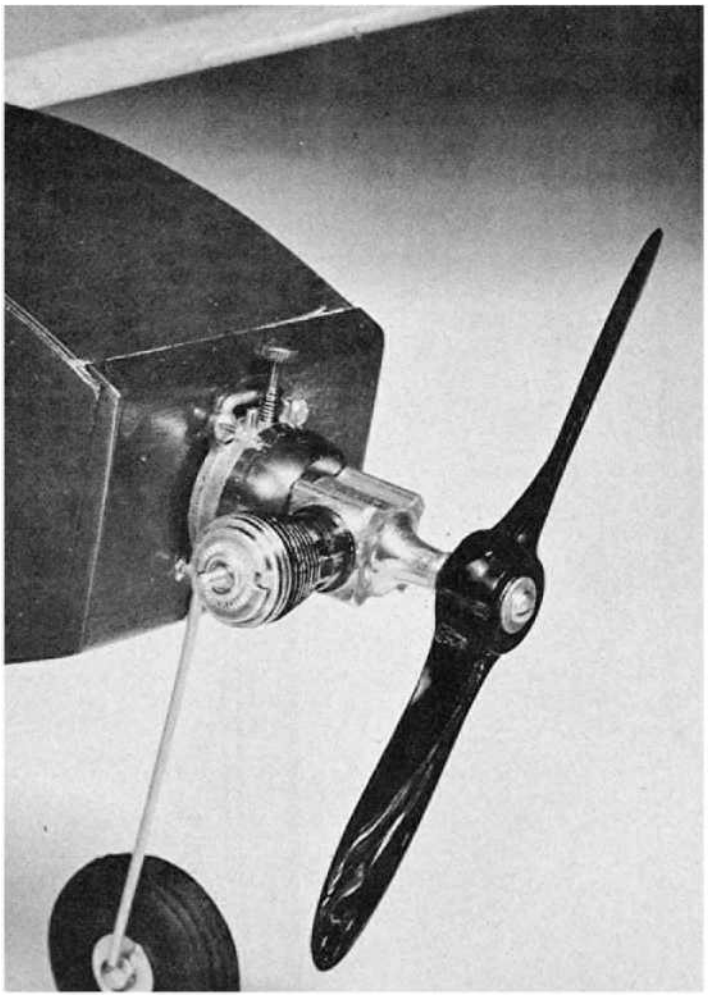


DQA 704

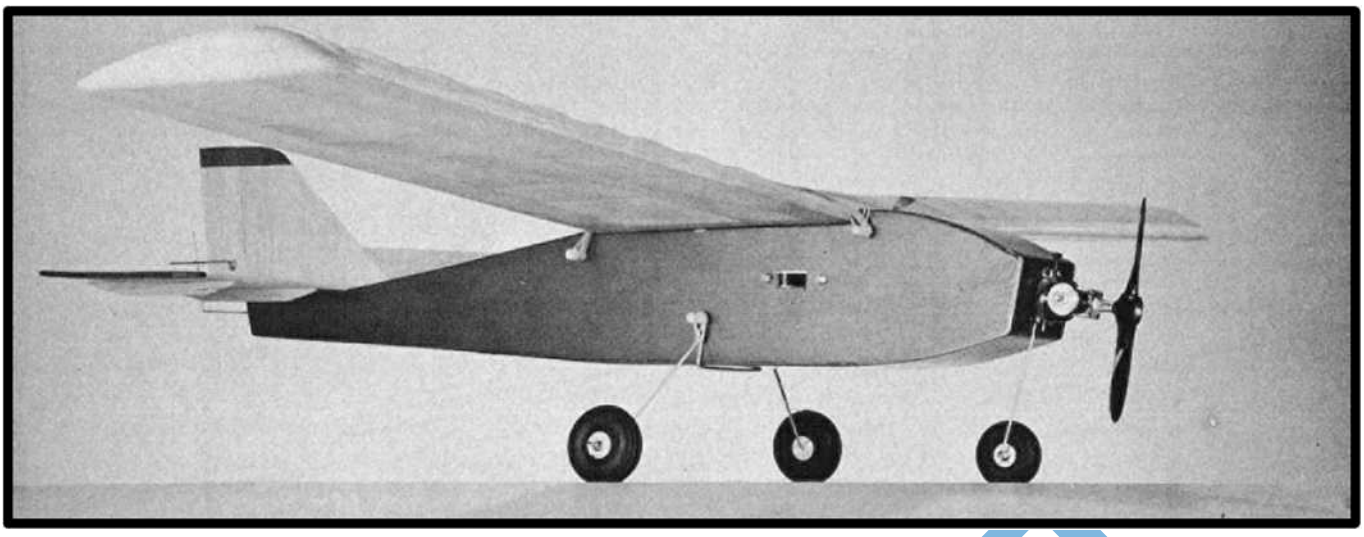
Design: S.K, Babcock
Text: Don Dewey
Flight Tests: Bill O' Brien

