The Wierd One

by Dick Sarpolus

and Arnie Pedersen

Is a backward birdie better? Can't say unless you try! A tail-first Radio Soarer to probe the elusive thermals.

Look at that dedication gentlemen, their very presence is melting the snow away. Ingrid Pedersen and Lynn Sarpolus share a common problem. Those tree stumps in background eat canards tail first.

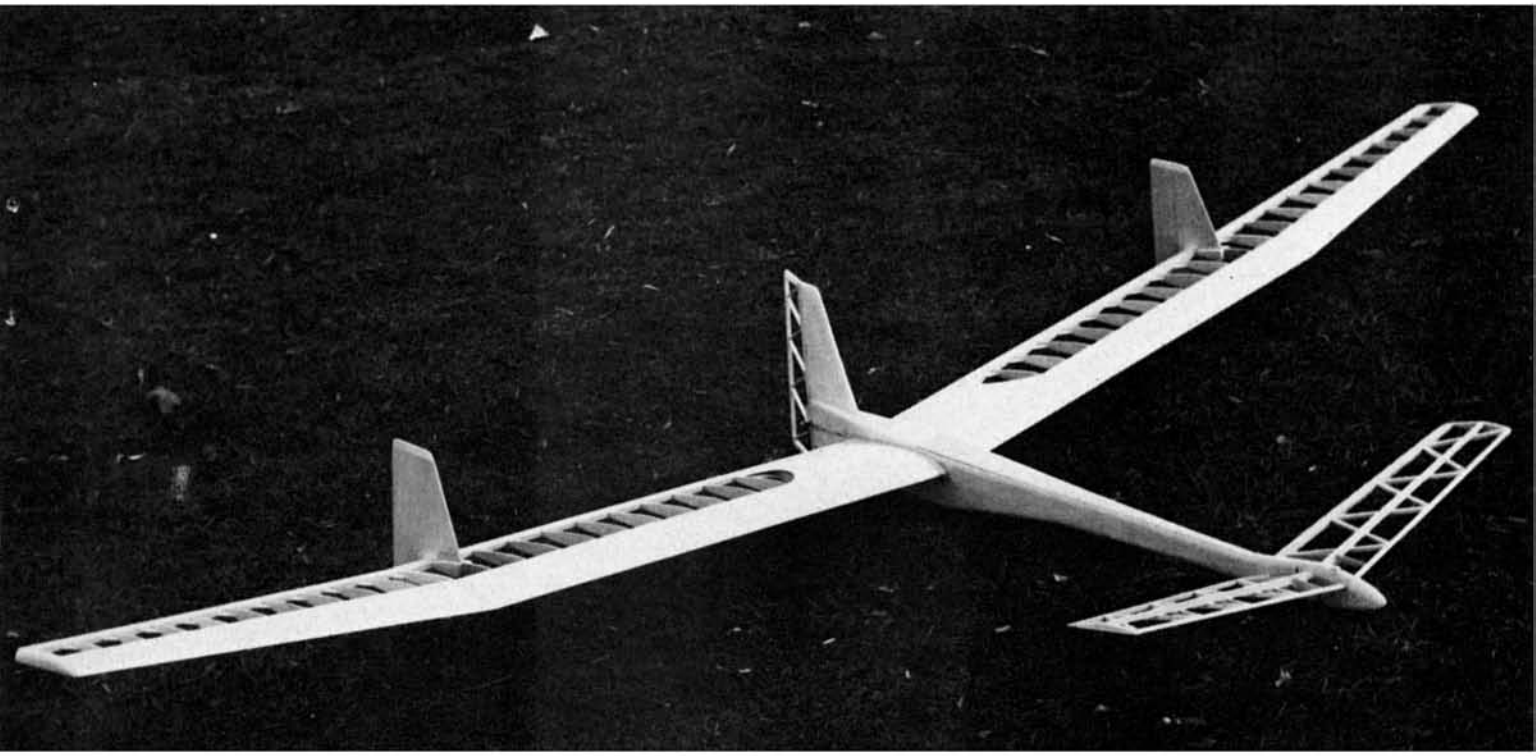
Here's a case where the name really fits the model! We know it's a weird one because Don McGovern wanted to publish it as soon as he heard about it. Seriously, this model flies well—a lot of effort went into its design and we would like to give you some of the reasoning behind our design approach. First of all we will admit that the basic purpose of developing a sailplane in a canard configuration was merely to be different—however we felt that a different design would not be considered successful unless it performed at least as well as a conventional design. Initial thoughts about the canard set-up indicated some possible advantages.

