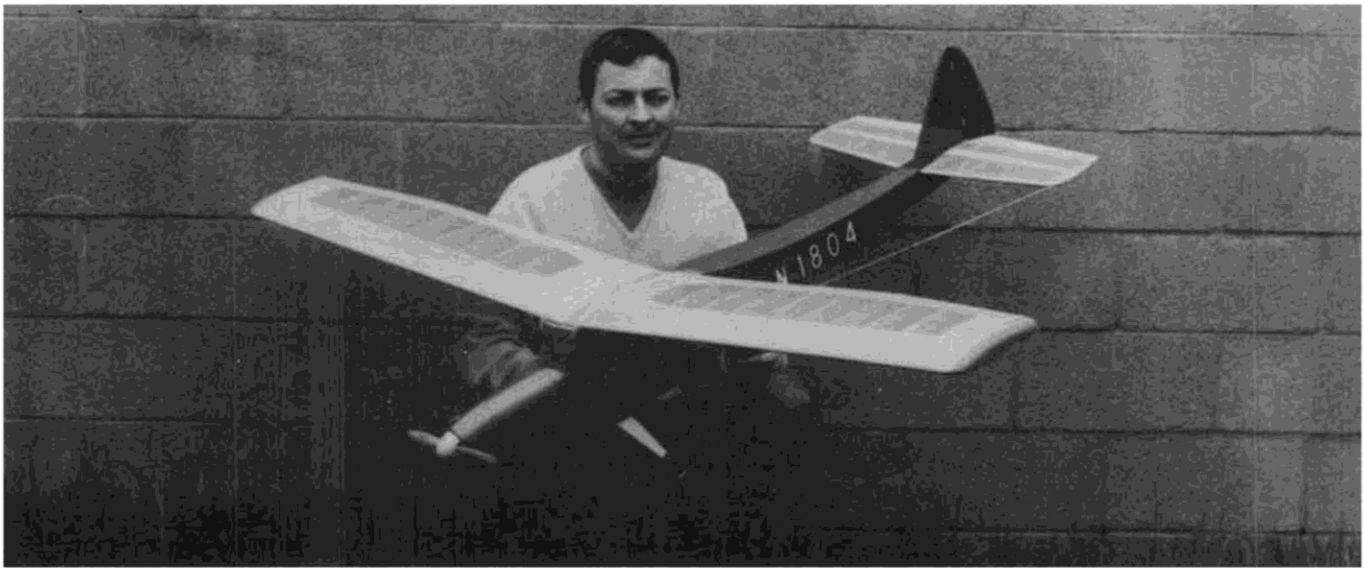


The only remaining photograph we have of the original Apprentice, taken in 1968. Weighing only 3-1/4 lbs., it flew very well with a Webra .20, was especially fun to do low-altitude "contour flying", a few feet off the ground and following the dips and rises of our grass field in Delaware.

THE "APPRENTICE"

By BILL NORTHROP . . . First introduced in the May 1968 issue of Model Airplane News, the big and light Apprentice continues as a first rate trainer and fun ship for model builders.

• *The Apprentice was designed about 13 years ago, when the author was Radio Control editor for Model Airplane News. In that period of time, many changes have taken place in the R/C hobby, but one thing has not changed . . . the need by beginners to have a genuinely easy and forgiving aircraft with which they can successfully get through their first few hours of flying time.*

In our opinion, the only design to possibly exceed the merits of the Apprentice in meeting the requirements of the beginning R/C flier, is Tex Newman's "Dragonfly," which we published in the February '76 issue of **MB.** *The Dragonfly is about the same size aircraft, but is even slower and more rock stable than the Apprentice. Hundreds of Dragonflys have been built and flown, by R/Cers of all accomplishment levels, who can attest to its "anyone can fly it" capabilities.*

However, we still believe that the Apprentice is "one up" in several ways. First, its appearance is more scale-like . . . something the beginner usually prefers. Second, the airfoil allows the beginner to progress further into his flying capabilities before feeling the need to "move on to something hotter."

It has the ease of construction and inherent stability of a flat-bottomed airfoil, but then the bottom surface curves up to the leading edge from the main spar (a man called Phillips got this named after him!), giving it an almost semi-symmetrical effect which allows good penetration in the wind, and sustained inverted flight . . . when you're ready to do it.