Full-size plans for a remarkable 32" span rudder-only proportional design. Extensively flight tested by RCM, the DQA 704 is the first step in the Age Of Proportional.

The D.Q.A. 704 was designed in the Summer of 1964 by Stu Babcock as a testbed for Babcock Controls' new BC-21 and BC-22 single channel systems. When ROM's Consumer Research Department received the first production unit of each system for evaluation, they were installed in two of these 32" span models — a welcome breather for our tired old fleet of test ships! After several days of F.T.E. (Flight Test Evaluation — space age terminology for an excuse to go flying instead of editing copy!), we were not only thoroughly convinced that Babcock's new single channel escapement and proportional systems were ideally suited for the sport flier and newcomer to radio control, but that the ship used as a testbed was one of the best flying, small field single channel airplanes w>e had run across!

The combination of the DQA and either one of these tried and proven control systems assures success for the beginner and gives him the feel of radio control flight at very low cost. It puts him in an excellent position to get his own opinions on larger more powerful airplanes and control systems that he will want in the future. The DQA is simplicity itself to build. The control systems are the easiest to install of any we have evaluated.

Performance-wise, the trike-geared mite tracked straight across the asphalt, lifted off easily, and bored straight into a gusty wind at a slight angle of climb. We got the impression that the 704 would probably bore straight ahead until it ran out of fuel unless we turned it — so, we started playing with the knob on the BCT-22 transmitter. A slight twist of the knob and the D.Q.A. responded with a beautiful banking turn, unlike the more "jerky" turns usually associated with escapement flying. Progressing downwind, now, the ship retained its altitude without any tendency to climb. Another right, and w'e turned about into the wind. Centering the knob on the transmitter we tracked, for a moment, straight on heading, then depressed and held the "full left" button. The D.Q.A. responded immediately by entering a left spiral. After a few spiral turns to gain speed, we released the button and the D.Q.A. went up and over into a loop, recovered easily, and once again bored on



into the wind with a slight climb. After a few more laps around the field, plus another couple of loops, the Pee Wee .020 ran out of juice and we began our descent. For the experienced single channel sport flier, the glide rate of the D.Q.A. would be too shallow and he would probably remove a slight amount of incidence — for the beginner in R/C, it is ideal— a flat, almost-floating type of glide reminiscent of the old free-flights. Turning onto the final leg, the 704 pointed its nose into the wind, tracked straight and steady, then touched down on all three wheels and rolled about twenty five feet to a stop.

Each flight thereafter was the same — smooth takeoffs, excellent wind penetration, smooth banking turns, easily executed loops, and a well-defined glide pattern followed by a hands-off landing.

When we telephoned Stu Babcock we were full of praise for the D.Q.A. After listening to our ravings for a few moments, he asked simply — "How about the radio gear?"

