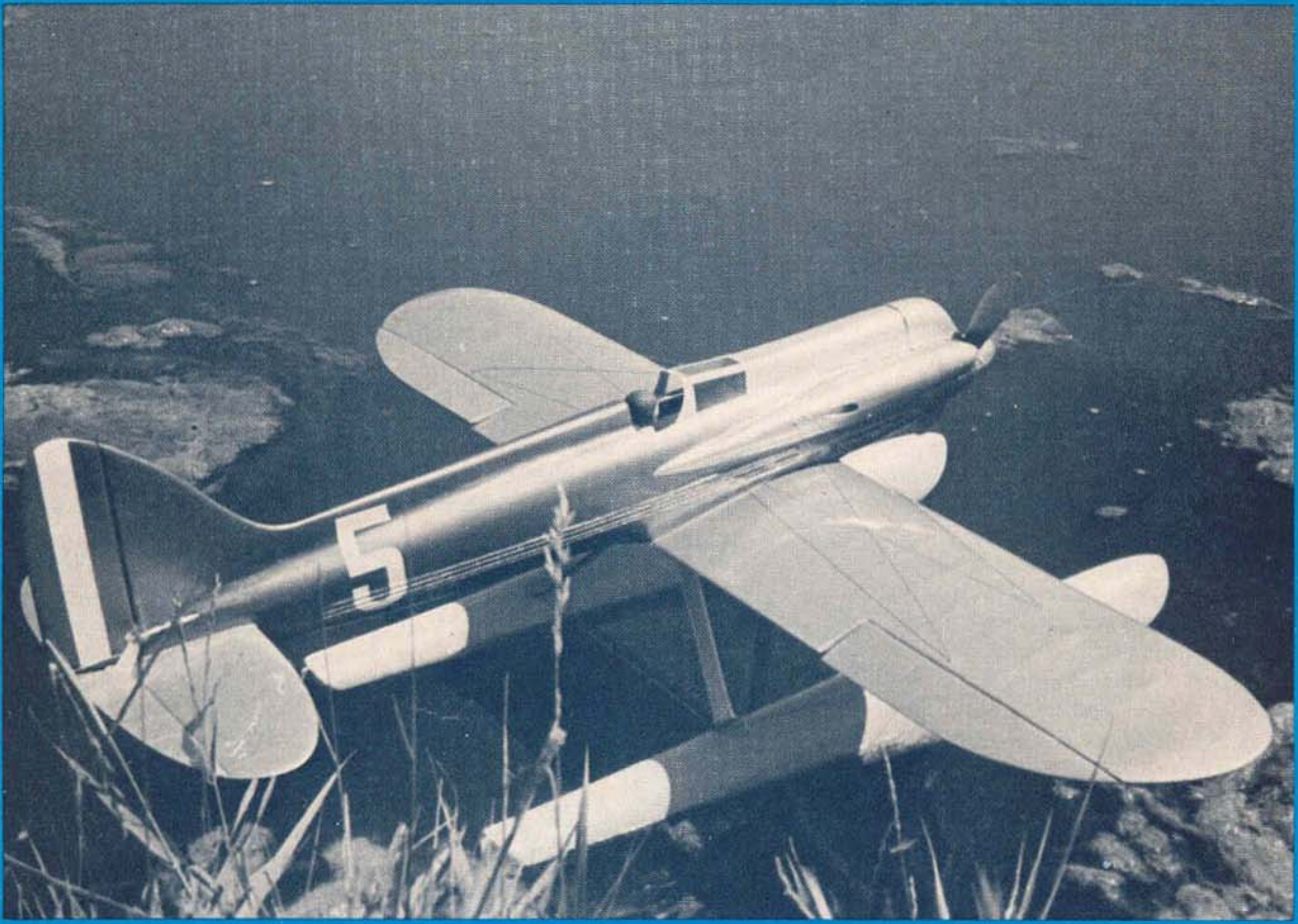

5


5

SUPERMARINE S-5

A Classic Racing Plane For .15-.25 Power.