Although it was published in the May 1968 issue of M.A.N., we still get occasional request for plans to the Apprentice, long since sold out by M.A.N., and therefore felt we should republish them. Incidentally, the M.A.N. plans were prepared by a guy named Walt Schroder!

Herewith the original article with a few updates in italics:

The Apprentice was designed specifically for the model builder who has decided to move into radio control. It was particularly designed for the beginning R/Cer who is located in a low R/C activity area and who will not have the help of an experienced pilot during the first flights.

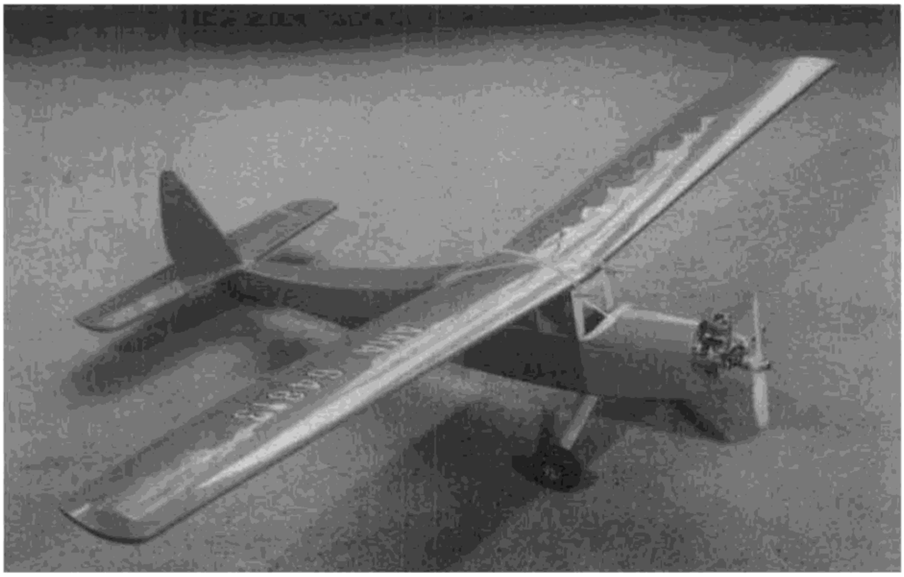
On the other hand, the Apprentice is the perfect ship for the veteran R/Cer to build for his young son who is showing that significant gleam of interest in his eye. And by the way, if your wife or girlfriend has finally given signs of resigning herself to her fate and wants to "try it sometime," build her a pink Apprentice and put curtains in the windows.

To suit the above requirements, we felt the ship needed an important design factor that has been left out of most present day "trainers." The plane should be large enough, and light enough, to fly steadily and slowly, giving the new pilot time to think about his next control movement.

This design consideration also provides another important factor missing in most so-called "beginner's" airplanes. It is no particular problem for an experienced flier to handle a somewhat badly trimmed airplane on its first flight, but the beginner has three strikes against him right at the start: an untried airplane, an untried radio (the bench and the air seem to be unrelated as far as radio operation is concerned), and an untried pilot. A large, lightweight airplane will permit test gliding, an almost forgotten art as applied to R/C. Through a series of test glides, the plane, the pilot, and the control system all have a chance to become acquainted with each other under less strained conditions, so that when the big moment occurs, that first powered flight, there is a better chance of survival all around. Most any experienced R/C pilot, if he's willing to admit it and can accurately recall his first controlled flight, will go along with this.

Another point in favor of a large, light airplane like the Apprentice is that it will take almost any kind of radio equipment. If the new R/Cer is fortunate enough to be able to afford a multi proportional system, there is no need to feel obligated to install it in a typical multi bird for his first flying lesson, nor should he feel obliged to work his way up through the single channel route. In the long run, if you are pretty sure of ending up with multi propo equipment, it would actually be cheaper to start out with it. *Work your way up through the airplanes, not the radios.*

We were asked if ailerons could be put on the ship, and this brings out another key point of the design, the inherent stability. Even Webster's old 1941 Collegiate Dictionary has that one figured. Webster says inherent stability is the "firmly infixed (inherent) property of a body which causes it, when disturbed from a condition of equilibrium or steady motion (stability), to



Charlie Bauer, Chicago, Ill., father of recent AMA Scholarship winner, Paula Bauer, sent us this and the photo on page 29 of his Apprentice, which he just recently sold after many flight years.

develop forces or moments which tend to restore the body to its original condition." In other words, the Apprentice, like any properly trimmed free flight model, will take care of itself in the air. If you disturb its otherwise tranquil flight by applying rudder and/or elevator, it will respond by going left or right and/or up or down, *but,* as soon as you neutralize controls, and with most systems this means releasing the stick(s), the Apprentice's inherent stability will take over and return the ship to normal flight . . . a comforting thought if you're a tyro and get yourself in a jam.