They're fine", we replied, returning to further exploits of the D.Q.A. "How about working this ship as a first bird for the newcomer to R/C, and as an all-around sport flier in conjunction with your new radio gear?", we asked.

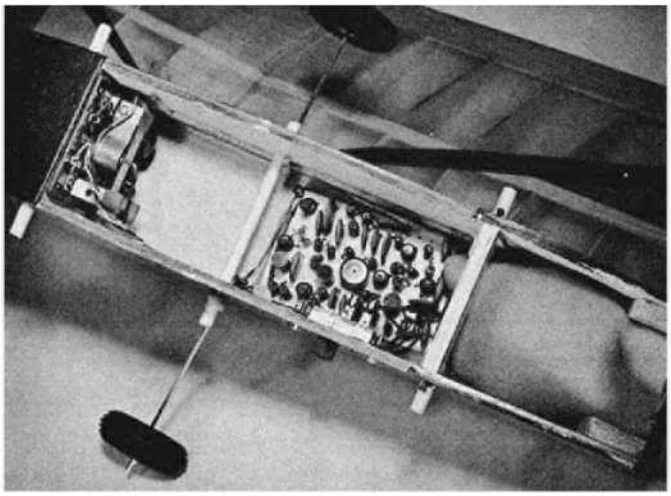
The head of Babcock Controls persevered through to the very end, maintaining a patient, and somewhat stoic silence, on the other end of the line. Perhaps through desperation, or the fact that we called collect, he then hastily agreed to presenting the plans herewith, mumbling something to the effect of "Some product evaluation...! Are you evaluating the radio or the airplane?"

For the more scientific minded, "DQA ." is a Babcock's which stands for "Damn Quick Airplane." The "704" was tacked on at RCM when it was determined that the entire bill of materials, including engine, came to exactly seven dollars and four cents! (Glen Sig a foose at Sig Balsa may not get wealthy over this one, but Glen's loyal supporters can always build the "Digester" in this issue!) In addition to being an excellent flyer with none of the erratic tendencies of many .020 size designs, the D.Q.A. is economical, extremely fast building, (one weekend), and very, very rugged. To test the latter feature, we deliberately brought the little bug straight down into the asphalt under full power with no more damage than popping off the firewall. Stu Babcock bounced his off the top of a culvert fence and down into a twenty-foot deep drainage ditch with only a fractured firewall as a consequence!

We followed our initial tests by building five more prototypes and passing them around to local RC'ers —all flew in exactly the same fashion. So, scrape the glue off the X-Acto,

Don Mathes launches the DQA as Sally Dewey operates the BCT-22 transmitter.

The worried look was in vain she cleared the Digester and assorted paraphernalia!



The BCR-22 receiver and PA-9 actuator installed in the DQA. Sponge rubber in the nose section hides the two 9 volt transistor batteries.

Three evenings to build . . . and you have a rugged sport flier for escapement or pulse. One of the best we have flown!

and let's get to work. If this is your first RC bird, follow the instructions throughout and you'll get off to a flying start in a great hobby! We'd like to hear about your airtime with the D.Q.A.

Bill of Materials

1— 14" x 3" x 36" soft balsa
2— 1/16" x 3" x 36" hard balsa
3— 1 /16" x 3" x 36" medium balsa
1— 3/32" x 4" x 36" medium balsa
2— 1/16" x 1" x 36" medium balsa
1—1/16" x %" x 36" medium balsa
1— 1/4" x 3/16" x 36" hard balsa
2--- 3/16" x 3/16" x 36" hard balsa
1—1/8" x 1/4" x 36" hard balsa
1—1/8" x 14" x 36" hard balsa
1—1/4" x 1" x 36" hard balsa
1-—sheet 1/16" plywood
1—sheet 1/32" plywood
1—scrap *i/g"*plywood
1— length 1/16" music wire
2- *1"* Veco or Perfect wheels
1—1" Veco or Perfect wheel
1—4" or 5" canopy

1-—yard colored silk

1—length 1/4" birch dowel

1—Cox Pee Wee .020 engine

1—Cox Hi-Thrust .020 prop

Cox Blue Can fuel, glue, clear butyrate dope, thinner, 8—2-56 x l/2" nuts and bolts (Perfect); 4—DuBro or Perfect 2-56 blind mounting nuts; Babcock BC-21 or BC-22 radio system.

