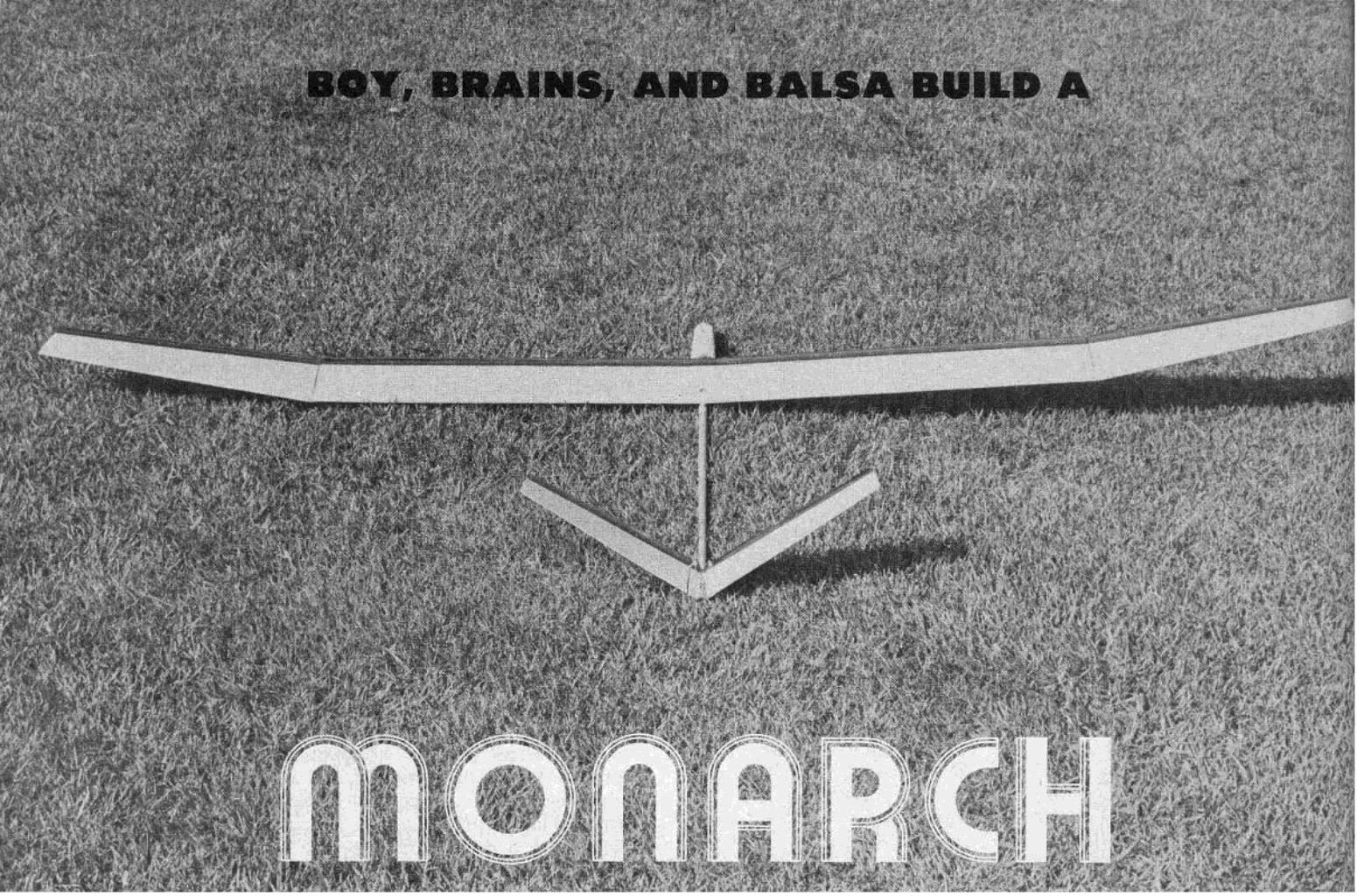
BOY, BRAINS, AND BALSA BUILD A



A 10'-6" span, lightly loaded sailplane that captures the best in thermal soaring.

By Bob Barns

● Those who are familiar with the pages of R/C Modeler are aware that, although much of the public may consider making model aircraft "kid stuff," the majority of those involved are adults. An exception to this pattern is Christopher Barns, now seventeen, who designed his R/C glider Monarch in the Fall of 1971 at the age of fourteen and turned fifteen while building it. His first two R/C gliders were a Phoebus built from a kit and a Cliffmaster built from RCM plans; Monarch is his third. In addition to his his model building activities and his normal school responsibilities (he is a high school senior) he found the time and energy to serve as president of the local group of model enthusiasts, the Davis Aero Modelers, several seasons ago.

