, bumblebees, Ugly Stiks, magazine editors - - - will soar like an albatross in good lift; the real challenge is to develop planes that are clean enough and fast enough to outrun the sink! Once you find your thermal, you're home free - - - what you need is a plane that will get you to it with maximum speed and efficiency.

Well and good. So you need a nice fast cruise speed, then. It sounds like all you have to do is add lead to your "Whistler 900," and **presto!** you have a modern design. And that works pretty well - - - until . . .

Until you try to slow it down for a precision landing. Then you begin wishing you could spray your ballast out in a fine mist, the way the big boys do. Or until that early morning contest round when you have to ride 6' diameter bubbles down a 15 mph wind for seven long, cold minutes! Then you wish you could drop your ballast in the lift, and pick it up again when it's time to move back upwind!

So raising your wing loading isn't the all-round solution - - - as anyone who's flown the Graupner "Cumulus" can tell you. (The Cumulus was one of the most efficient designs to come out of the sixties, an airplane that "flew better than it oughta" — but its 11 oz./ft. wing loading finally dragged it out of the skies, as far as U.S. competition goes.)





Photos this page show Steve Work assembling his Bird at the Pensacola FAI Finals. Black hat is a must: Thornburg always takes his off on the last flight, and loses.

BIRD OF TIME
Designed By : Dave Thornburg

TYPE AIRCRAFT
Competition Sailplane
WINGSPAN
118 Inches
WING CHORD
Center — 10"
Tip Taper — 11¾ to 3"
TOTAL WING AREA
1070 Square Inches
WING LOCATION
Shoulder Wing
AIRFOIL
Flat Bottom
WING PLANFORM
Constant Chord Center
Tapered Tips
DIHEDRAL, EACH TIP
1½" polyhedral - 5" at tips
OVERALL FUSELAGE LENGTH
49¼ Inches
RADIO COMPARTMENT AREA
(L) 9" x (W) 1½" x (H) 2¼"
STABILIZER SPAN
29 Inches
STABILIZER CHORD (incl. elev.)
4" (Avg.)
STABILIZER AREA
130 Square Inches
STABILIZER AIRFOIL SECTION
Symmetrical
STABILIZER LOCATION
Fin-Mounted
VERTICAL FIN HEIGHT
11 Inches
VERTICAL FIN WIDTH (incl. rudder)
8" (Avg.)
REC. ENGINE SIZE
NA
FUEL TANK SIZE
NA
LANDING GEAR
NA
REC. NO. OF CHANNELS
2 or 3
CONTROL FUNCTIONS
Rud., Stabilator, (rel. tow hook)
BASIC MATERIALS USED IN CONSTRUCTION

Fuselage	Balsa, Spruce, Ply
Wing	Balsa, Spruce, Ply
Empennage	Balsa
Wt. Ready-To-Fly	41 Ounces
Wing Loading	5.5 Oz/Sq. Ft.

We need a higher cruise speed without a sacrifice in weight, then. So what does the "Bird of Time" do about this quandry? Just what the big boys did: it goes after a better airfoil and a cleaner profile.

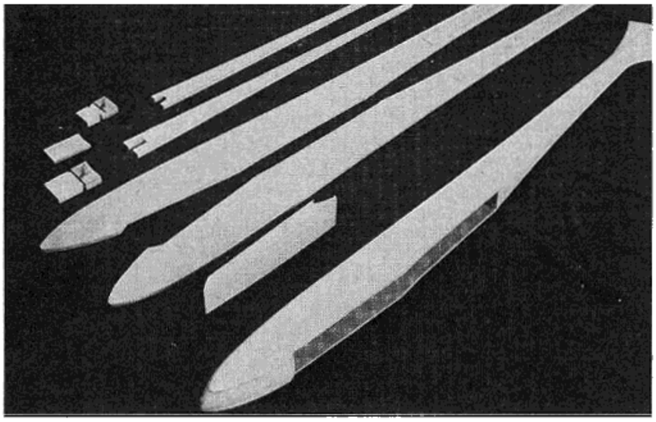
The cleaner profile comes easy: get rid of excess frontal area, square corners, protruding dowels and skids and switches. Find a wing tip shape that's still quiet at 50 mph. Move the stab up out of the wing wash as far as practical, because down wash characteristics vary radically with airspeed, and nobody knows what the hell **really** happens to the air around our wings under actual flying conditions.