The most apparent advantage was lighter weight; we were essentially taking a conventional fuselage, cutting the nose section off at the leading edge of the wing, and throwing it away—along with its canopy, shaped blocks, and nose weight. By correct R/C equipment placement, we could easily get the correct C.G. location—we thought—without using the added weight common in conventional designs. Next was streamlining—for what it might be worth. Initial sketches, we felt, indicated a canard design could be cleaner, less drag. As for flight characteristics, we knew the horizontal stabilizer area would necessarily be larger than normal, and that combined with a conventional wing planform and airfoil should result in at least normal soaring performance. We read that canards had very gentle stall characteristics, and that would be an advantage.

Now that we knew what results we wanted, it was time to draw up a construction plan. The wing was first, and easiest. It is essentially our standard "Nebula II" wing, 103 inches in span, 15.4 to 1 aspect ratio, 935 square inches area, 10% flat bottom section, as kitted by Ralvin Industries. The stab was next: we decided on 225 square inches, just about 25% of the wing area. This percentage was based on canard comments that very large stabs were needed for stability; 25% was as large as we cared to go. The fuselage was drawn up by the time-honored method of making it big enough in the right places to contain the radio equipment where we thought it would be needed for balance. A full moving stab was used for simplicity and efficiency. Wing incidence was set at three degrees based on our conventional model experience. What little we had seen on canards indicated the stab should be set at a much higher incidence; we set ours at a slightly higher angle than the wing. Rudder area was large; this was a real unknown as with the rudder so close to the wing we didn't have any experience to draw upon to decide if the model would turn. C.G. placement was another guess; we put it right at the wing leading edge to start with and put the tow hook in a normal relationship with the C.G.

The above comments describe the initial flight configuration; several major changes had to be made to that configuration which we will go into. The end result was a good flying aircraft; in the interest of further experimentation we will also mention several additional design change ideas that we have not tried. Perhaps you experimenters out there may care to try them; we would welcome your comments and/or results.

The first test glide was beautiful; as close to perfect as one could wish. Many comments were made concerning T.W.O.'s flying "off-the-board" which were reinforced by succeeding test glides. These initial comments were changed abruptly when the first launch, by electric winch, resulted in an immediate stall and vertical dive into the ground. This proved several things—the structural integrity of the fuselage, the safe location of the wings, the vulnerability of the forward located horizontal stab, and that new design airplanes don't always fly great in the beginning. Immediate changes made were adding weight to the nose to move the C.G. about six inches forward, and moving the tow hook about nine inches forward. We didn't want that experience to be repeated. To digress a bit, the stab vulnerability was solved by several changes. A wire nose skid was added and more dihedral was put into the stab—these changes gave the stab more, therefore safer, ground clearance. In addition a new stab was built of somewhat stronger construction. A big help was the thought of using 1/8" brass tubing rather than 1/8" wire for the stab pivot rod. Now if the stab tip does hit the ground in most cases the 1/8" brass and 1/16" wire stab rods will simply kink and bend with no damage to the surface.