Now, about those ailerons. The inherently stable airplane will respond nicely to elevator and rudder controls, but it has rather fixed ideas about being induced to roll with ailerons. In many I.S. designs, the plane will actually yaw in the *opposite* direction from the aileron control given! The cure for this is to make the airplane *unstable* about its longitudinal axis, or fuselage centerline. The simplest way to do this is to drop the dihedral. In fact, without even resorting to ailerons, you can increase the maneuverability of an airplane (also increase its instability) by lowering the dihedral somewhat. However, now the airplane will require constant control corrections to keep it in level flight. It cannot take care of itself and will crash if the pilot does not make up for its lack of stability.

This type of instability is not bad. It's a necessary ingredient of airplanes designed for maximum stunt capability, but the beginning flier needs this like a hole in the head. Until you can take off, fly around for ten minutes, land, and be perfectly relaxed and on top of the whole situation from beginning to end, you're not ready for an airplane that demands constant "second nature" attention throughout its flight. End of sermon.

We had originally planned to include flying instructions in this article, aimed at the individual who does not have access to the assistance of an experienced pilot. Before we knew it, a separate article was developing. It just can't be done in a few words. So, get busy now and build the Apprentice. We'll get you into the air next month *(or soon thereafter).*

WING

Although the wing has our own SSS714 airfoil (somewhat semi-symmetrical, the 714 is our area code), it can and should be constructed on a flat, true surface. The section is actually straight on the bottom from the spar on back. Washout is built into the outer, twelve inch tapered portion of each panel.

After covering the wing plan with Cut-Rite or Saran plastic film, begin construction by pinning down the bottom trailing edge of the inner straight portion of the wing in addition to the bottom 1/4 inch square spar. The latter must be blocked up off the board with scraps of 3/32 inch balsa. Angle the spar hold-down pins toward the rear so they will not interfere with installation of the top spar and leading edge sheeting that comes a little later.

Glue and pin in place ribs W-1 through W-3, tilting W-1 with the root rib dihedral jig. Don't glue the outer W-3 rib to the trailing edge just yet. Now glue and pin down ribs W-4 through W-7. Next, prefit and then slide in place the tapered tip portion of the bottom trailing edge. Apply glue only after it is in place. Also, the outer W-3 rib can now be glued over the butt joint of the trailing edges.

Put glue in the notches and press the top 1/4 inch square spar in place. Next, add the 1/8 inch thick sub-leading edge. The top of this strip should be beveled before putting it in place. Incidentally, if you're using a runny glue such as Titebond, adding the sub-leading edge can get messy since the glue will be dripping off some of the ribs before you get them all coated. Try this: lay the strip backside-up on top of the ribs, and where it crosses each one, apply glue to the strip. Now pick it up, slap it on the front of the ribs, and pin it in place.

While this is drying, prefit the top trailing edge pieces. Using a ball point pen, mark the bevel line on each piece, and with a razor plane and sanding block, bevel the edges down to about 1/32 inch thick. Remove any pins that may interfere and glue and pin the top trailing edges in place. Titebond is not too good here because its moisture content tends to relax the wood fibers and causes the edge to curl, making pinning difficult. Either go to a cellulose cement, or counteract the Titebond curl by moistening the top side of the sheet. *(The new, thick cyanoacrylates take care of all of this.)*

The last item that may be added before removing the panel from the board is the top leading edge sheeting. Use plenty of pins and wipe the outside surface with a damp cloth just prior to installation in order to ease the bending strain. Butt the sheet tightly against the rib notches and allow the excess to extend beyond the sub-leading edge. Let this much of the assembly dry overnight.

After removing it from the plan, turn the wing over and pin it down by the top spar. Slide a jig strip of 1/4-inch square material under the wing until it blocks up the trailing edge, keeping the wing from rocking. Make sure the jig strip is parallel to the spar, then pin everything down tight to keep the wing straight. Now install the webbing in front of the wing spars, followed by the bottom front sheeting. Of course, that sub-leading edge has to be beveled off first.