Construction

Wing: Commence construction by making a cardboard template of wing ribs W-l, W-2, and W-3. Carefully cut 18 W-l's from 1/16" sheet, 2—W-2's from 1/16" sheet, and 2 W-3's from 1/4" stock. You can also cut two slightly oversized W-l's from l/4" sheet to serve as wing tips. Now gather ribs together, with the exception of the tips, (all W-l's, all W-2's, etc.) and sand uniformly to match your template.

Lay a piece of waxed paper over the wing plan and tape both plan and waxed paper to your building board. Pin down 1/16" x 3/4" lower leading edge and 1/16" x 1" lower trailing edge. Pin 3/16" square spar in place over plan. Glue 1/4" x 3/16" leading edge to lower leading edge sheet previously pinned in place. Cut and fit lower 1/16" center section sheeting, the two pieces fitting flat on the board between the leading edge and lower spar, and between the lower spar and lower trailing edge sheet strip. Now glue each rib in position, making sure each is directly over the plan and at right angles to the building board. Glue the top spar and top trailing edge sheeting in placed Add the 1/4" sheet tip. Add l/l6" sheet webbing between spars in two center wing bays of each panel, making sure the grain is vertical. Cut and fit top center section sheeting, pinning in place until dry. Follow the same steps for building the opposite wing panel, making sure you have one left and one right.

When the wing panels have dried thoroughly, remove from the board. Cut two pieces of balsa 1 1/4" high by 5" long and pin one under each wing tip to obtain dihedral angle under each tip. With this blocking installed, line up the 1/4" center rib with the edge of your building board, then with a sanding block held firmly against the edge of the building board, sand the appropriate angle into the center rib. Repeat with opposite wing panel. When these two panels join together accurately, re-glue each by rubbing a thin coating of glue over each and allowing to dry. Then, glue each rib again, butt join, and allow to dry overnight.

When completed, remove dihedral blocking and lightly sand entire wing. Glue a strip of Top Flite pinking tape, gauze, or a 1" wide strip of silk around entire center joint. Brush on two coats of clear butyrate over entire framework. When dry, sand lightly with 400 wet-or-dry paper, then cover wing with four pieces of colored silk, grain running span wise. If you have never covered a wing before, cut an oversized panel of silk for each wing half, top and bottom, four pieces in all. Loosely fold silk into approximately a 6" square and immerse in a pan of water. Unfold the silk and lay over a turkish bath towel to absorb the excess moisture. Take your dope brush and brush on a strip of clear butyrate about 1" wide across the center section and immediately lay one end of the silk over the doped portion. Press out any wrinkles with your finger. Allow to partially dry, then brush clear dope on the leading and trailing edges about two bays at a

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D.Q.A. 704

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time, stretching your silk chord wise across the wing as you go to remove wrinkles. Repeat for the entire length of the panel, finally securing the end of the silk to the tip. Re-dope any areas where wrinkles occur and pull silk taut. While one panel is drying, repeat this process with the opposite panel. Then, return to the first panel you covered and trim off the excess silk overhang with a double edged razor. Dope down any protruding edges, rubbing them smooth with your finger. Now proceed to cover the reverse side of each panel. When thoroughly dry, mix a quantity of fifty percent clear butyrate dope and fifty percent dope thinner and add a few drops of warp resistor or plasticizer to prevent warpage. Brush on several coats of this thinned dope mixture, brushing chord wise, and making sure there is not so much dope on your brush as to seep through the silk and run on the inside surface. Allow each coat to dry, then repeat until all of the pores of the silk are filled and no bubbles appear in the individual pores when the dope is applied. Two types of covering material requiring the least amount of dope to fill the weave, and thus less weight, is Esaki silk, and the newly imported colored silk distributed by Royal Products Company of Denver, Colorado.