Photos: Dick Sarpolus except where noted

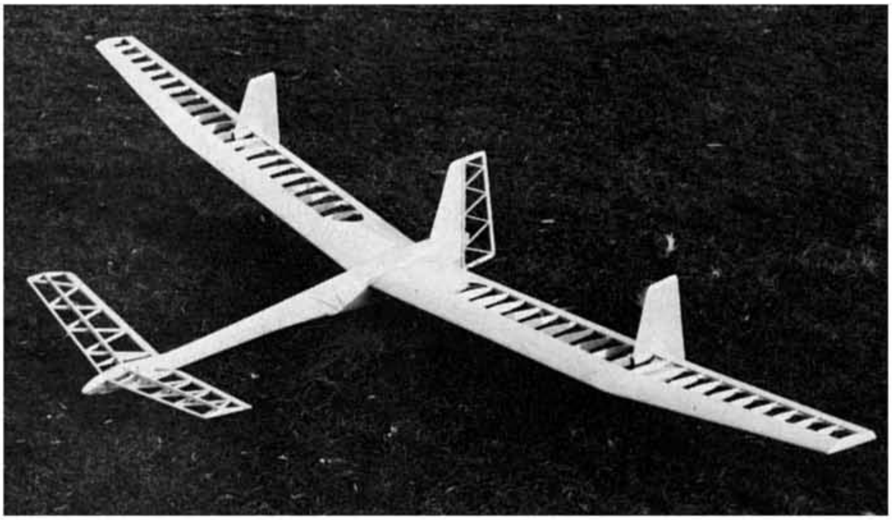
More incidence was adjusted into the stab and again our hand glides were fine. The next attempt at a launch resulted in another crash; the tow hook was too far forward and we couldn't climb; couldn't control the plane. Moving the tow hook back several inches gave us our first successful launch—not very high, but it was flying. And it did turn! Visual orientation was a problem and still is to some extent; this is solved only by more flight experience.

It seemed logical to continue moving the two hook and the C.G. rearward to permit better, steeper climb, launches. The R/C equipment was moved forward in the fuselage to let us remove the weight which had been added to the nose. This worked, to a point, when the model began to lose all stability past a certain climb angle. Much flight testing had us to a point where the model could be launched and flown, but only if the pilot was careful not to get the plane into a nose-high attituae, at which point it would go crazy and usually gyrate down to the ground. We might add that all the crashes occurred at low touch-down speeds with little damage; usually the front stab suffered.

Another design change made was to move the entire rudder and fin several inches to the rear, thinking to give the rudder more effect. No help. Next we felt that the wing was blocking air flow to the rudder in a nose-high attitude, so we added much fin and rudder area below the fuselage. This presented tough structural problems; the model would rest on a wire skid and the tip of the underslung fin/rudder. Since it didn't help our flight stability problem anyway, we removed the bottom fin/rudder pieces. Several non-productive weeks went by before we thought of something else to try. We made two fixed rudders and taped them onto the wing, out at the polyhedral joint. The problem here was thought to be that if the "wing rudders" solved the instability problem during climbing, would just the center rudder serve to control the aircraft? Linkage problems to control the wing rudders, and/or use ailerons or spoilers, would complicate our model too much. Well it worked! The wing rudders apparently add enough stability that the model now can climb steeply for a good launch, and the one central control rudder is ample for good flight control. Stalls are gentle.

The plans depict our final configuration. The wing rudders are removable for transportation, held in place with breakaway wooden toothpicks. Flying characteristics are basically normal; there is a tendency to nose up and slow down in a turn, so a little up elevator or even some down elevator is sometimes necessary during turns. Remember: up elevator motion makes this plane dive, and down elevator motion makes the nose go up! Perhaps a swept forward rudder hinge line would help here. Another untried variation is more extensive dihedral in the forward stab, going to a vee-tail configuration. This might add stability as the wing rudders did. Some have suggested a forward rudder location; we don't intend to try this as we feel the maximum side area should be behind the C.G. for stability. (I agree, having once tried it, with extremely bad results . . . Editor) Perhaps the forward vee tail could be controlled with an aileron/elevator mixer unit, with the aileron movement coupled to the rudder. Plenty of experimentation room.

Construction is conventional. The wing, being flat bottom, is easily and quickly built. Don't leave out the vertical grain



The forward tailplane of a canard is in a vulnerable position, though radio guidance insures it. **Top:** Two fixed outer fins, one center rudder for turns. Hooks and rubber band retains the panels.

spar webs—they add much strength. The stab is simple, lightweight construction. The fuselage is a basic box, rounded off as much as the corner triangle stock will allow. "Beauty is in the eye of the beholder," somebody said. We like the T.W.O.'s appearance; maybe it grows on you. We use MonoKote on the surfaces; universal choice for sailplanes. Paint the fuselage, unless you like applying MonoKote to fuselage shapes; we don't. We have gone into the construction procedures in considerable detail; the average builder should have no trouble making the "T.W.O."