The "better airfoil" is something else. I've suspected for a long time that our sailplanes generate far more lift than they need. (What?! Heresay! Too much lift? Thornburg's finally gone bonkers!) But even the slide rule disciples among us will admit that you pay a tremendous penalty in drag for every ounce of lift you extract from an airfoil --- that's one of those rare points on which full scale theory and modeling practice seem to agree.

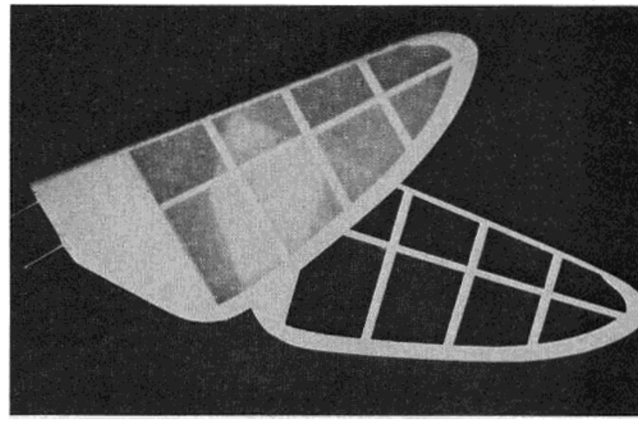
And if, like me, you're naive enough to think that, in normal sport or contest conditions, the difference in sink rate between a high-lift airfoil (i.e., the Windrifter section) and a relatively low-camber section (i.e., the modified 374 of the Windfree) is small enough to ignore, then you're ready to take the Two Giant Steps to a better sailplane airfoil:

(1) Build it as skinny as possible. In the thirteen aircraft built so far in the 'BoT" series, I've been down as low as 8% thickness. (This is hardly radical: the "Legionaire" flies at 8%.) But the "BoT" shown on the plans is back to 9% --- I just couldn't "feel" any real advantage to the thinner wings, and the sacrifice in structural rigidity wasn't worth it to me.

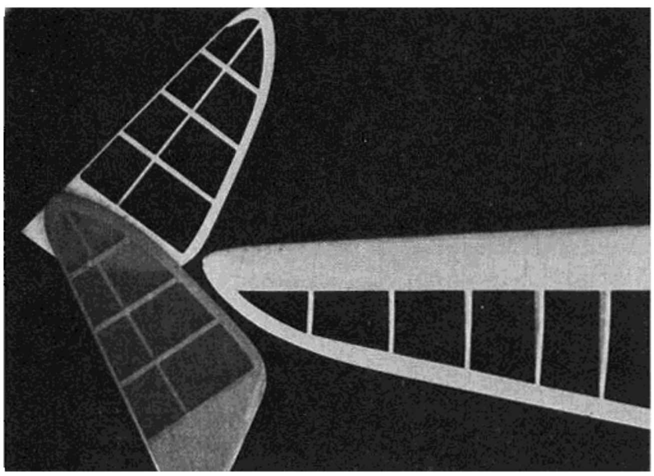
(2) Raise the entry point of the airfoil. This is the big "secret" to the airplane