The Monarch has a wingspan of 10'6", weighs 41 ounces ready to fly and has a wing area of 1016 square inches, giving a wing loading of 5.9 ounces per square foot. This is about 75% of the wing loadings of most other aircraft of its class. The aspect ratio is 14:1. The airfoil design is a modified Clark Y 11% section, with the high point at 36%. The radio gear is a Kraft Series 70 four channel with two KPS-12 servos.

Readers can see from the photographs that there is a considerable similarity between the Monarch and Airtronic's Grand Esprit. The Monarch, however, had been flying eight months before Chris' first knowledge of the Grand Esprit, which came in the RCM issue for August 1972.

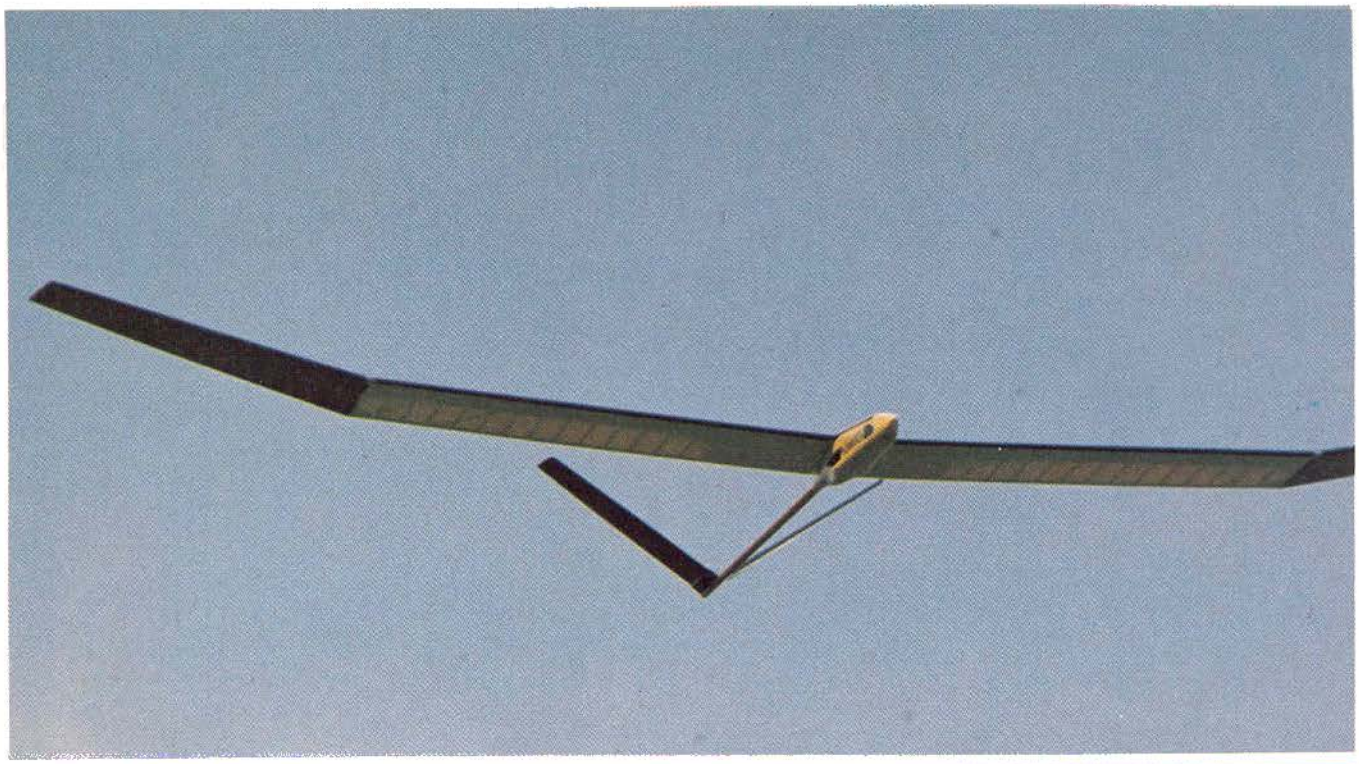
It can be seen that the design differs in some important respects from that of most thermal gliders. The lack of a visible antenna is one of the more hidden innovations; it is inside the fiberglass tail boom. The full flying Vee tail is the most prominent of the design features. The flying surfaces are held to their pivots at the end of the boom by the pressure of the control rods. This technique was chosen for its strength, ease of construction and economy.