The Wing Ribs

The wing ribs may be cut directly from the patterns on the plans or cut by following this procedure:

Cut two main and one tip rib template from 1/16" plywood or other suitable material. Next, stack fifteen 1½"x7¼" rectangles of 3/32" medium balsa between the two main rib templates, one near each end, to allow two lengths of 4-40 threaded rod to go through the stack. A nut at each end of the rods will hold the stack solidly. Next, carve it to a rough outline, then sand the balsa down to the templates. Cut the spar notches, using a razor saw and a square file. When you remove the rods and templates you will have the ribs for one root panel.

Stack eleven balsa rectangles between one root and tip template. Secure the stack, the rods and nuts, then carve and sand as before for the two tip panels. Use the templates on the plan to cut six 3/32" plywood ribs.

Trim 3/32" from the top of eight of the main ribs, from the back of the spar notch to the trailing edge to allow for the root sheeting.

The Wing Assembly

Working from the plans, locate and mark the holes for the wing support tubes on one of the 3/32" plywood root ribs. If you have access to a drill press, stack all six ribs. Clamp them together and drill the holes for the 1/8" and 1/4" I.D. tubes. If only a hand drill is available, drill the rib you have marked first, then use it as a pattern to mark and drill the rest.

Place the plans on a *flat* working surface and tape or tack wax paper over the drawings. Working from the plans, cut the 3/32" bottom root panel sheeting to proper width and pin it down. Glue and pin down the 1/8"x3/8" spruce spar at the rear edge of the lower sheeting. Make certain that the rear edge of the spar and the sheeting are even. Pin down the trailing edge over the plans and use two main ribs to check the spacing of the trailing edge to the spar. Cut the lower center-section sheeting to fit between the spar and the trailing edge, then glue and pin the sheeting in position. Put all balsa ribs in place to assure a proper fit. Next, remove the first rib and apply glue where it touches the sheeting, spar and trailing edge and replace it. Repeat with the rest of the ribs. Make sure that the ribs are at right angles to the spars. The end rib should be glued in, tilted 1/16" inward to allow for the angle of the polyhedral joint.

Roughen the brass tubing for the wings with coarse sandpaper, then clean them with alcohol or dope thinner. Press three of the doubled root ribs onto one set of the tubes. Arrange them for the proper spacing and at right angles to the tubes, then glue this tube and rib unit in place. The top spar is now added.

Cut the 3/32" vertical grain webbing to fit between the ribs in front of the spars as shown. Note that the first four bays and the last bay on the root panel have double webbing. The webs on the first bay of the tip panels are also double. Pin and glue the webs in place. Apply epoxy generously around the intersections of the ribs and tubes, and also to the adjoining webs. Now glue in the 3/32" triangular rib gussets. We suggest elevating them on 3/32" scrap during the installation to prevent them from touching the wing covering when the wing is complete.

The top sheeting is now cut to size. Apply glue to the top spar and to the edge of the ribs from spar to the front edge. Add the top sheeting and pin it in place, making sure it tightly conforms with the rib contour. Cut and fit the top center-section sheeting. Glue and pin it tightly to the ribs, then let the wing panel dry at least eight hours before proceeding.

At this point, remove the wing panel from the building surface. Sand the sheeting even with the front edge of the ribs. Glue the 1/4"x3/8" leading edge on and hold it in place with pins and masking tape while the glue dries. Next, sand the leading edge to the contour shown on the plans. The curvature should be even over the length of the wing. Add the 1/16" plywood wing fin mounts as indicated. Repeat the construction sequence for the other root panel. Be sure to build the root panel reversed, as shown in phantom on the plans.

Follow the same construction methods for the tip panels. Note that the first rib tilts inward 1/16" to allow for the polyhedral angle. Cut slots in each of the four ribs for the 1/8" plywood polyhedral braces to pass through, as shown on the plans. Dry assemble the root and tip panels on the braces to be sure that all fits and lines up well.