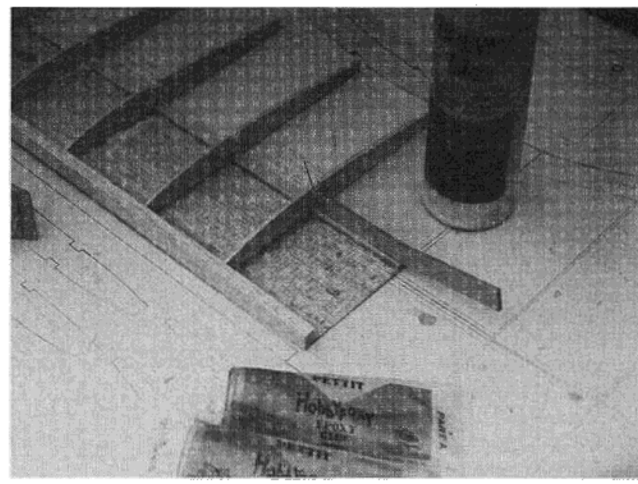
The fuselage is assembled from sheet and blocks. Not shown in photo is the noseblock and bottom block. Shaping is easy with a razor plane.



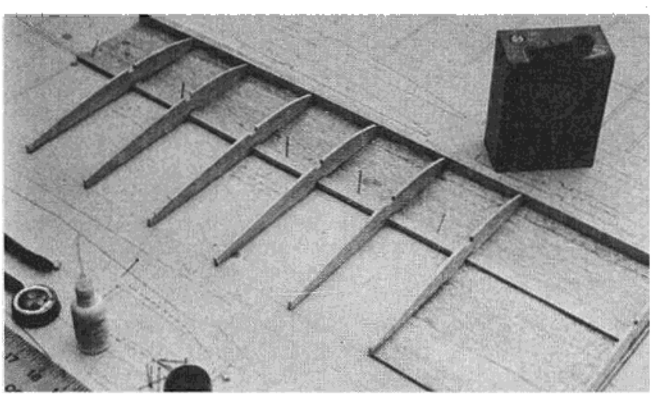
Stabilizer halves, covered and uncovered. Transparent MonoKote is a must to show off the Bird's structure.



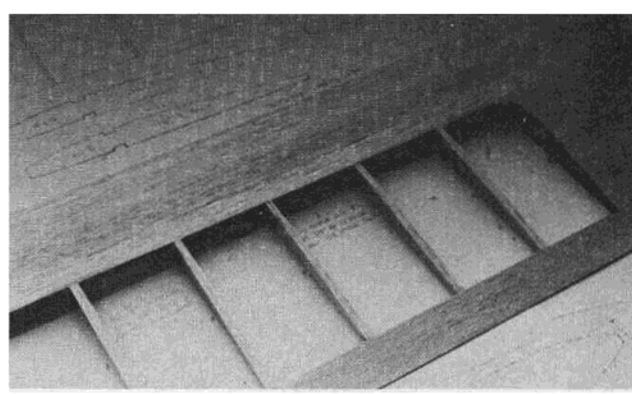
The wing and stabilizer tips have that classic "Wolf Hirth" look from the thirties. Don't be fooled — it's not simply a floater, but a carefully designed speed plane as well.



Takes courage to build a wing over the plans without using waxed paper between. Not recommended for folks who go heavy on the glue.



Wing construction is conventional, no tricks. Cyanoacrylate and baking soda good for gluing ribs to bottom sheeting.



Wing is sheeted with 1/16" C-Grain balsa back to the spars. Cap strips on top only.

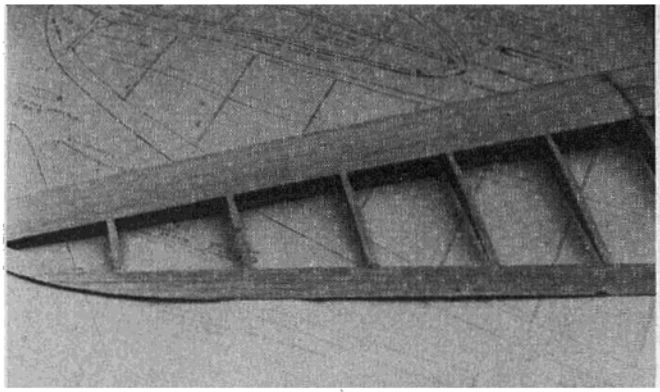
that turned 12.8 seconds in the FAI speed run at the 1976 L.A. Semi-finals, while loaded to only 9.6 ounces/ft. It's the basis of the famous "Miller Mod" to the Aquila airfoil.