Once the webbing and bottom sheeting are in place and the glue has hardened, the wing is beyond the point of no return so far as its straightness is concerned. Eyeball it from every possible angle to make sure there are no permanent "warps."

Repeat all of the above for the other wing panel, and for heaven's sake make sure it's opposite hand! An easy way to do this when you have only one-half of the wing plan is to rub oil into the critical locating points on that half. This makes the paper transparent enough at these spots to turn the plans over and build the second panel on the back side. The final steps before joining the two panels are trimming off the building tabs on the tip ribs, and gluing the 1/4 by 1/2 inch leading edges in place.

Using a large sanding block, dress the root end of each wing panel so that you will obtain a smooth, uniform butt joint at the center. Pin one panel to the building board with the bottom spar and trailing edge held down securely (stick some of that Saran under the root rib). Apply glue to the root section of the other panel, press it into place, prop the tip up 6 inches (to the bottom of W-7) and pin the center joint together at the leading and trailing edges to maintain alignment. Allow this to dry thoroughly.

Make room for the dihedral braces by slicing out that portion of ribs W-1 and the inner W-2 which is between the spars and the trailing edge. Epoxy the braces in their respective locations and then trim and reinstall the ribs. Scrap sticks may be sprung between the trailing edge and the main brace to hold it in position until the epoxy hardens. Finish the wing structure by adding all of the tip and center section sheeting and the tip blocks. The Hoerner design is optional and has not been proven for better or worse on this model.

TAIL

Carefully select all tail section wood for lightness. An extra ounce in the tail will require adding three ounces in the nose to balance the airplane, and that's a useless 1/4 of a pound that nobody needs.

The basic 1/4-inch thick stabilizer frame is first built right over the plan. While it is pinned down, you can add the top 3/16 inch main spar, the 1/8 inch tip fillers, and the 3/16 inch center section fillers. Leave a 1/4-inch slot for the fin.

Once this much is dry, remove all pins holding the 1/4-inch square spar and leading edge and add the 1/16 by 3/8-inch spar caps. Purpose of the caps is to provide a smooth, uninterrupted surface from outside edges to center spar and to avoid the annoying little covering kinks that usually form as ribs try to push into spars under tension of the covering. When stab is dry, remove from plan and add bottom spar, filler pieces, and caps. Plane and sand everything to shape for covering.

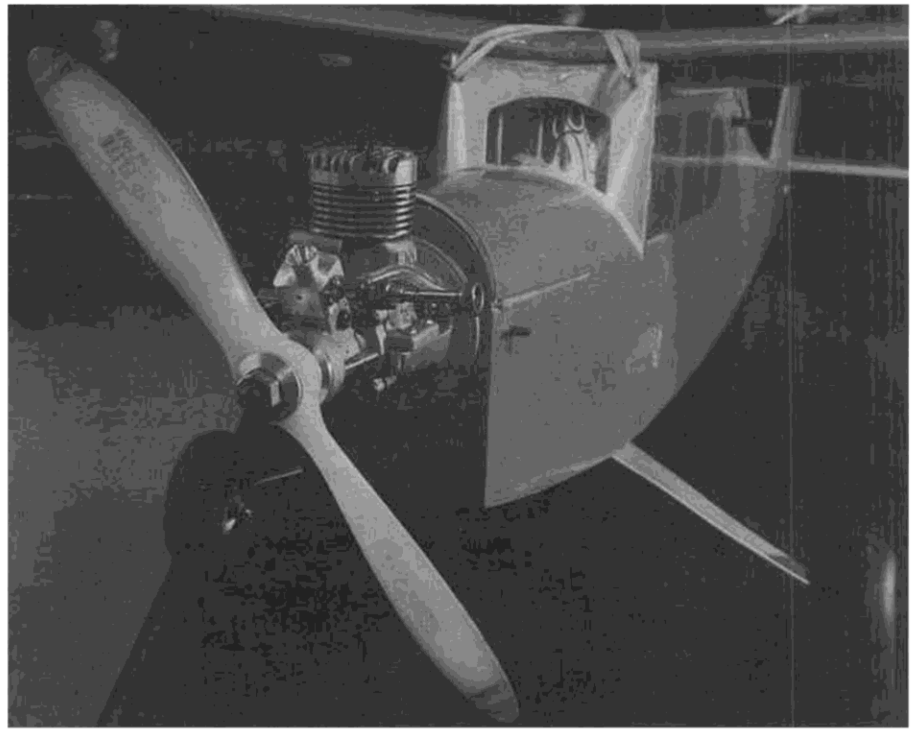
The fin is built from 1/4 inch materials and needs no further explanation. The rudder and elevators are simple solid sheet material and only require the addition of ply inserts for control horns. Note that the elevators are only rounded at the trailing edge, not tapered to an airfoil shape as is the rudder.