Disassemble the root and tip panels and pin or weight them down. Coat the adjoining ribs with epoxy. Use plenty of it on the polyhedral braces and in the slots. Re-assemble the root and tip panels and block up the tips to the angle as shown on the plans. Allow the epoxy to cure completely. Remove the wings from the table and fill gaps, dents or dings with a good surfacer. Sand the wings smooth. Wipe all dust off and cover with MonoKote or similar material.

The Stabilizer

Cut two each of stab ribs #1 and #2 from the pattern on the plans and drill the holes for the 1/16" and 1/8" I.D. brass tubing.

Facing page: Just a skeleton (the plane that is). Lynn holds near C.G. Simple in structure, standard techniques. Seems to fly in reverse gear.

Above: Sorry boys, we vote for page 26. Take those frozen girls out to dinner. Arnie and Bill found the "Weird One's" a wholesome experience!

Working on a flat surface, cover plans with wax paper. Pin down the ¼"x¼" balsa leading edge and the ¼"x1" tapered trailing edge stock. Next glue on the ¼"x½" stabilizer tips and fit and cement the ¼"x¼" balsa diagonal strips. Glue ribs #1 and #2 in place and note that rib #1 is installed at an angle as shown on the plans. Add the ¼"x½" diagonal from the trailing edge to the rear of rib #1. Cut the spars from ¼" sheet, so that they taper from ½" high at the root to ¼" at the tip. Apply glue to the stabilizer where tne spar will touch and pin the spar in place. Let the glue dry very well.

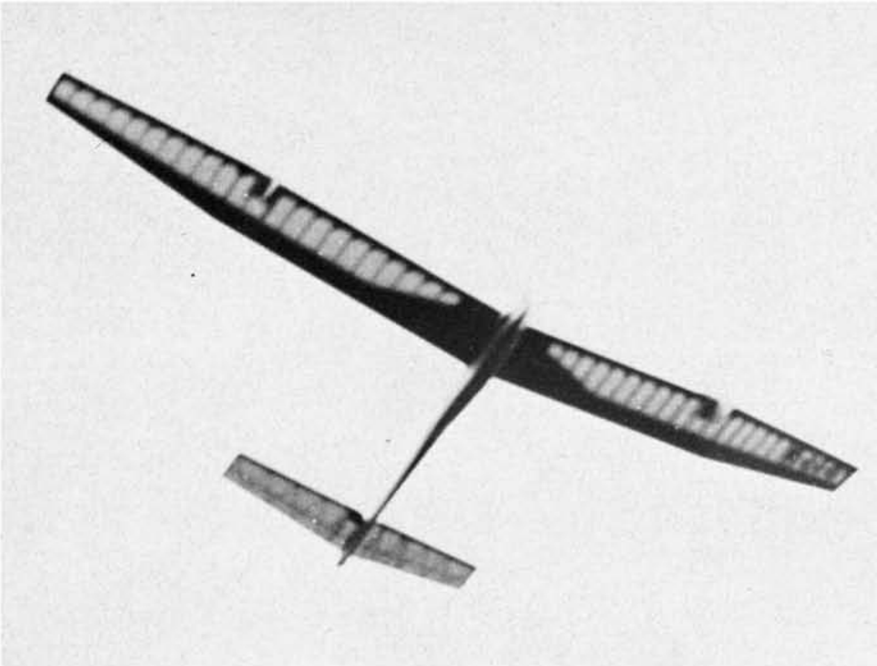
Remove the stabilizer halves from the board and sand the leading edge round. Sand the tip block to slant from spar down to leading edge and down to the trailing edge. Roughen the brass tubes with sandpaper, then clean them with alcohol or thinner. Press them into ribs #1 and #2 as shown. Following this, slip the stabilizer halves onto the support wires. With the bottom of ribs #1 flat upon the table, block up each tip to 3¼". Apply epoxy around the tubing and rib intersections and let cure.

The Wing Fins

The fins are constructed from ⅛" hard sheet balsa. Cover the fin plan area with wax paper as before. After cutting and

FM photo: Jim Boyd

It collapses whenever you want. Also depending upon the fortunes of flight. Wing panels pull, as do the tail surfaces for cramming into compact sized vehicles. A stimulating new concept in R/C.



fitting the fin pieces, epoxy them together and pin down on a flat surface. Sand the fins to a streamlined cross-section.

