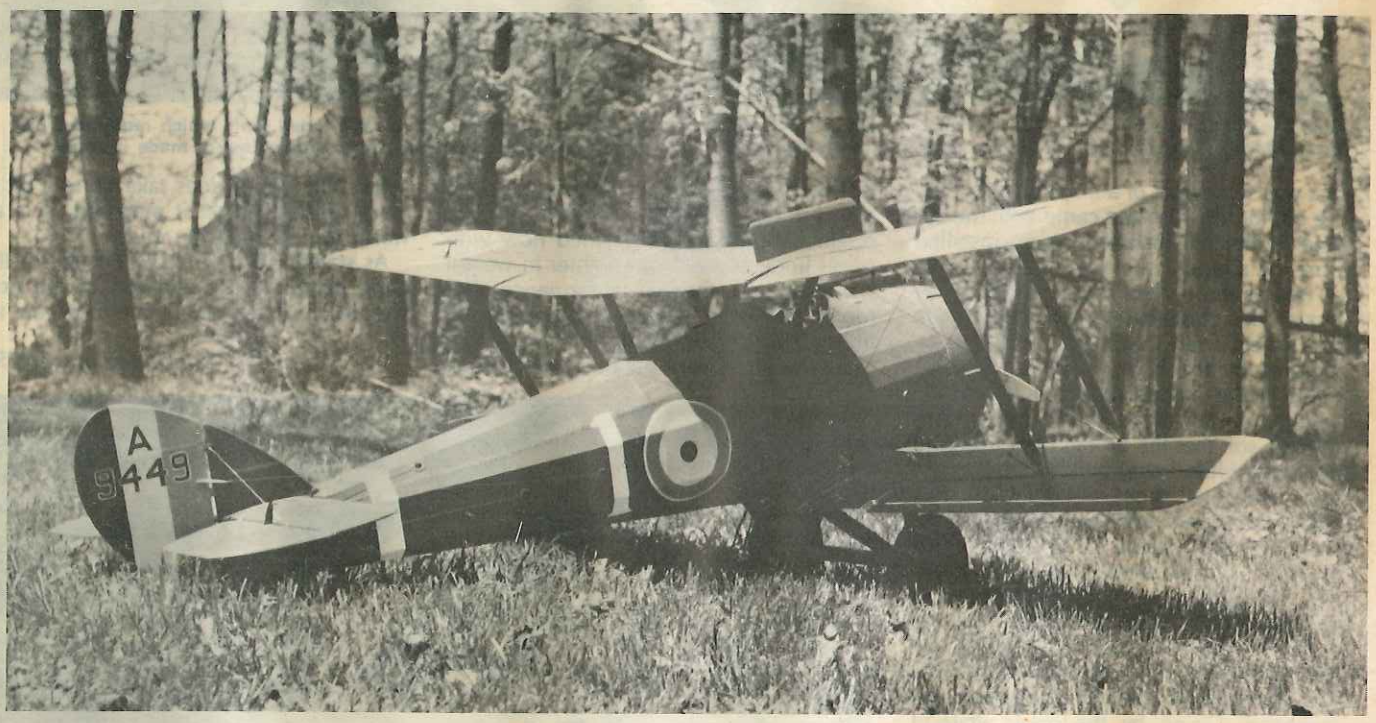
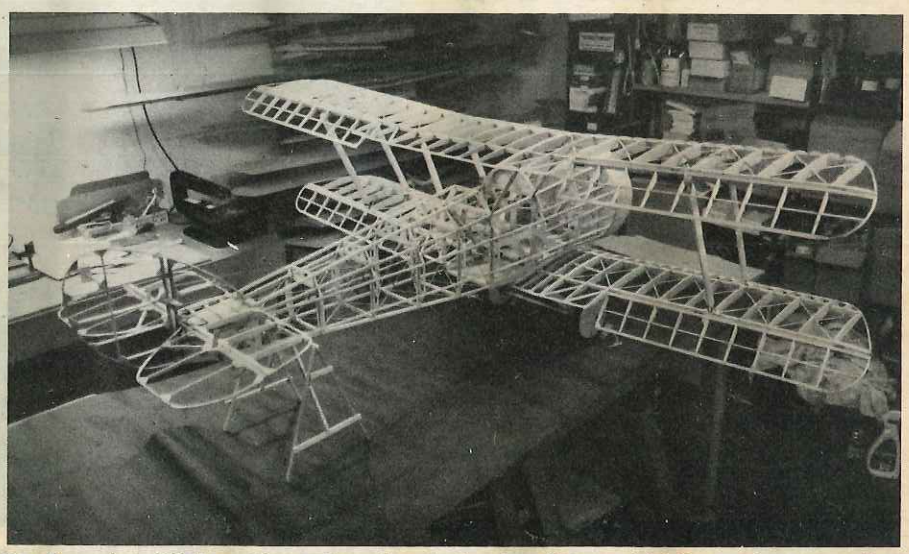
A Quarter Scale deHavilland DH-5



By HANK ILTZSCH . . .An unusual project, and not one for the faint of heart! The DH-5 was an obscure, difficult to fly ground attack fighter in WWI. This model is a faithful reproduction of that aircraft.