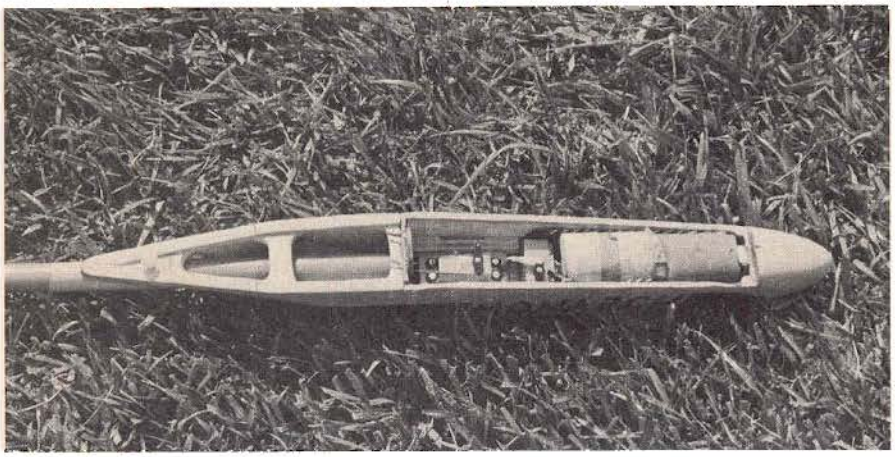
As a result of having seen a number of mid-air collisions at slope soaring races Chris instituted one easily constructed and completely hidden feature: the insertion in a slit on the leading edge of the wing of a length of .035" music wire glued in place. This has proven highly satisfactory crash insurance when the aircraft has struck unyielding objects, resulting in only slight or no damage where major damage might otherwise have occurred. He has not been able to determine the weight of the glue holding the wire in place, but is quite certain that it and the wire, which weighs only 3/8ths of an ounce, do not add as much as an ounce to the weight of the ship. This is very cheap, light and effective crash protection indeed!

The Monarch has proven itself to be a very effective design; a highly responsive, high performance aircraft with a low rate of sink, penetration equivalent to gliders of higher wing loading, and a normal flight speed about 75% that of most thermal gliders. As with most other sailplanes with a 65% Center of Gravity it has a quick but predictable stall. Its polyhedral tips allow it to turn quickly, maintain its bank angle and recover equally quick.

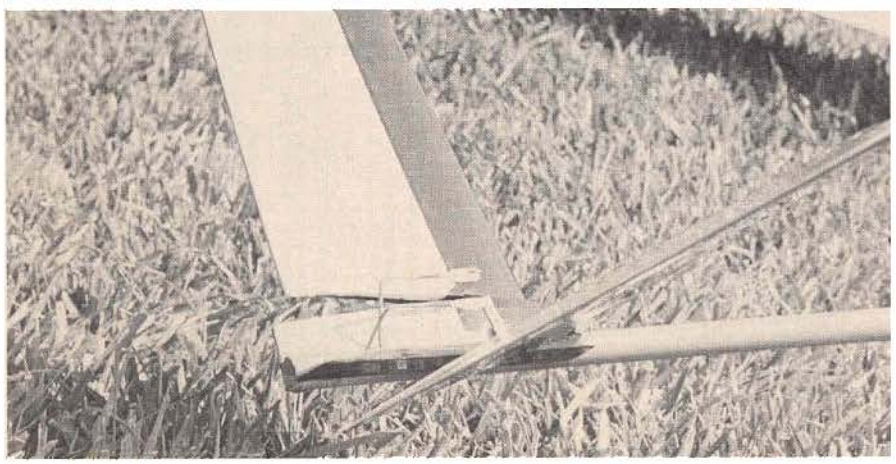
The Monarch has given flights of twenty to forty minutes at the local airport, the city park, and the playing fields of the University of California at Davis. On Picnic Day 1972 on the UCD campus it was flown as part of the Davis Aero Modelers flight demonstration where it showed to hundreds of spectators, many for the first time, that a motorless aircraft can sustain flight for many minutes.