Fuselage Structure

Laminate the plywood doublers to the fuselage siding with epoxy. Cut and glue down all triangular stock as per the plans. Add the plywood triplers for the ¼" wing support rod as shown.

Working with the fuselage siding upside down on the bench, glue in formers #4 and #6, making sure the sides are parallel. When the glue is dry, add formers #1, #2 and #3. Crack the fuselage sides just behind former #6 and glue the siding to the tail post. Now remove the fuselage from the board and add the nose block. Glue on the ⅛" sheet front top blocks, and install the ⅛" plywood stabilizer supports and the stabilizer Nyrod.

Add the ⅛" balsa sheeting to the fuselage top and bottom, leaving the hatch area open and the area over the stabilizer. Install the ¼" sheet balsa fin and the ⅛" plywood stab fin by cutting slots in the top and bottom sheeting and epoxy them vertically to the fuselage.

Carefully locate the holes for the stabilizer pivot tubing and drill them. Locate and cut the drive wire clearance slot. Using a 3/16" dia. drill, enlarge the pivot holes in the balsa, only leaving the smaller hole in the ply support untouched.

Cut the wing root fairings from ¼" balsa, a little bit oversized. Locate and drill the holes for the wing support rods and the clearance hole for the rubber band wing retainer. Put the wing rods in one-half of the wing and thread on the fairing. Sand the fairing down to conform with the wing root exactly and mark it to show which wing half it matches. Repeat with the other wing half and fairing.

Carefully measure the root fairing position on the plan of the fuselage. Pin the fairings in that position on the sides of the fuselage. Mark the hole locations using the fairings as a guide. Remove the fairings and drill the holes for the support rods.

Connect the stabilizer bellcrank to the Nyrod, then slide the ⅛" I.D. pivot tube through the fuselage siding and bellcrank. Insert the ⅛" O.D. stab pivot and the 1/16" dia. music wire. Assemble the stabilizer halves on the pivot and wire. Sight down the fuselage to be sure the stab is horizontal to the fin. When satisfied with the alignment, spot glue the pivot tube inside the fuselage on its side. Fill the 3/16" recess around the pivot tube with epoxy. When cured, repeat with the other side. Add the ⅛" top sheeting over the stabilizer bellcrank, and sand the corners of the fuselage round, exposing a good ⅛" of the triangular stock.

Thread the ¼" and ⅛" dia. wing support rods through the fuselage, then slide the wing onto the rods. Level the wings in relation to the stabilizer by sliding the rods sideways to tilt the wing. Sight down the fuselage to be sure that the wings and stabilizer are parellel and that the wings are at right angles to the fuselage. Use 5-minute epoxy to spot-glue the rods where they enter the fuselage. Let the epoxy cure completely.

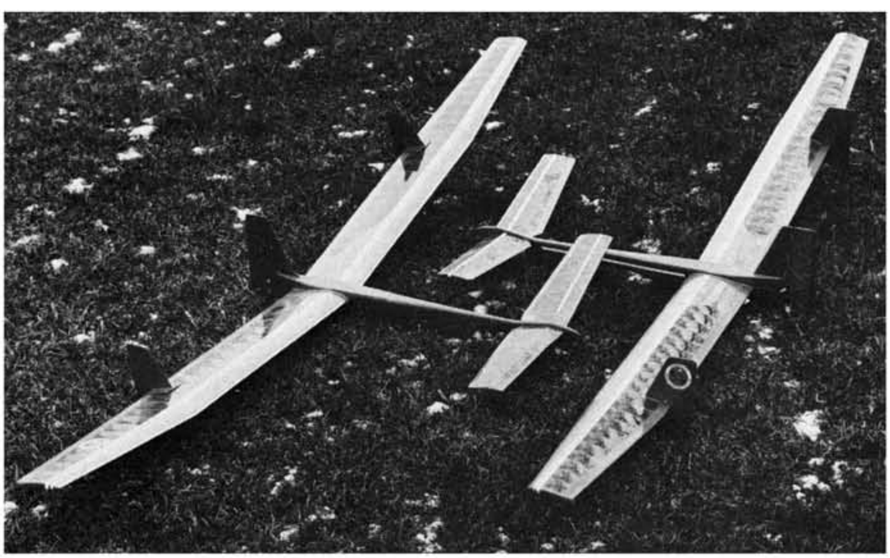
Working through the hatch, install the two #5 formers to the front and back of the ¼" dia. rod, then apply epoxy generously around wing rod and fuselage joint and former #5. Remove the wings from the rods, thread on the fairings and replace the wings.