Now set the wing aside for two or three days so that the dope will "cure" — that is, to allow all of the thinners to reach the surface and evaporate.

Fuselage: Begin fuselage construction by cutting out two fuselage sides, exactly as shown on plans, from 1/16" hard balsa. Be sure that the wing and stab platform areas are **exactly** as shown. To change these angles of incidence will drastically affect the flight trim of the D.Q.A. Cut out two fuselage doublers from 1/16" sheet, the grain running lengthwise. Glue doublers to fuselage sides and allow to dry. Cut out firewall F-l from plywood two formers F-2 from 1/16" balsa, the grain of each F-2 running opposite to the other, then glue both F-2's together; cut one F-3 from 1/16" plywood one F-4 from 1/16" balsa and one tail former F-5 from 1/16" plywood. Cut one fuselage bottom 5 14" x 2 l/4// from 1/16" plywood. Check to make sure this is perfectly square as it is used to align the fuselage sides.

Mark off the locations of the formers on the fuselage sides. Add the *1/8" x 1/8"* longerons to the top and bottom of each fuselage side piece. Add the 1/8" square actuator slide supports to each side, followed by the 1/8 x 1" tripler pieces to each side of the nose. When dry, lay one fuselage side down and glue former F-2 and F-4 in place. Before they are dry, cement the 1/16" ply fuselage bottom to the side and to F-2 and F-4. When square, this will align your fuselage sides. Add the other side piece. When thoroughly dry, add the firewall, cementing in place with white glue and holding in place with masking tape until dry. Glue the 1/4" square tail piece in place and add the 1/16" ply tail former, holding this assembly in place with tape until dry.

Now take some 1/16" sheeting, grain crosswise to the fuselage length, and plank the top rear of the fuselage from the trailing edge of the wing to the stab platform, and on the bottom from F-5 to F-4 where the plywood base commences. Add the 1/16" ply bottom planking to the nose section, forming the bend and holding again with masking tape until dry. Use a good grade of white glue wherever a plywood-balsa joint is required. Add the 1/4" square cross brace in front of Former F-2.

Next, take your Cox Pee Wee .020 and carefully remove the four back bolts from the fuel tank. Be sure not to drop the thin fiber gasket between the tank and crankcase of the engine. Carefully turn the engine itself until the cylinder points sideways, without moving the tank and needle valve assembly. Now reinstall the four tank bolts and secure in place, tightening carefully so as not to strip the threads. Locate the engine in the center of the firewall, making sure the top of the needle valve clears the top of the fuselage, then drill four 7/64" holes in firewall F-l. Install four 2-56 Du- Bro or Perfect blind mounting nuts in these holes in the rear of the firewall. Do not mount the engine at this time, but insert each of the 2-56 bolts and tighten down in order to secure the blind mounting nuts to F-l. Remove the bolts and put the engine away for the time being.

Cut a 1/4" x 2 1/4" strip of 1/32" plywood and secure to the top of F-l for the hatch hold down. Cut a piece of 1/32" plywood to size shown for the hatch itself.

Cut the stabilizer from fairly hard 3/32" sheet balsa, butt-joining two sheets if necessary. Cut the tips from 3/32" x 1/2 stock to act as stiffeners. Add the *1/8* x 1/4 stiffeners to the underside of the stab. Locate the stabilizer on the fuselage and check to see if it sits level. When this is assured, glue in place.