Raising the entry point (adding "Phillips' entry") effectively lowers the mean camber of the airfoil. You do this, and you're going to sacrifice some lift, agreed. But you get a tremendous decrease in the induced drag, particularly at very low angles of attack. In short, you get a wing that moves quick, even at very low wing loadings. And that ain't a bad banana.

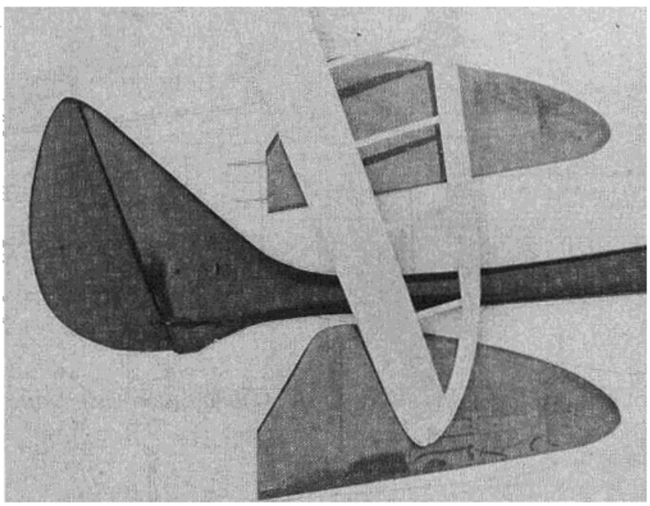
(You still fretting about that lost lift? Then take another look at the lift formula: lift varies with the square of velocity. And I just gave you an increase in cruise speed, right? So you actually got back more lift than you threw away. I **told** you we had lift to burn.)

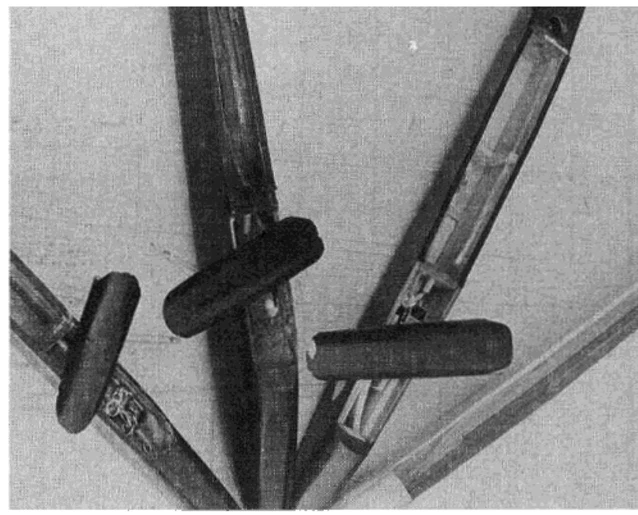
So much for esoterics.

People ask about the appearance of the Bird. "Why does it look so funny?" The fact is, if your aerodynamics are sound, you can wrap most any shape you choose around them. The "Bird of Time" is a kind of "copy from memory" of a Nordic glider from the early 'fifties called "Big Time". It appeared in *Model Airplane News*, but my ragged copy had its plans pirated by a razor blade



LEFT: The wing tip shape is classic, makes the plane stand out immediately in a sky full of today's popular kit designs. May disappear in a flock of buzzards, however. BELOW LEFT: The Bird has some classic shapes, right out of the Golden Age of soaring. Designer's debt to Wolf Hirth and Frank Zaic is obvious. BELOW: Four early Birds shown, two with radios installed. Plans show wider-fuselage version, more popular with folks who have fat fingers.





decades ago.

The wing shape was originated by Germany's most famous pre-war soaring pilot and designer, Wolf Hirth (who invented thermals, on a trip to America in 1930). The Hirth wing shape was popularized in the U.S. by Frank Zaic, unquestionably the dean of model soaring in the States. I could tell you what I **suspect** the trailing edge shape does to reduce interference drag at the polyhedral joint --- but I promised an end to esoterics.