BY G.A. FLANDRO

Possibly one of the most beautiful aircraft ever designed, the 1927 Supermarine S.5 racing seaplane led the successful British attack in the famous Schneider Trophy Competition. The S.5 was one of a series of racing seaplanes designed by R.J. Mitchell, and was the forerunner of the immortal Battle-of-Britain Spitfire.
. . . . Don Dewey

I trace my life-long involvement in airplanes to a Saturday afternoon towards the end of World War II when, as a youngster, I saw a motion picture entitled "Spitfire" (original British title was "First of the Many"), which depicted the life and times of the famous designer R.J. Mitchell. I was fascinated by newsreel shots used in the picture of the silvery seaplane racers as they competed for the coveted Schneider Cup. Mitchell's career was devoted to the design of the fabulous line of Supermarine racing seaplanes, and his efforts led to the three successive wins which won the Schneider cup permanently for England in 1931.

His design innovations were definitely decades ahead of the times, and the graceful beauty of the 1925-1931 Supermarine racers has, in my eyes, never been equalled. These were very specialized vehicles, designed to take-off only from water, fly a seven lap 190 mile course at high speed, and alight again on the water.

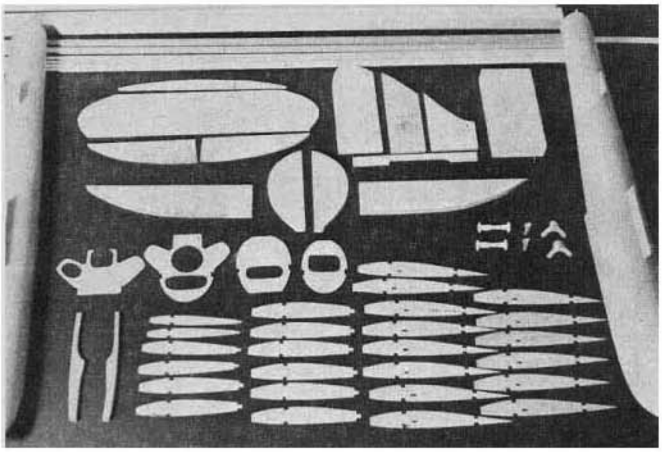
During the 1920's and 30's these were the world's fastest aircraft; the Supermarine S.5 captured the record in 1927 at 282 mph using the Napier Lion engine. This was bettered by an improved version, the S.6, using the new Rolls-Royce 12-cylinder "R" engine, forerunner of the famous Merlin. The S.6 and S.6B raised the world speed record to 358 and finally to 408 mph using a special "sprint" version of the Rolls-Royce R. One can clearly see, in these aircraft, the rapid evolution of high-speed aerodynamics, and the story of their tremendous impact on the design of the fighter aircraft later used in World War II has been often repeated. In the semi-elliptical wing planform and beautifully faired fuselages of the Schneider trophy racers there is a definite link to the redoubtable Spitfire of Battle-of-Britain fame.

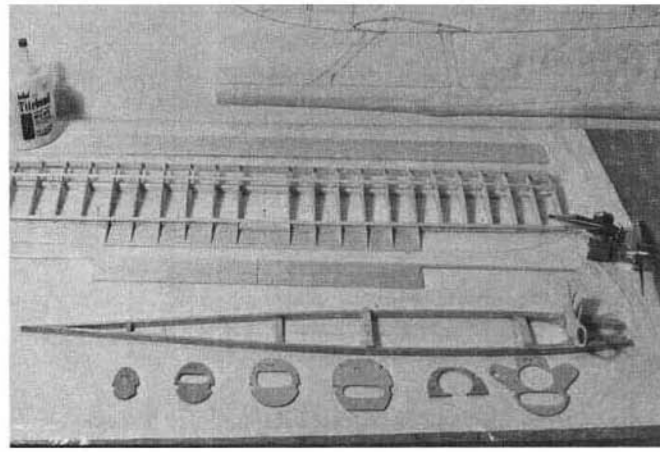
The devlopment of lightweight micro-miniature proportional radio control equipment has produced a tremendous revolution in R/C model design. It is no longer necessary to build huge ships modeled on the 2" or 2½" = 1' scale to achieve the desired combination of scale detail and acceptable flying qualities. The 1" to 1½" = 1" formula using engines in the very successful and well developed range from .15 to .19 cubic inches is now entirely practical. The many advantages of smaller models are so obvious they hardly need mentioning; lower material bills, faster building time (less area to sand, etc.), much lower fuel consumption, easier transportation of models, and on-and-on, ad infinitum.