The Monarch's towing characteristics are excellent, whether on the winch or by hand. It climbs straight, with no tendency to snap roll, and can sustain a very high towing angle resulting in a higher than normal





ABOVE: With the wing and hatch removed, the Kraft radio with sliding servo tray is cleanly visible. Note fibreglass tail boom inserted into balsa fuselage. BELOW: All-flying V-Tail connected to servos via pushrods with C-bends and Goldberg Snaplinks. An excellent sport thermal sailplane . . . .



MONARCH
Designed by: Chris Barns

TYPE AIRCRAFT
Sailplane, Thermal
WINGSPAN
126 Inches
WING CHORD
9 Inches
TOTAL WING AREA
1016 Sq. In.
WING LOCATION
High Wing
AIRFOIL
11% Mod. Clark Y
WING PLANFORM
Constant Chord Center Panels, Double Taper Tip Panels
POLYHEDRAL
2½° — 10°
O.A. FUSELAGE LENGTH
58½ Inches
RADIO COMPARTMENT AREA
(L) 10⅜" X (W) 1⅞" X (H) 2"
STABILIZER SPAN
34 Inches
STABILIZER CHORD (incl. elev.)
5 Inches (Average)
STABILIZER AREA
170 Sq. In.
STABILIZER AIRFOIL SECTION
Flat Bottom
STABILIZER LOCATION
V-Tail
REC. NO. OF CHANNELS
2
CONTROL FUNCTIONS
Full Flying V-Tail
BASIC MATERIALS USED IN CONSTRUCTION:
Fuselage .....Balsa, Ply, Fiberglass Tail Boom
Wing .....Balsa, Plywood
Empennage .....Balsa
WEIGHT, READY-TO-FLY
41 Ounces
WING LOADING
5.9 oz./sq. ft.

The wing, as in most sailplanes, consumes the lion's share of construction time and effort. The tips are removable and built separately; the center section is built flat until the dihedral is put in late in the process, which eases construction considerably.

The wing is started with a piece of 48" x 1/16" x 3' as the bottom forward sheeting. Add the center sheeting back to the T.E., and the 1/2" wide sheeting strip to the tips along the L.E. After the bottom capstrips are in, the 1/8" x 1/4" spruce bottom spars are installed. Note they do **not** come to the centerline, but end flush with the inside surface of the first outboard rib. The ribs, which can be made by stacking, are added next.

Glue the beveled end dihedral braces (1/4" square spruce). Follow with the tip tubes — see sections on plans for the details. Now add the top spar and vertically grained shear webbing, 1/16" balsa except for the 1/32" plywood on the two outer rib bays. Shear webbing is glued to the forward side of the top and bottom spars.

Cut off the excess capstrip lengths and glue the T.E. in place, then the 1/8" x 1/4" L.E. backing strip. All corner braces come next. The L.E. sheeting follows, back to a line 1/16" forward of the trailing edge of the top spar. Add the top capstrips, except for the outer rib bays, where the sheeting goes on to prevent cover wrinkles.

Before gluing the L.E. in place, insert the wire. Using the back of a dull razor blade make a groove for the wire, fill with Titebond or epoxy, and press the wire in with your thumbnail until it is flush with the surface. Glue the reinforced L.E. in place. It does not extend across the middle 2½" of the wing.

Before the top and bottom dihedral braces can be put in, the 1/8" plywood sheeting in the center section must be glued to the bottom sheeting. With the 1/4" x 1/4" dihedral braces on each side in place, block each tip up 1½". Using 6 hour epoxy, glue the 1/8" plywood dihedral clamps in front and back of the braces, holding with suitable small clamps, such as clothespins, until the glue sets.

Two rib-shaped sections are installed back to the dihedral clamps straddling the centerline. Put the locator dowel between them protruding 9/16" beyond the L.E. backing strip. This must be notched slightly to allow the dowel to lie flush on the plywood. Fill in around the dowel with epoxy.

The center section top sheeting can now be installed, as can the 1/16" plywood cap ribs on each end of the now-completed wing structure.

If you're here, the worst is over. Both tips are built similarly. Use your own system for making the tapered ribs.

The wing tips are a block of 1" balsa glued to the outer rib. First cut to the extension of the airfoil section and then to the outline shown on the plans. Now, carefully draw a line 1/16" below the top surface and parallel to it. Remove all balsa from this line back to the flat surface of the wing undersurface where it joins the outermost rib.