So I'll just say this, instead: Build yourself a "Bird of Time," and trim it to the rearward C.G. position shown on the plans. I think you'll find it to be the **quietest** sailplane you've ever flown.

And that's the only measure of efficiency we currently have.

CONSTRUCTION

Wing:

I usually begin with the wing, because once the ribs are cut, the plane is half built! There are a number of ways of duplicating the ribs: Xerox them off the plans, spray-glue the Xeroxes to plywood or aluminum and cut masters (this if you can foresee building more than one plane, or have friends who might want one). Or spray-glue the Xeroxes directly to balsa and cut the ribs out two at a time. Or lay the balsa under the plan and "pinhole" the outlines onto it. Or use carbon paper. Or cut up the plan.

Cut from hard, C-grain, 1/16" x 4" balsa four pieces 24" long and 3⅝" wide (that's a top measurement; the bottom sheet is approx. 1/16" narrower). These are the top and bottom leading edge sheeting for the inboard wing panels. Glue the spruce spar in place on one of the pieces. Using masking tape, glue a leading edge to this same piece. Note that the leading edge doesn't join the sheeting at exactly 90°. Use a rib to get this angle correct. Pin this assembly lightly in place over the plan. Add the "A" ribs (but not the "Circle AA" ribs) using cyanoacrylate and starting at the spar. Roll each rib forward as you glue it, to be sure that the curve of the Phillips" Entry is maintained. Now pin the assembly solidly in place over the plan and add the bottom center sheeting and the trailing edge. Use Titebond to join the ribs to the trailing edge.

From hard 3/8" balsa cut the filler wedges that go above and below the fiberglass arrowshaft. Roughen the shaft with sandpaper and glue in place with 24-hour epoxy. Add all "Circle AA" ribs and the four plywood shear webs immediately. (You may want to shear-web the two middle bays of the shaft, just to hold the epoxy in place until it dries. Use 1/16" balsa, vertical grain.) Slice away portions of the polyhedral joint rib and epoxy in the leading edge brace and the polyhedral brace. Add the 3/8" shear webs in all remaining bays, then glue the top spar in place.

Installing the leading edge to sheeting is about the only tricky step in the wing construction. Here's how I do it: Block up the leading edge with 1/8" scrap balsa, so it will bear weight. Fit the top sheet to it and sand as necessary for a tight joint. Before gluing, run a piece of masking tape down this joint, but don't stick the tape to the leading edge yet --- stick it only to the 1/16" sheeting.

Now we're ready for glue. Using Titebond, lay a generous bead down the top spar, but don't spread it. Run a quick bead down each rib, then lay a thin bead across the 1/16" sheeting, trying not to get too much on the masking tape. Put the front of the sheeting in place and tape it to the leading edge. Now spread the big bead on the spar, remove the excess, and quickly pull the sheeting down onto it. Use an inch of masking tape in each rib bay. Two good straight-edges are invaluable at this point: one down the front edge of the 1/16" sheet, the other right down the spar. Both need to be weighted with about three to four pounds. Be certain the sheet doesn't bow up in the middle as it dries --- make it follow the rib contours exactly.

Add the center section sheet and capstrips, and you're ready to shape the leading edge. I make a simple female template from scrap plywood, and spend a little time getting a uniform shape to the entire leading edge. The first 10% of this airfoil is about as important as the last 90%. Don't make the L.E. radius too small, if you want to go fast.

Add the plywood root plate, and use the completed panel and steel rod to help align the root rib and arrowshaft of the second inboard panel during construction. Try to keep the dihedrals fairly close to what is shown on the plans. Exact dihedral angles are just solid numbers for insecure folks to cling to, but the dihedrals shown (1.5" plus 5.0") seem to be a good all-round compromise for the Bird.

The tips go together about like the inboard panels. Note that the top sheeting has to go "up and over" the larger ribs B, C, and D -- so its leading edge won't be a perfect straight line.