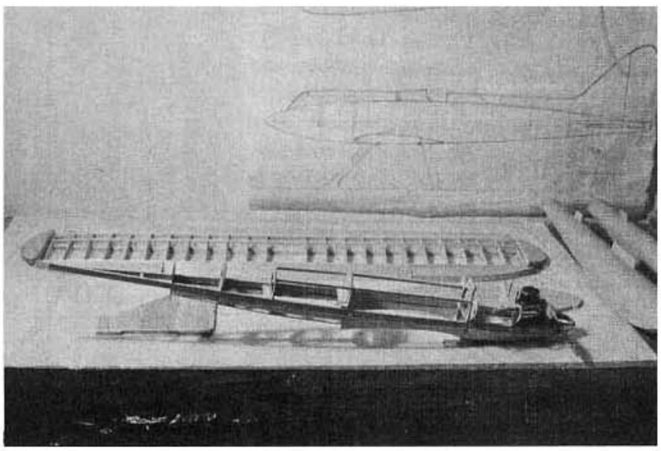
There has been much talk lately of cutting down racing speeds for safety and for encouraging the less-skilled flyer to participate. What better way to accomplish this than by using the smaller engines permitted by reduced control system size and weight? The astute reader will by now have discerned what all this is leading up to – a cautious suggestion that there ought to be some study of a modeler's version of the Schneider Trophy Seaplane Race using small radio controlled airplanes patterned after the Curtis, Supermarine, Gloster, and Macchi racers of the pre-war years. Here is both a virtually untouched reservoir of appealing designs for the scale builder and the possibility of a racing event which would be tremendously appealing to the onlooker and truly challenging to the contestant and model designer. There is just nothing prettier than a scale-type R.O.W. This type of racing may also lead to solutions for some of the safety problems. What better way to ensure spectator safety than by flying the models over the water? It might also be noted that crashes in water are usually less severe, and damage is often slight if care is taken to protect the radio gear from water damage.

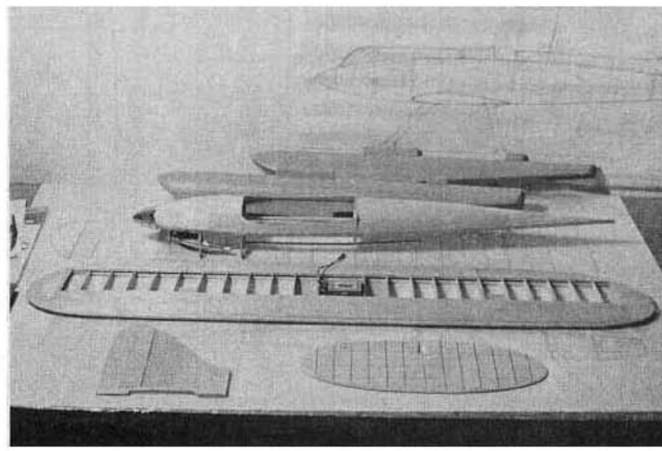
Before I get carried away too far, I should state that this article was not intended to push any new racing events, but rather to indicate that there are some modeling areas which remain virtually untouched and are worthy of some development work. This article describes an initial exploration into some of the possibilities just described, making full use of the availability of advanced radio equipment, materials, and design techniques.

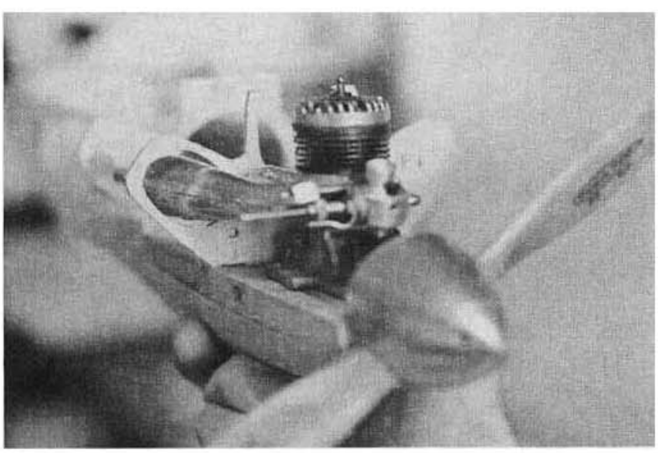
I chose the Supermarine S.5 from among many other worthy Schneider designs for practical as well as esthetic reasons. First of all, the advantages of an upright engine installation are well-known, and this can be accomplished in the model S.5 without deviating from the scale outline. An interesting feature, which emerged in the design process, was the possibility of completely submerging (don't use that word too often around a seaplane jockey) a muffler system in one of the cheek cowls. If your flying lake is close to a populous area, this could be an important consideration – much has been written concerning the dwindling supply of flying sites due to uncontrolled engine noise. Another obvious advantage of the muffler installation is the channeling of exhaust gases completely away from the airplane. My S.5 is completely untroubled by the usual gummy castor oil smear – this is important when you are trying to maintain a fragile set of scale details and decals. The major design constraint for the model was that it be the absolute minimum in size required for efficient operation with a hot .19 RC engine. The scale which appeared to best meet these requirements was the 1.5" = 1' conversion. This results in a model which can be built from standard material lengths without any splicing required, and allows use of easily available scale accessories. The model is so compact that it can be easily transported to the flying site without dismantling. This is a significant advantage where it is necessary to protect the inner workings from moisture. The system can be