FUSELAGE

The fuselage is of typical sheet wood box construction. Hobbypoxy II was used on all doublers, Sig Epoxy glue on all heavy-duty points, and Titebond for anything else. Doublers, upright stiffeners, and longerons are all added before joining the two sides. The top longerons of 3/16 square may need a series of partial saw cuts to help them follow the curve.

Proper and square alignment in early construction stages is important, so with this in mind, do not, repeat, do *not* cut out the window area (if you do it at all) until the fuselage is just about completed. Join the two sides by epoxying F-7 and F-8 in place. We temporarily pinned a six-inch wide sheet of wood across the bottom of the fuselage between F-7 and F-8 to keep things true until the epoxy cured.

Next, cut two 3/16 square by 2-7/8 inch long cross pieces and glue and pin them in place at the vertical stiffener location which is 12 inches aft of F-8. Pull the tail posts together and bevel the inside surfaces until the total width of the two sides at the post is a little over a 1/4 inch. When this is glued together, the rear fuselage assumes a natural curve from F-8 to the tail post. With 3/32 balsa applied crossgrain, plank the top from elevator cut out to F-8 and the bottom from tail post to the 3/32 ply landing gear base. Also epoxy this in place. Use a 4-inch wide piece of planking just aft of F-8 on the top and score the underside down the middle so it will press into the "V" at the top of F-8 and gradually blend out to a flat section.



Charlie Bauer's Apprentice is powered by an Enya .35, about the most you'd want to use. Although not necessary, a side-mounted engine, with cowling, greatly improves the appearance.

Epoxy F-1 into place using 1/4 by 1/2 inch spruce sticks with rubber bands stretched across them to hold the sides tightly against the bulkhead. Force pins through the sides and into F-1 to prevent sliding. Next, epoxy in place the tank floor F-9 and F-10 "instrument panel" bulkhead F-6. Another set of sticks and rubber bands just ahead of bulkhead F-6 should cozy everything up nice and tight.

While this is curing, you can glue in and carve the upper windshield block, drill out for the 1/8 inch dia. music wire wing dowels, and prepare the various ply pieces that are then epoxied in place along with the wire dowels. If you want the little extra touch of realism afforded by real honest see-thru windows, cut the balsa siding out now, guided by the ply doublers. Notch out the outer sheet sides as shown to accommodate the hardwood 3/32 by 1/4 vertical dividers. Since we used Super Monokote, the job of applying "glass" was easy. The sides were covered, including the window area, with one chunk of the instant skin. The S.M. was ironed down around each window frame, and then, using cotton sticks and Kleenex, the color/adhesive was removed from the clear plastic backing film from inside the cabin *using butyrate thinner.* Presto! Daylight!

Meanwhile, back at the schnozz ... Glue in F-5, the hatch stop F-4, the short 1/4-inch square stringer from F-5 to F-6 and then plank the windshield cowl. We did this with two pieces which were first well soaked in hot water and taped into place over the bulkheads. When dry, it was an easy matter to trim them to shape and glue in place with only a few pins necessary.

Now construct the removable hatch framework right on the fuselage, using three 1/4-inch square stringers and bulkheads F-2 and F-3. You may want to insert pieces of Saran before gluing, so the hatch won't become a permanent part of the structure. After trimming the side stringers, the hatch frame was sheeted in the same manner as the windshield cowl. Don't forget the 1/4 inch overhang on each end.

The exact engine cowl construction will vary, depending on the engine used and whether it is mounted upright or tilted to the right. We mounted the Webra .20 turned 90 degrees to the right. Whatever you decide, remember that the center of the fuel tank should be at the same level as the engine's needle valve. If mounted upright, you will probably have to drop the thrust line slightly, and as a result, may need a little more downthrust. We have long been in favor of radial mounting, and suggest either a Tatone mount, Midwest "T" bars, or an aluminum plate bolted directly to the back plate of the engine.

We left the bottom nose planking until last, in case your engine mounting required blind nuts below the tank floor. Now this can be cross grain sheeted with hard 1/8 inch balsa. Obviously, it must be feathered down to 3/32 where it meets the ply landing gear base, but the idea is to prevent the battery pack from exiting the hard way (through the bottom) if you should plop down ungently.