If you plan to land on the wingtips very often, shear web them all the way out, the tip of the rudder or stab, I will personally jump up and down on your Bird of Time until it is no more. Antennae go **inside** fuselages, out of the slipstream. The last radio I owned that needed a vertically polarized receiver antenna was a Berkeley Super Aerotrol, in 1956.

cleanest possible Bird, or are you more interested in ease of radio installation and maintenance? If you're looking for top speeds, then you might want to consider slimming the fuselage down until it's only "battery pack wide" --- and that's a battery pack with the plastic case removed, wrapped in one or two layers of electrical tape! The vertical dotted lines on F-1 show the fuselage width as I build it for speed.

Don't be misled by full scale formulas for length to width ratios; they simply don't apply to models. The top slope-racer designers will tell you: **skinny planes go faster than fat ones, at the same wing loadings.**

The fuselage structure is very conventional. Use Titebond to glue the ply doublers to the sides, unless you have a very slow acting cyanoacrylate. Clamp them flat under a set of encyclopedias, or your fat aunt, until they're thoroughly dry. Afterwards, go around all the edges with cyanoacrylate, just to be sure.

Glue both sides to the noseblock with Titebond or epoxy; clamp them with masking tape. Build up F-1 and F-3 and install the wing hold-downs before epoxying them in place. Don't omit the plywood doublers; I did that once, and pulled a wing off at a rather important contest. It was embarrassing.

Glue the fin in place with Titebond, so it can be shifted for fuselage alignment. Try to build the fuselage fairly straight; I rarely do, myself, but that's no excuse for you to be sloppy. All you have to do to insure good alignment is lay the nose (forward of F-1) flat on a flat surface and measure up to the centerline of the fin. Now flop it over on its side and measure the centerline again. Make both these measurements the same and your fuselage is straight. Epoxy in the 1/8" spruce stiffener and it will stay straight.

Add the NyRods and the elevator bellcrank assembly. Use the cable-type pushrods; Du-Bro, Sullivan and Su-Pr-Line all make them. Epoxy the nylon every 3" along the fuselage sides, and keep them as straight as possible. Pin the square brass tubing to the bellcrank with zero slop, and drill the 1/16" hole for the front stab wire very accurately.

At this point you may want to bury a piece of light plastic tubing down the inside of the fuselage to feed the antenna through later. Personally, I use one of the pushrod cables for an antenna, clipping off an equivalent amount of the factory antenna and soldering the remaining pigtail on with a short section of heatshrink, so that the servo doesn't flex the solder joint when it moves. I don't do this in my power planes, but I've flown glider competetion for four years this way, and I've never had a glitch.

If I catch you running your antenna out from under the wing and straight back to the tip of the rudder or stab, I will personally jump up and down on your Bird of Time until it is no more.

Glue the 3/8" top and bottom balsa in place with Titebond. Install the towhook of your choice. I have used both EK and Radio Sailplanes releasable hooks, and both are 100% reliable. People who tell you otherwise are mistaken.

Mark the bottom/front fuselage outline on hard 1/2" balsa (or 3/8" stock, if you want to save weight); cut it out and glue it in place with Titebond or epoxy. Rough out the hatch from block balsa or two layers of laminated 3/8" soft, and spot glue it in place while you carve the fuselage to shape. I start with a block plane, then move to 60-grit sandpaper on a block.

Before you can finish carving the tail, you'll want to add the hardwood block for the stabilizer main bearing. If at all possible, use a drill press to make the hole for the brass tube --- stabilizers always look better when they're square with the rest of the plane. (They probably fly better, too. I wouldn't know.) Remember that stabilizer neutral should be about zero degrees to the bottom of the wing, aft of the spar. This gives you a few degrees of positive decalage, and is a safe place to start trimming from.

Use cyanoacrylate to install the 3/32" ID brass tube. Make sure the stab fits, and works smoothly through its full range (at least 1/2" total throw, measured at the front wire). Then add the 1/4" dorsal fin and the 1/16" sheeting to both sides. Shape the fin and blend it into the fuselage. Use a little Dap Spackling Compound to fill, if necessary.