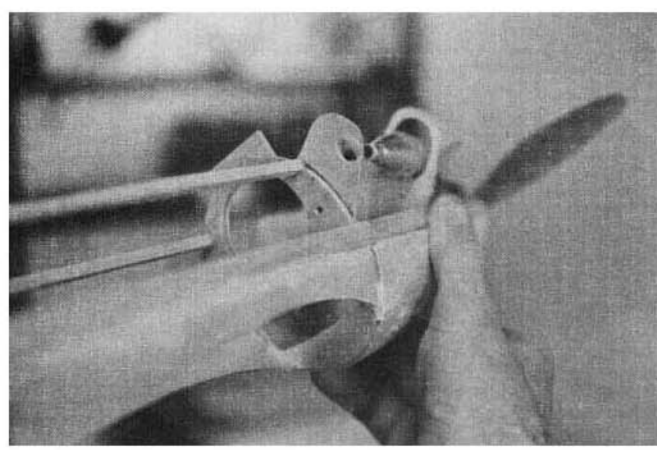


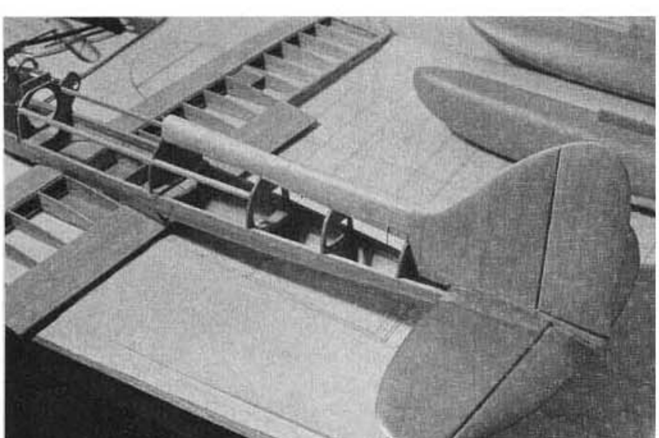


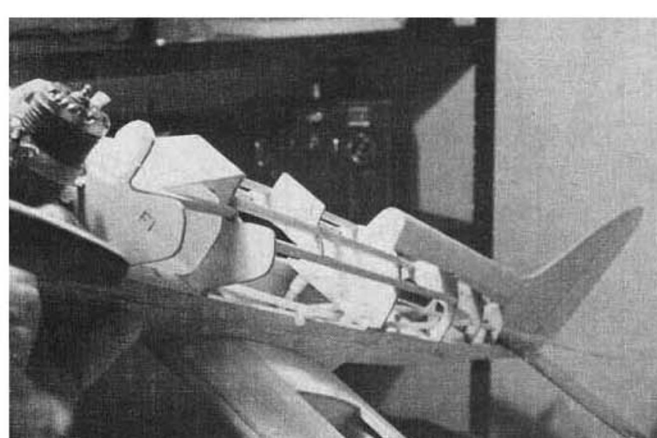


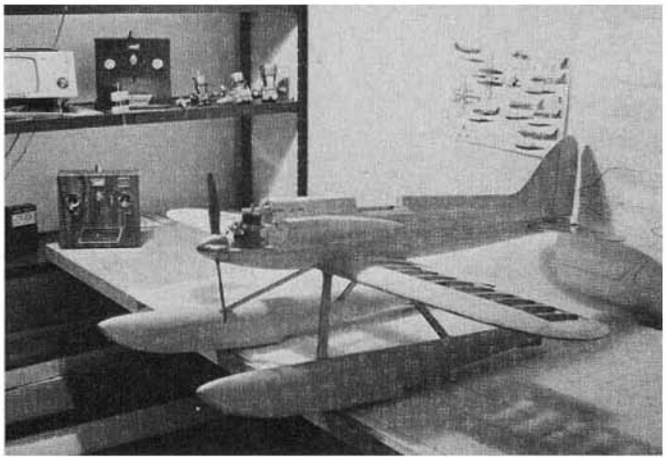


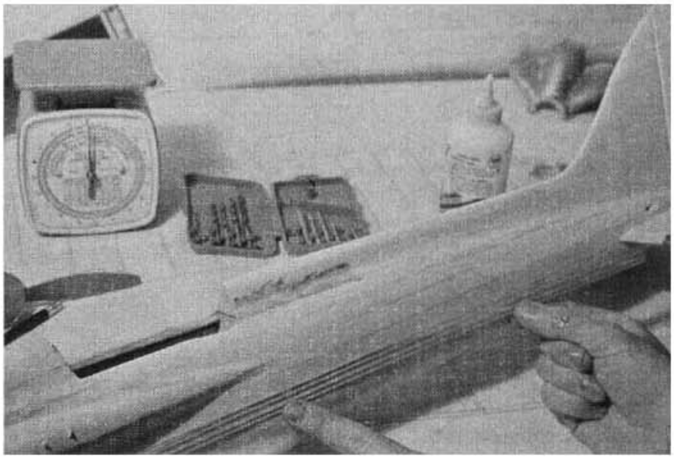


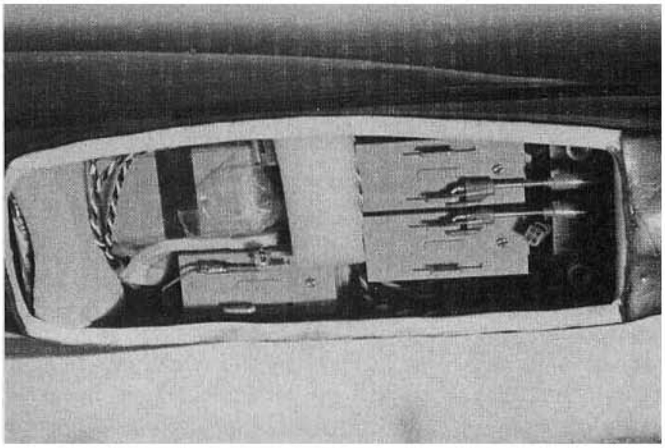


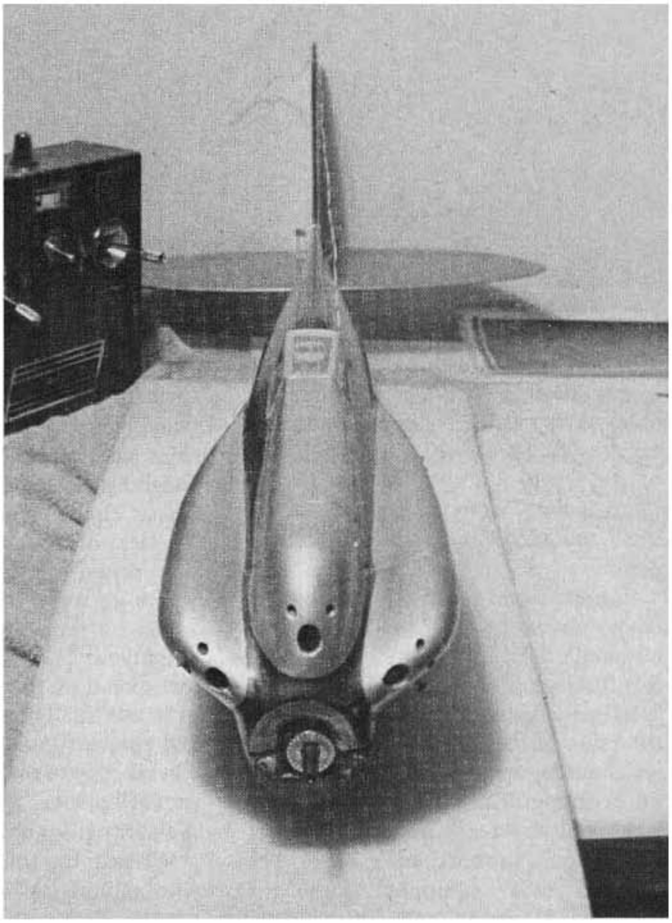


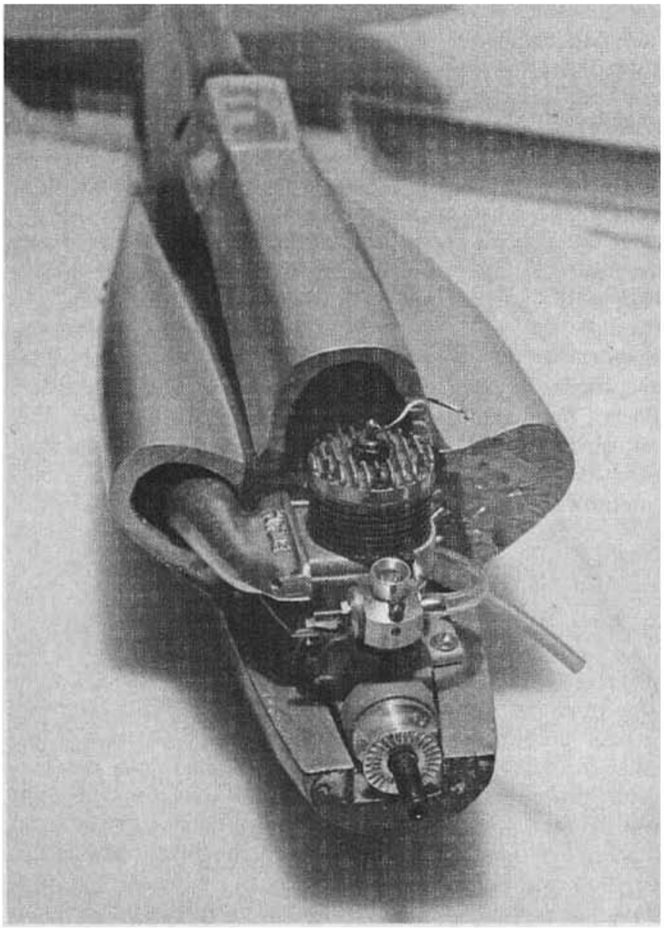


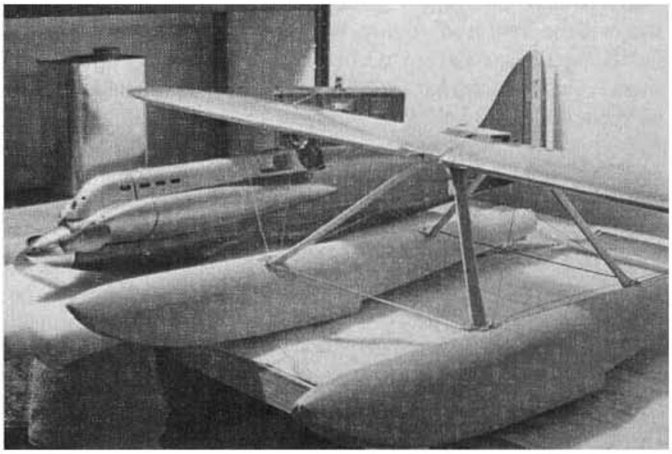


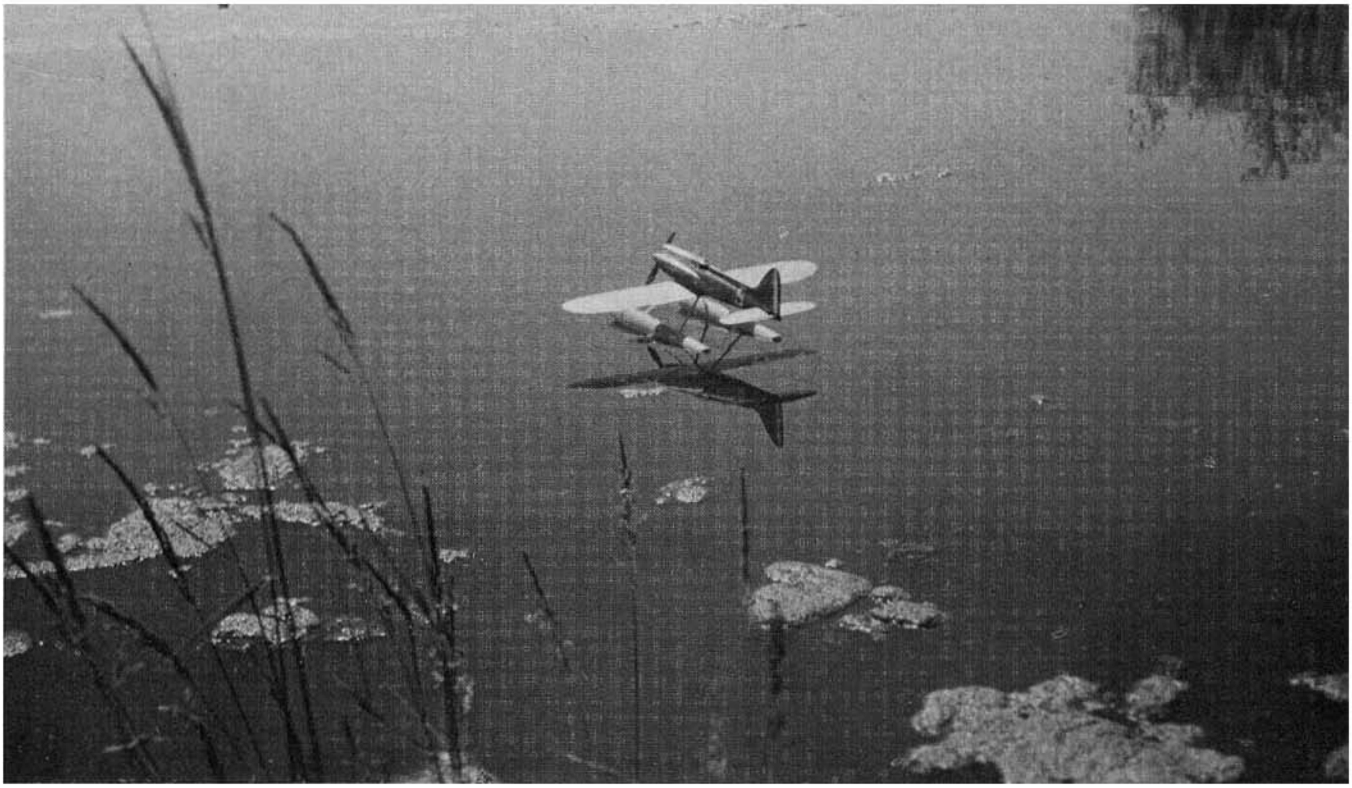












completely checked out, the wings installed, and moisture seals checked before leaving the shop for the flying pond. The model fits handily in most car trunks, and even in the back seat of the trusty V-dub. Needless to say, there is not room enough in such a small model for old-style radio equipment.