• The DH-5 was designed in 1916 by Geoffrey de Havilland, as a tractor biplane replacement for the DH-2. With an awareness of the fact that conventional biplane designs could not give the excellent upward and forward vision inherent in the DH-2 pusher configuration, he decided on the rather radical approach of the DH-5. The wings of this design were given 27 inches of reverse stagger, thus making it possible to seat the pilot under the leading edge of the upper wing. This resulted in excellent pilot visibility, but as it would turn out, a rather disappointing fighter aircraft in general.

From its initial testing stage, on through its service life and retirement, the DH-5 was never popular with the pilots. Initially, it was simply a reluctance to accept the unorthodox configuration which contributed to its bad name; however, subsequent field service brought out some serious shortcomings which were primarily a poor rate of climb and being extremely difficult to land. In fairness to the design, this aircraft was never equipped with a large enough powerplant to overcome the rate of climb problem. It is obvious from the many reports of landing accidents, however, that the aircraft was suspect in this area. It was probably a question of time needed for familiarization, but at that point in the war things were moving too fast for the RFC pilots to spend a great amount of practice time overcoming the landing problem. We must remember that at this period in aircraft history, there were really not many pilots with extensive experience, so anything a little away from the "norm" could not always be coped with. Another example of this was the Martinsyde "Elephant," which was unpopular with pilots because it "floated" on landing. The one attribute the DH-5 did have was toughness. It was pretty much relegated to a service life as a ground attack aircraft, and it's ability to absorb punishment from ground fire became legendary. Overall, the DH-5 was not one of the shining lights of WWI aircraft, however, it is an interesting and ex-



The framed-up DH-5 awaiting radio and control surface linkages. This is a project not to be undertaken lightly; the rewards of construction are certainly self-evident in these photos.

citing looking aircraft on the ground and in the air. I might add here, before going on to the construction of the model, that I was able to clearly demonstrate both the shortcomings (power and landing characteristics) and toughness of the DH-5, during the model's somewhat checkered career.

I want to emphasize that modeling the DH-5 is not for the "faint of heart" or the modeler with somewhat limited experience in scale modeling. It is a *very difficult* subject to execute and to fly, but it is so unusual an aircraft that I am sure there are others out there willing to accept its challenge. I chose to model the DH-5 for several reasons. First, to the best of my knowledge, it has never been done in a large (1-inch or greater) scale or R/C configuration. Secondly, all the areas and moments looked very favorable, and except for the reverse stagger it looked pretty much like many other successful models of WWI aircraft. In retrospect, however, I can see why it has not been done, since there really is not very much information around for documentation.

If you are to do this model, in addition to acquiring a set of plans and this article, invest in a Profile No. 181 (if you can find one) and a copy of the excellent Joseph Nieto drawings available in a large format for the modest sum of $1.00 from the National Air and Space Museum. This particular aircraft color scheme (if you can say that any RFC aircraft of this period had a "color" scheme) was from the book "Men and Machines of the Australian Flying Corps 1914-19" by Charles Schaedel. At the end of this article I have listed all other sources of information that I was able to find.

I have corresponded and exchanged information and notes with John B. Shively of Port Charlotte, Florida, who has been building a full-scale replica of the DH-5 from the same information that I used in constructing the model. Although it has not been flown yet, it should be near completion. I am sure John would be glad to assist and perhaps supply photos of his aircraft for documentation to builders of this model. Although John is an extremely experienced WWI aircraft builder and flyer, I don't envy him as he has to sit in the cockpit for the first flight. I did not!

The following should be considered as a general outline for the building process. I think I have covered everything in the plans, but in any case an experienced builder should be able to think through those areas which may be somewhat ambiguous. It is for this reason that it is important to have all the graphic and pictorial materials you can gather from the reference list included at the end of the article. The Nieto drawings in particular will be an invaluable aid in the assembly of the various bits and pieces.