When completed, cut the fin, rudder, and dorsal fin from 1/16" sheet, following the grain pattern indicated on the plans. Glue in place on the fuselage, making absolutely sure the fin and dorsal are straight up and down and centered on the fuselage. Add the rudder with four pieces of Top Flite hinge or pinking tape, or with nylon thread and figure-8 stitches, making sure that they are absolutely free of any binding or stiffness whatsoever!

Now, the entire fuselage may be sanded with 320 wet-or-dry paper. Cut three small strips of Top Flite hinge tape and glue around both corners of the firewall and fuselage sides and between the firewall and ply bottom. This will greatly reinforce the firewall in case of rough landings. Now brush on four or five coats of the 50/50 dope-thinner mix. Sand lightly after the second coat and again just prior to the last coat. When you dope the stabilizer, be sure to dope both top and bottom as quickly as possible to prevent warping. A small amount of color trim maybe applied to the wing and fuselage, but don't overdo it! Color dope adds weight rapidly to these small ships!

When thoroughly dry, cut the wing and landing gear hold-down dowels to length. Drill holes where shown on the fuselage side view and install the dowels, gluing on the inside of the fuselage with white glue. Form the main gear and nose gear from 1/16" music wire as shown. Add two small wood screws on each side of the fuselage, located in the center of the 1/4" square crosspieces in front of F-2. The hatch slides into place under the ply strip on top of F-l and is held in place with a rubber band stretched over the top of the hatch and secured to each wood screw.

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A small bubble canopy of about 4" or *5"* length may be purchased and glued in place in the wing center section if desired. Pactra C-77 glue is the best adhesive for securing the canopy to the wing. If a canopy is used, it will be necessary to stretch your wing hold-down rubber bands straight back from leading edge to trailing edge dowel, rather than crisscross as in the more conventional manner.

The overall weight of the 704 should not exceed eleven ounces complete with radio equipment installed.

Equipment Installation

Both the Mark VII 9-volt escapement furnished with the Babcock BC- 21 system and the PA-9 magnetic proportional rudder actuator furnished with the BC-22 system have identical mountings. Following the manufacturers instructions exactly, cut F-3 to accept the desired actuator, then install with four 2-56 nuts and bolts. Slide F-3, with actuator in place, between the slide rails in the fuselage sides. If you are using the Mark VII escapement, cut a length of .045 music wire to size and install, soldering the escapement arm to one end of the wire. The opposite end is bent up at a right angle parallel with the rudder. A small yoke of thin music wire is fashioned and installed on the rudder with a single 2-56 nut and bolt and two 2-56 washers. This yoke can be moved up or down to alter the amount of rudder throw desired. Be sure to solder a small brass washer or ferrule to the torque rod wire in front of F-3 and on the outside of F-5 to make sure that there is no more than 1/16" play back and forth on the torque rod. If you are using the BC-22 proportional system and the PA-9 actuator, install the wire rod and balsa torque rod exactly as instructed on the manufacturers spec sheet.

Check again to be sure that there is no binding in the hinges, and that the rudder yoke has enough clearance to prevent any binding against the rudder torque rod. Too, check the torque rod to make sure there is a small amount of play back and forth with no binding against the formers. This is absolutely essential for reliable performance.

Install the receiver by gluing it to a piece of sponge rubber the size of the base of the receiver. Glue this foam rubber with receiver in place to the floor of the fuselage aft of former F-2. Connect the two wires from the BC-21 to the two lugs on the Mark VII, or the three wires from the BC-22 to the three lugs on PA-9, per the manufacturers instructions. With the escapement system, mount the switch and test panel in place on the side of the fuselage, gluing the fiberboard base to the inside of the fuselage, the switch protruding from a 3/4" x 1/4" hole in the fuselage side. Run the battery leads through Former F-2, install a 9 volt transistor battery, wrap completely in foam, and install in the compartment area behind the firewall. Make sure all of your wiring is cabled, or twisted together in a neat bundle, then spot glue along the fuselage sides to hold in place out of the way of the actuator.