If you're a real weight fanatic, you'll want to build up the rudder, using ribs and open bays --- or at least drill the one shown full of lightening holes. In the past, I've done both. If you make it as shown, find absolutely **punk** 3/8" stock, stuff so light and weak that even the indoor builders have passed it by: styrofoam with a grain. I mean **light**.

Most folk who've built Birds have covered the fuselage with MonoKote. They all agree that it's easier than MonoKoting a golf ball, but not **much** easier. I use silk and low-shrink Sig dope, back to the elevator bellcrank, then Japanese tissue. If you decide to use glass cloth, you're on your own --- just remember that the entire plane should weigh right at 41 ounces, and the wing is almost twenty ounces of that.

The more flexible plastic films (Solarfilm, Econocote) will make life easier on the fuselage, but I wouldn't recommend anything but MonoKote for the wings.

For a nose skid, I buy a cheap floormat

from the auto department of K-Mart, and cut it perpendicular to the "treads." Cut away the MonoKote and cyanoacrylate it directly to the wood.

Flying:

Balance your Bird 1/4", or a little less, behind the spar. Hand glide it to see that the elevator setting is in the ball park. With the C.G. in this range, you'll find that the plane will **fly** at a wide range of elevator settings, but it will only **perform** at one. To find that magic setting, you need flat, cool, morning air, preferably dead calm. I can't tell you where the setting is, but I guarantee you'll know it when you find it: the plane will speed up just a little and "go on step," and the L/D will appear to double. I can tell you this much about looking for the setting: it's way off on the down elevator end of the spectrum. It's much closer to zero-zero trim than anything you've ever flow, unless you're an old hand launch glider flyer.

When you find the magic setting, mark it on the side of the fin with a pen, so you can get it back when you want it. Remember, it will vary slightly with C.G. changes, and with extreme air-density changes, so you may need more than one mark.

Now let's talk ballast. In flat, early-morning contest air, I usually fly dry, even up to a 15 mph wind. Sometimes this is the only way to max, and other times it's a mistake. The Bird penetrates better at 5.5 ounces/foot than any plane I've ever flown at that wing loading, and I often let this superior penetration go to my head. A clean design is no protection against turbulence, especially the sort of wind shadows cast by trees and hills and tents and cars and pilots (like me) who stand directly upwind of a landing spot. The only sure protection against this kind of turbulence --- and against large patches of cold, sinking air -- is **inertia**, and inertia takes weight.

I strongly recommend that you make up two white pine blocks that fit exactly into the open areas in front and behind Former Two. Drill them out on top and pour molten lead or beebees and epoxy into them both, until you bring the total weight of your Bird up to 52 ounces, **without changing the Center of Gravity**. Mark these two blocks "7 oz./ft." and stow them in your field box.

Learn when to use them. Don't be a dummy, like Thornburg, and go up into hot, violent afternoon air at 5.5 ounces. Ballast up to seven, and when you find yourself in a "square city block" of pure sink, you'll have inertia enough to get out of it, before it sucks you into the ground, tail first.

Then, when the contest calls for a speed event, make up another pair of blocks and load them to about 9.5 ounces a foot (70 ounce flying weight). Practice the speed course with them to find out where the Center of Gravity wants to be for the average dive angle you need to complete the speed run. The "max aft C.G. for speed" shown on the plans is about where I flew my best FAI speeds at sea level --- at Denver I flew my practice runs at dawn, in the cold morning air, and never once got on step in the heat of the day. Practice a bit under the actual conditions of the contest, and I think you'll find your Bird of Time is easily competitve with other designs loaded much heavier than you are.

If you have any questions or comments, I'm at 3635 Mt. Vernon, Sebastopol, Calif. And if you can't bear the thought of all that cutting and hacking, I'm planning to put out twenty or thirty hand-cut kits this fall, to help pay the rent. Rattle my cage for prices and details. □

By H.E
RCModeler
Jan.1979