I strongly suggest the purchase of the cowl, as noted on the plans, from T & D Fiberglass. Since there were two types of cowls used on the DH-5, I had Tom Keeling mold the cowl smooth. This way a builder can select a prototype with either a rib-reinforced cowl, as shown on the plans, or one which has only flush, riveted, joining strips. A cowl can be built up from ply and balsa rings, as was my original; however, the execution of the proper asymmetrical curvatures is very time consuming.

CONSTRUCTION

The fuselage is built up from a frame with outside formers added in the same manner as the prototype. The basic framework is made up of 1/4-square spruce and balsa. Build one on top of the other in order to get perfect duplicates. Reinforce the joints with round toothpicks per sub view on the plans. This system of cross reinforcement has given me excellent results in terms of strength with practically no weight pick-up. Simply drill about 3/4-inch into the wood with a 5/64-inch drill, insert the pointed end of a round toothpick, drive in, "Hot Stuff," and cut off. Offset them slightly in order to have room for the cross brace reinforcements. After the frame sides are constructed, add the fretted 1/16-ply doubler pieces to the inside of each frame. Epoxy in the firewall and tail pieces, square all the way. Add the cross pieces top and bottom. The bamboo cross bracing can be added at any stage of this construction, whenever convenient. Material for these can be purchased at most stores supplying Chinese food. They are called bamboo skewers and can be bought for under $1.00 for a package of 100 in different lengths and diameters. Use either Duco cement or epoxy to put these in. They add a great deal of strength and very little weight. My calculations showed only about 2 oz. of weight for the whole aft fuselage. Be sure to thoroughly cement the crossover points. Add formers to the top and sides of the fuselage and then add the stringers.

BUILDING THE WINGS

When the basic fuselage is completed, build the upper and lower wing center sections. Fit the lower sections first. You will note that the lower front fuselage formers of 1/4-ply are slotted to accept the lower wing stub spars. This allows you to fit these at the proper incidence angle, then fill in these slots top and bottom of the spars. These stub sections are removable. After fitting the lower wing stubs, add the fairing of 1/4-balsa over the top of the inside ribs to the fuselage side. This should wind up being about the thickness of the rib and provides an anchor point for the covering in this area. Allow sufficient clearance over the ribs for their covering.

The fitting of the upper wing center section is somewhat tedious. Using the plan side view, make a jig which is not as wide as the fuselage and will hold the wing section at the proper height and incidence. I made mine from some 1/4-inch, 3-ply scraps. Make up and install all wing center section brass fittings per plan. Install hardwood blocks in the fuselage for strut anchor points per plan. Drill these out at the approximate compound angle needed for the cabane braces, which are 3/16-inch brass tubing. Insert stub sections of 7/32-brass tubing into the hardwood blocks with the wing center section jigged over the fuselage in its proper position. Fit the 3/16-brass cabane struts into the wing sockets and stub fuselage fittings until a satisfactory set up is achieved and epoxy in the fuselage stubs. Drill through each fitting point and install a small bolt. I used the small Proctor bolts for these. Now make up and install the fairings on the cabane struts. Mark the struts as to their proper location. The whole unit can be removed and reinstalled later by simply lining up the bolt holes again and bolting together. The rigging points or anchors in the fuselage should be added per plan. When the rigging is installed later, you will find that the center section can be rigged for minor changes in the incidence and rake with these wires. When all are attached, the center section is very rigid.

LANDING GEAR

Build and bolt on the landing gear. This is basically a 3/16-inch tempered wire frame with 1/8-inch wire cross braces, with fairing added. I used grooved-out pine for the fairing but any method you prefer will do. The landing gear is held into the grooved blocks with metal strips and screws. The lower inner and outer 1/16-ply pieces, which simulate the metal pieces on the prototype, require a bit of fussing and fitting as they are put on at the point where the landing gear bends down to vertical. Use hardwood inserts between these pieces and epoxy them on as there is quite a bit of stress in this area. Use drops of white glue to simulate the bolt heads on these pieces. The axle assembly is 1/4-inch tempered steel with pieces of 1/4-inch I.D. brass tubing and washers silver soldered on the ends. The tubing must project at least 3/16-inch beyond the axle end so that it can be drilled to accept the cotter pin keepers.