The stabilizers are easier yet. First the bottom sheeting, then the ribs on top, add the L.E. and T.E., and the 1/8" x 1/8" hard balsa spar. Add the tube, 1/4" OD aluminum, into the first three ribs, braced between the top and bottom sheeting, but not heavily — every ounce here calls for **six** ounces up front. The top sheeting is back to the spar and is as shown on the plan. The root ribs are 1/16" plywood with the control horns an integral part of them. Be sure the horns are 90 degrees to the tube both ways. The stab tip is identical to the wing tip procedure.

Before building the fuselage check to see that the radio gear you will be using will fit inside. Minor variations in size to allow for different gear will not be critical. Better now than later!

The fuselage is based upon the fiberglass boom, a section of ocean fishing rod, tapered from 7/8" to 5/8" and 45½" long. If not available locally, try Kermit Walker, 408 Westwood, Lodi, California 95240. ($3.50 each.) Make the two rear bulkheads of 1/8" plywood to fit snugly around the tube. Glue in place, then cut out the bottom sheeting of 1/4" balsa and glue in place exactly parallel with the top of the boom tube. The 1/4" side sheeting is next; it should extend about 1/4" beyond the rear-most bulkhead. Glue to the middle bulkhead and forward bottom sheeting; when dry, clamp into position and glue to the rear bulkhead. Be careful that you have proper fuselage alignment when doing this. Add the front bulkhead and its two corner braces. The fairings on the bottom rear are next. They are strictly a cut-and-fit, trial-and-error process.

The wing platform design is shown on the top view of the fuselage; it is cut from 1/4" balsa. Install with a 1/4" rise to the front to give 2 degrees positive incidence to the wing. Cut a saddle block and glue to the threaded bolt block; sand to fit snugly in the wing platform space and carefully glue precisely in place so the bolt threads will be in alignment when the wing is put in place. Wing seating tape goes on the top of the platform. Add the front nose block, sand to shape, and add the keel piece.

Use your choice of towhook systems — two hooks are located 1¼" and 2½" back from the L.E. line respectively. Build up the hatch cover and lightly tack-glue to the fuselage, then sand to fit. The hatch cover is held in place at the rear by the wing locating pin and in front by the "L" wire mount sliding in a small aluminum tube into the nose block.

The stabilizer mounts are solid balsa 1" wide, and carved to airfoil section to match the stab. Wrap sandpaper around the tube to obtain a perfect fit. Put the 3½" long pivot pins in place before gluing on; these pins must be very carefully positioned parallel to the bottom and perpendicular to the root gluing surface or the trim of the sailplane will be difficult to adjust properly. For strength fill the tubes with dowels for 2¼" of their distance out from the tube. Fiberglass the root blocks in place after gluing them on parallel to the bottom of the boom tube. Use as little fiberglass as possible — keep the weight down. Cut out the control rod slots.

Align the wing by first putting a temporary plate in front of the middle bulkhead, lining up the centerlines of the fuselage and wing and pressing the wing down lightly onto a pointed stud marker (which can be made from excess bolt material) placed in the bolt hole. This will mark the exact location for drilling a clearance hole for the 1/4" nylon hold-down bolt.

After drilling the hole all the way through the wing, cut a clearance hole in the top sheeting for the bolt head to pass through. The bolt head will bear on the 1/8" plywood sheeting in the wing. Clean up and strengthen the access hole edges with a cardboard tube section. (We used a 3/4" rocket tube.) Put the bolt in place, put the pre-drilled bumper plate in front over the L.E. pin, center everything exactly, and glue the bumper plate in place. For additional security drill and pin with small dowels glued in.

Because it gives a covering free from warping we used MonoKote on the wings and stabs. After covering put the necessary 1/4" washout in each tip. The fuselage is painted with sealer and dope. It gets somewhat of a beating from the surfaces it lands on and although the original doesn't have it, it would be worthwhile considering fiberglassing it before doping, at least on the bottom . Keep it light!

When built in late 1971 the total cost(exclusive of radio gear) was $40.00, which included $17.00 worth of MonoKote. We would estimate the price now to be about $45.00.

We are not giving directions for radio gear installation since all vary slightly. Pushrods are 1/4" x 3/8" balsa, with "C" shaped wires on the back end and Goldberg Snaplinks to the horns. (See photos.)

The antenna can be dropped through the first time by the pin-and-thread technique. It is held in the rear by an "S" hook and rubber band to provide tension; when pulled out tie a follower thread on first so there will be a line in the tube ready and waiting for the next time you want to put the antenna in place.

Now you control the Monarch of the skies! □