For the antenna, do not use the 1 vertical music wire whip recommended by the manufacturer. The drag of this antenna is too great for the small size of the D.Q.A., and will cause a scalloping, or swooping, tendency in flight. Two other methods may be used — a straight piece of hook-up wire 18" long running out the bottom of the fuselage and spot glued along its length, with the remaining portion of the antenna allowed to trail out behind, or a piece of 16" hook-up wire glued along the length of the trailing edge of the wing and connected to the antenna at the receiver with a snug, one-pin connector.

Install your engine with the four 2-56 blind mounting nuts and add a Cox .020 Hi-Thrust prop. Add the main landing gear and secure in place by running a small rubber band through each leg of the gear and over the dowel several times.

Following the manufacturers instructions for the BC-21 system, remove the antenna from your Babcock transmitter, and add the small bulb furnished across the two prongs on the test panel installed in the fuselage. Do not turn the receiver switch on. Insert a nylon tuning wand in the receiver slug and tune for maximum brilliance. Then, tune the tone frequency adjustment on the transmitter for maximum brilliance. Add one section of antenna and one loading coil and repeat this process. Finally, install the complete antenna and tune for maximum brilliance and adjust the transmitter tone for maximum brightness on the bulb. When this is accomplished, you will have more range than you will ever need. Remove the bulb and turn off your transmitter. For the BC-22 the process is the same except that no bulb is used. Just watch the rudder actuator while tuning with the same procedure as above.

Flying

Be sure the D.Q.A. balances exactly where shown on the plans. Shift the battery or add weight as necessary to achieve the proper C.G.

Select a calm day and take the D.Q.A. to a schoolyard or grassy area for the first glide tests. Gently launch into the wind — you should have a steady glide forward followed by a three-point landing with no tendency to balloon out, stall, or nose down. If your C.G. is correct and the model noses down, add a small (1/32") shim under the leading edge of the wing. Repeat as necessary until the nosing-in tendency is corrected. If, on the other hand, your D.Q.A. tries to scallop or stall in the glide, add the same amount of shim under the trailing edge of the wing until corrected. Correct any tendency to turn left or right in the glide by bending the torque rod at the rudder until the glide is straight.

When test gliding with the BC-22 proportional system the transmitter and receiver must be turned on and
the rudder set at neutral.

For the first power flights, select a calm day. Fill the Pee Wee tank with Cox Blue Can fuel. Start the engine, adjust the needle valve, and allow about thirty seconds to elapse. Now gently chuck the D.Q.A. forward, nose **slightly** downward, into the wind. Allow the model to gain about a hundred feet of altitude before applying a command. (You did turn on the receiver, didn't you?) The model should bore on straight ahead with a slight amount of climb. Notice any tendency to turn left or right. If the glide is straight and it turns left under power, add a washer under each motor mounting bolt on the left side. If the model has a tendency to turn sharply right, reduce the amount of right thrust. If you are flying the BC-22 proportional system, don't give violent amounts of left or right easy does it! If you get into trouble, don't fight the knob — just bring it back to neutral and let the plane fly itself out. The biggest tendency to overcome when, for example, your model goes into a right spiral, is to counter with full left! Before you know it, you're weaving all over the sky and on your way to a prang! This model will free- flight quite well when trimmed out properly and will fly itself out of any difficulty you may get it into if given a chance. When in doubt... let it have its head.

When you land, bring it gently around into the wind, straighten it out, and it will land hands-off. If you're slightly cross-wind, a small amount of correction with rudder may be necessary.And there you have it. A Sunday flier that will be good for many a flight and a barrel of fun.

Seven dollars and four cents for an airplane and engine, and forty-nine or fifty-nine dollars for a radio system, and you're into a wonderful hobby. If you're an old-time sport flier, put a D.Q.A. together, take it out to the local field, unfold your canvas chair, erect your umbrella, pour a cup of coffee, have your wife launch the plane, and have a ball! It's the only way to fly! ----------