THE TAIL

Build the tail surfaces next. These are fairly simple and details are spelled out on the plans. The aluminum tube outer frames have proven to be very good in actual service on several of my aircraft. The secret here is to use the Nyrod insert. This allows the tubing to be bent to almost any curved shape, straight or compound, without collapsing. The Nyrod can be removed after bending, but I prefer to leave it in as it weighs very little, contributes to strength, and allows easier straightening of bent areas from shunts, etc. Joints are made with short pieces of 1/8-inch dowel. Fit the stab to the fuselage, using the rear balsa fairings to adjust for incidence which should be no more than 1-degree positive. The manner in which the stab is fitted does allow for some adjustment of the incidence, if desired.

The fin is attached to the fuselage rear (groove out the stern post) with #2 x 1/2-inch sheet metal screws and the brass front fuselage bolt fitting per plan. At this point you must decide on how you want to operate the rudder and stab. My first construction included a crucifix arrangement aft of the cockpit area with pushrods running from the servos which were set

up close behind the firewall. Later, I eliminated the vertical portion of this assembly and went directly to the servo for more positive operation of the elevator. The rudder is still best operated via a pushrod to a U-control horn, as the cable runs need to be parallel in order to give adequate rudder movement with the big rudder horns. It will require the use of some inside Nyrod cable guides for the controls, in order to operate out of the scale opening positions. Once in place, these become convenient guides in the event a cable run needs replacing. It will require some time and patience in this operation to get smoothly operating controls.

ASSEMBLY

Build up the wings and ailerons and install the horns, cable connectors, etc. The wings are fitted to the center section and lower wing stubs with connector pieces per plan. These pieces are bolted into the wing center section and lower wing panels rather permanently. Because they are bolted, however, replacement is not difficult in the event of breakage. Carefully drill the bolt mounting holes only after the wings are completely fitted and trial rigged. Then install the blind nuts in the appropriate places for permanent fastening.

With the wings fitted to the fuselage assembly, construct the interplace struts to the proper length to give the correct incidence readings. Brace and hold the wings in the correct position during this procedure to assure correct length and fit of the struts. Bolt the interplane struts in place and using fishing line or whatever, put on temporary flying and landing wires. The landing wires will establish the dihedral, while the interplace strut wires will establish the outboard incidence. This allows the flying wires to be disconnected for disassembly and simply tightened and safety-wired upon assembly. Disassemble for covering, etc. when satisfied. The control cables for the ailerons must be in place before covering. Make them extra long coming out of the exits so that final fit can be made after covering and painting.

This completes the basic construction of the aircraft. One can then proceed to finish off the top fuselage fairing panels, fit the engine and cowl, tail skid and sundry other items which should be done before covering and finishing.

COVERING AND PAINTING

I prefer Super Coverite as a covering material. Obtain a large roll of it in the antique color or at least enough of the antique to do the bottom sides of the wings and stab. I used a new technique for the stitching on this aircraft and it worked out quite well. You can use the following method or the make-up and paste-on technique, whichever you prefer. Fold over the straight edges of two good-size pieces of Coverite and heat seal about 1/2-inch. Make up a large frame similar to a crochet or needlework frame giving a large (1-foot wide by 2-feet long) square opening. I used 1 x 2 wood stock. Use Scotch tape, masking tape or thumb tacks to hold it to the framework. Thread up a large sewing needle with 20 lb. test braided fishing line and begin carefully placed stitches, approximately 3/8-inch between them and as per the subdrawing on the plan. Pull the edges together with each stitch but not tight enough to pull on the overlap. Working carefully, I was able to do one foot in about 20-30 minutes. When you reach the end, knot the line and place the sewn fabric on a flat surface, still in the frame, and carefully adjust the butting edges straight. Then apply a 1-inch wide strip of Coverite to the back side of the stitching. Heat-seal firmly. Move the fabric up the frame and continue until you have a 4-5 foot length of stitched fabric. You will note on the plans that the fabric is stitch-joined the length of the upper main longeron from the firewall to the front edge of the stab. It is also stitched along the bottom longerons from station #3 to the same rear point. Brush on a coat of Coverite's "Quick Stick" to the back side of the stitched area. The entire framework of the aircraft should be coated with "Balsarite." Carefully place the stitch line of the fabric along the longeron and using the heat iron fasten it in place. Next, pull the fabric on one side, then the other, to the next logical longeron top and side, and heat fasten. Cut off, leaving at least 1/4-inch and roll and heat seal this to the underside of the longeron. The piece can then be entirely heat shrinked. You will note that the ersatz seam will open up slightly at this point. Leave it alone as the full-scale fabric coverings do this. Along the cowl front, and at the fuselage rear points and other stitch areas, you can cut lengths of the stitching only and heat-seal them in place. After painting, they look almost as good as the stitches along the longerons.