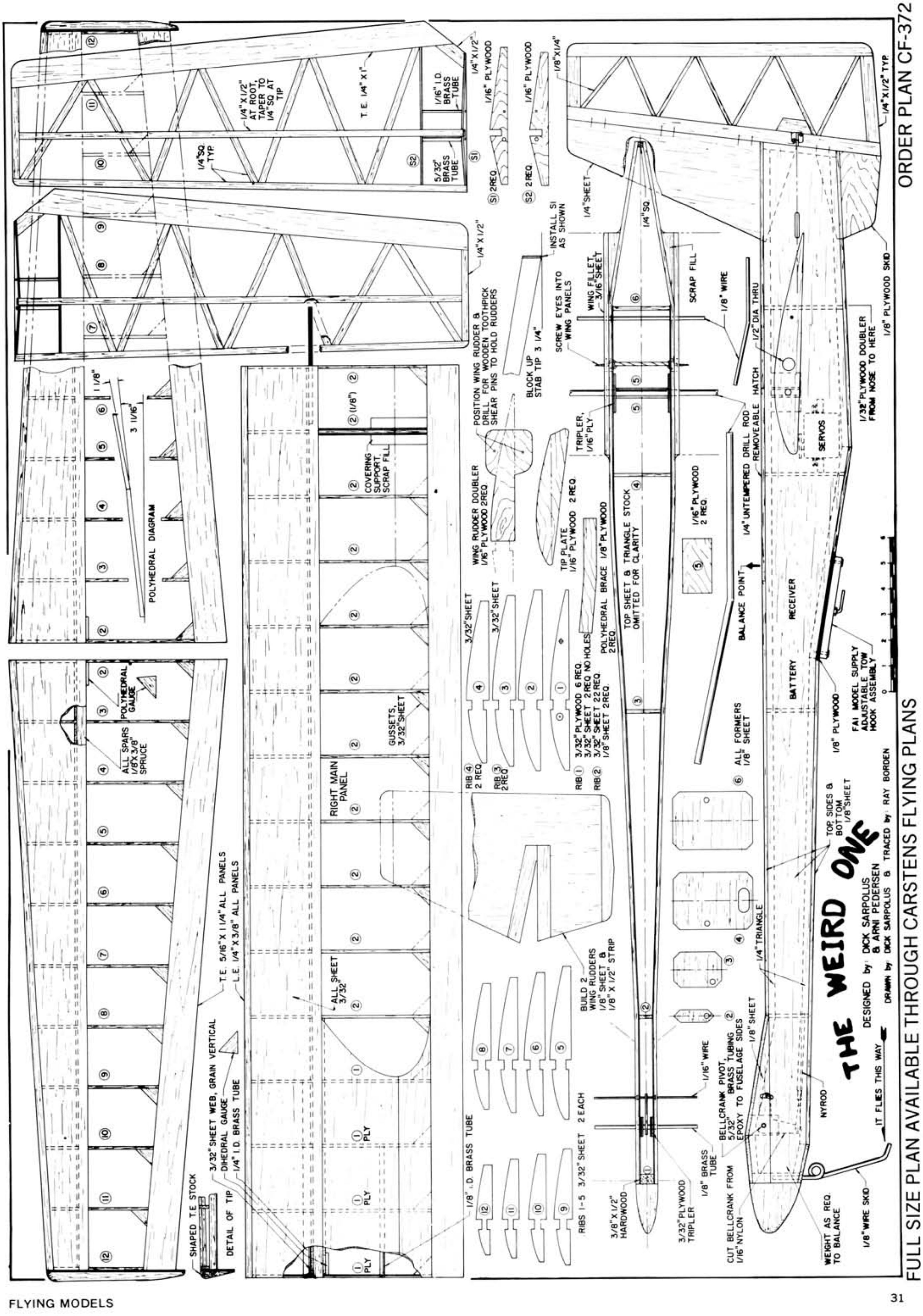
Coat the fuselage side of the fairings with epoxy and slide the wings and fairings to the fuselage. Keep the fairings flat against the wing roots and allow epoxy to set. Fill the gaps between the rear edge of the fairings and the fuselage with wedges cut from scrap. Build up the fillets around the root fairings with Epoxolite or epoxy mixed with a filler. When cured, sand the fillets to blend with the fuselage.