Continued on page 70

To help prevent nose overs during landings and taxiing and to improve general appearance, your aluminum landing gear may have to be altered to reduce ground clearance. Clamp the center section in a sturdy vise, keeping the bend to be altered as close as possible to the jaws. Using muscle power, carefully open the bend to reduce the angle. Check for accuracy and evenness by measuring the height of each axle hole with the gear laid upside down on a flat surface. Height above surface should be two inches if you use three inch wheels. Finally, bend the outer tabs to provide vertical wheel position.

The gear location shown is a little touchy on rough ground, especially for a beginner, so you may wish to move it ahead about 1-1/2 inches. Relocate the ply base accordingly if you do this. On smooth ground or a paved runway, there should be no problem for anyone with the gear located as shown.

Getting back to the cowl, the construction shown is fairly simple and can be adapted to any engine. Let your engine determine the location of the 1/8-inch ply nose plate. Cut a chin block and left cheek to suit, install all three and then fill in the curved top portion with wedges of 1/4-inch sheet. Note the caved-in right cheek designed to deflect exhaust from the side mounted engine.

At this point, mix up a large batch of Hobbypoxy II or Sig Epoxy, thin it to a pastey brushing consistency with dope thinner, and pour a big blob of it into the aft end of the tank compartment. Slowly rotate the fuselage until you're sure the unreachable area is well covered, then brush out the rest until the tank compartment is completely coated. Do the same with the engine cowl and the hatch.

RADIO INSTALLATION

As with flying instructions to a beginner who will not have the help of an experienced pilot at hand, a long book could be written on proper radio installation. There are so many different systems that can be used with the Apprentice, that there just isn't room on the plans or in this text to describe how to install all of them. The original airplane was equipped with a Gold Medal Kraft KP-4, which fortunately was the only radio at our field on 53.4, what with a six-ounce Sullivan tank and a .20 cubic inch engine. Talk about long trips! The KPS-9 servos were mounted three abreast just aft of F-7 on 3/8 inch square mahogany cross bearers, and the motion is transmitted by Ny-Rods. Balance is right on the mark, without extra ballast needed. The 500 mah pack is about two inches in back of F-1, followed immediately by the receiver.

Total weight, ready to fly, with empty tank, is three pounds, eleven ounces. The experimental *(it had just been introduced)*, semi-transparent, blue and yellow Super Monokote undoubtedly contributed to the low weight, and plug number 2, the whole ship was covered in about three hours. Having diddled with this stuff for about three years now, we've learned there's a place for everything. Don't try to fight it into cowls or around complex nose shapes, or into concave vortex tips. An occasional "fix" of dope fumes is good for every modeler.

FLYING

The Apprentice has now had three lengthy test flights. Actually, it only took about one minute of the first flight to find out everything was better than planned. The rest of the time was spent putting the poor bird in all sorts of impossible attitudes, letting go of the controls, and watching it recover to straight and level flight within seconds.

From a 45 degree stall, the ship mushes down to a level attitude, losing only about ten feet of altitude, and simply resumes flying. No oscillating whatsoever. From a completely vertical stalled position, the ship falls back slowly, somewhat sliding, but mostly doing a mild whip stall. In fact, you could call it a marshmallow whip (sorry). The nose drops to about 20 degrees below the horizon, flying speed builds up, the nose raises to about 10 degrees above zero, the plane mushes back to level attitude and again, normal flight is resumed. About 25 feet of altitude is lost. Remember, this is hands off, no controls, from the stall point through to straight and level flight.

Hands-off recovery from a steep turn takes about 360 degrees, and with mild turns, there is no loss of altitude. On the second flight, I handed the box to an innocent, unsuspecting spectator, who shakily maneuvered the Apprentice through several left and right turns before turning completely to jelly. Starting the third flight, I advanced throttle, held the tail down with up elevator until the plane picked up speed and then got off the controls. The takeoff was (ahem) better than the previous two!

Incidentally, a smidgen of right thrust is needed for the Webra .20. For larger engines, be prepared to add a little more. And speaking of engines, don't blow the whole thing by hanging on anything bigger than a tired .35. Even at that, cut the power back and/or add a muffler. The Apprentice was designed and does fly as a trainer. If you want a bomb or something with ailerons, you're barking up the wrong airplane. •