Finish out the covering job and then paint with your favorite finish. I use acrylic lacquer almost exclusively as it is easy to get almost any color you need and the cost is relatively low. I know that acrylic is not fuel proof, but unless you shower the aircraft with raw fuel you won't notice this. It is immune to the exhausted castor, etc. and in the case of gas engines it *is* fuel proof. The under surfaces are left in natural antique color, painted with 2 or 3 thinned coats of clear acrylic. When brushing these lacquers always heavily lace them with "retarder." I dilute my paint, 1 part paint to 1 part thinner, with the thinner being 50% "retarder" and 50% regular lacquer thinner. The following is the paint blend I used on my DH-5, which comes pretty close to the color shown in the Schaedel book. As there is no accurate information available on WWI colors, it is probably best to come as close as possible to whatever color the aircraft appears in your documentation. I used the following blend of Lucite acrylic colors (% by weight): 7444L Brown — 67.7%; 3295LH Brown — 11.4%; 6911LH Green — 2.3%; Plasticizer — 10%; Flatting agent — 8.7%. This gives a semigloss finish. Add more flatting agent if you want a flatter finish, however, many of the B&W photos I have seen show a slight sheen to the finish.

RIGGING THE DH-5

After painting, assemble and add the final rigging. Recheck all incidences, cable runs, control freedom, etc. Safety-wire all turnbuckles except those going from the flying wires to the fuselage. These are field assembly safety-wired. Assembly of the aircraft only requires two bolts per wing panel, connecting the flying wires to the fuselage and the aileron cables to the control fittings from the fuselage. Of course there are many small details not specifically mentioned which will have to be done to complete this aircraft.

FLIGHT TESTS

Initially, my model finished out at just under 15 lbs. and was powered by an O.S. 1.2 Gemini twin which was well broken-in. Initial flights showed it to be grossly underpowered, and it appeared to be tail heavy. I moved the C.G. forward about an inch (this required about 1 lb. of weight up front) and succeeded in getting some marginal flights. It was on one of these early flights that I encountered the strange landing problems with this aircraft. I had it set up well on final approach with a good sink angle, and what I thought was plenty of speed, when at about 5 feet high over the edge of the field it simply dropped from the sky. There was no tip stall syndrome or other such phenomenon. It just quit flying and no amount of up elevator did anything. After several of these (I am a bit thick at times) I accepted it as part of the aircraft's idiosyncrasies.

I then decided to pull out the O.S. twin and mount a Quadra and viola! — it flew handsomely, although it still appeared to be underpowered through certain maneuvers. The aircraft survived two very bad shunts at various intervals. On the first occasion, the left wing pair folded coming out of a very slow, clean, split-S and went straight in from about 100 ft. This was to be the first demonstration of two of the model's virtues—one its strength. Considering 16 lbs. went straight in, surprisingly little damage was done. Secondly, because the model is built in subsections, its disassembly for repair expedited the job. Although it took a few weeks to get it back together again, part of this time was spent in relocating the firewall. This was put in the position shown on the plans as the false firewall, in order to completely get the Quadra under the cowl. I also modified the flying wire hook-up, as it was a weakness here that caused the mishap.

Several more flights were flown before a radio problem led it astray and it was "strained" through some pine trees. Back to the hangar again. Since that repair job, only minor problems were encountered, mostly on landing. I gradually moved the C.G. aft to the point shown on the plans and educated myself in landing technique. You have to land this aircraft with about 1/8-throttle on all the way to touchdown similar to the Pitts. Then let it run out on the gear, holding slight up elevator and the tail will come down as the speed diminishes. If you have to dead stick this

bird, dive for the field with all the airspeed you can generate and flare it about two feet or less above the ground.

The configuration of this aircraft appears to generate an inordinate amount of drag, thus accounting for, I think, the landing characteristics and the flight performance. Like the full-scale, it needs more power than one thinks it should need. I am going to put a 2.5 Magnum in it for next season and swing a 22 x 10 as I think this is what it needs. I used mostly a 20 x 8, however, I found that a 24 x 6 at 5700 rpm gave the most realistic flights I ever achieved. Unfortunately, this is overkill for a Quadra, and it would tend to load up coming down on the throttle and would not pick up again. So if you put an engine on it that will turn up a 22 x 10 or 24 x 6-size prop, you will have a very realistic flying machine. It has no match in looks in the air, and fly-bys are quite impressive. They say beauty is in the eye of the beholder—so some may say it is ugly. If you like its pugnacious looks and want a real challenge, build one. It is certain that you will have the only thing like it at any field.

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