Happy flying, and have some fun backing into those thermals.

FM photo: Jim Boyd

Orientation in the air will get you, but it's slow and glider-like and gives you time to react. **Below:** A pair of T.W.O.'s discuss ways to confused the next flyer. Bill reports fine on power pod.

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IT FLIES THIS WAY
POLYHEDRAL DIAGRAM
RIGHT MAIN PANEL
ALL SPARS 1/8"X 3/8" SPRUCE
T.E. 5/16" X 1 1/4" ALL PANELS
L.E. 1/4" X 3/8" ALL PANELS
3/32" SHEET WEB, GRAIN VERTICAL
DIHEDRAL GAUGE
1/4" I.D. BRASS TUBE
SHAPED T.E. STOCK
DETAIL OF TIP
POLYHEDRAL GAUGE
1/8" I.D. BRASS TUBE
ALL SHEET 3/32"
GUSSETS, 3/32" SHEET
COVERING SUPPORT, SCRAP FILL
RIBS 1-5 3/32" SHEET 2 EACH
RIB 1 3/32" PLYWOOD 6 REQ.
RIB 2 3/32" SHEET 2 REQ NO HOLES
RIB 3 3/32" SHEET 2 REQ.
RIB 4 1/8" SHEET 2 REQ.
BUILD 2 WING RUDDERS 1/8" SHEET & 1/8" X 1/2" STRIP
WING RUDDER DOUBLER 1/16" PLYWOOD 2 REQ.
POSITION WING RUDDER & DRILL FOR WOODEN TOOTHPICK SHEAR PINS TO HOLD RUDDERS
TIP PLATE 1/16" PLYWOOD 2 REQ.
POLYHEDRAL BRACE 1/8" PLYWOOD 2 REQ.
BLOCK UP STAB TIP 3 1/4"
INSTALL S1 AS SHOWN
S1 2 REQ. 1/16" PLYWOOD
S2 2 REQ. 1/16" PLYWOOD
1/4"X1/2" AT ROOT, TAPER TO 1/4"SQ AT TIP
T.E. 1/4" X 1"
1/16" I.D. BRASS TUBE
5/32" BRASS TUBE
1/4"SQ. TYP.
1/8"X1/4"
1/4"X1/2" TYP.
1/4" SHEET
1/4" SQ.
TOP SHEET & TRIANGLE STOCK OMITTED FOR CLARITY
TRIPLER, 1/16" PLY
SCREW EYES INTO WING PANELS
WING FILLET 3/16" SHEET
SCRAP FILL
1/8" WIRE
1/16" WIRE
1/16" PLYWOOD 2 REQ.
1/4" UNTEMPERED DRILL ROD
BALANCE POINT
ALL FORMERS 1/8" SHEET
3/8" X 1/2" HARDWOOD
3/32" PLYWOOD TRIPLER
1/8" BRASS TUBE
BELLCRANK PIVOT, 5/32" BRASS TUBING EPOXY TO FUSELAGE SIDES
CUT BELLCRANK FROM 1/16" NYLON
1/8" SHEET
1/4" TRIANGLE
TOP SIDES & BOTTOM 1/8" SHEET
NYROD
WEIGHT AS REQ. TO BALANCE
1/8" WIRE SKID
BATTERY
RECEIVER
SERVOS
REMOVEABLE HATCH
1/2" DIA THRU
1/32" PLYWOOD DOUBLER FROM NOSE TO HERE
1/8" PLYWOOD SKID
1/8" PLYWOOD
FAI MODEL SUPPLY ADJUSTABLE TOW HOOK ASSEMBLY