I guess I picked up the "small-bug" from absorbing so much of R.J. Mitchell's design philophy – the actual S.5 fuselage probably has the smallest fuselage cross-section ever achieved; the pilot actually sat on the floor with his shoulders pressed against the cockpit coaming. The model was carefully layed out to accept any of the newer miniature proportional rigs. The original was equipped with the XL-Series Micro Avionics system. Only minor detail changes in servo mounting will be required to use the Kraft (with small servos) or Orbit equipment. Unless you have a "flat-pack" airborne battery pack, you will have to use a different fuel tank arrangement to make room.

Still another advantage of the 1.5" = 1' scale is that commercial floats can be used with only slight deviation from scale. The original was equipped with Gee-Bee Line 27" vacuum formed floats for the initial testing and development flying. The scale purist will want to build scale floats, and this can be easily done using one of the standard pontoon layouts. The simplest method is to cut a vertical keel from sheet balsa, add formers to right and left, and then plank with sheet and strip material – this will produce a float system weighing several ounces less than the plastic floats. If you are handicapped by lack of suitable flying sites, or if you desire to fly in a scale contest where no water is available, removable wheels or even a take-off dolly may be employed. The main wheels should be just ahead of the float step, and must protrude far enough that the airplane can rotate for take-off. Steerable tailwheels may be attached to the water rudder pivots for (excuse the expression) ground handling.

I'll skip the time-worn cliches about who should and should not build this model. This project is obviously an initial thrust in a new direction – there are still many unknowns – but the results to date are extremely promising. The prototype was my first experience in seaplane design and practice. I had nightmares about the oft-mentioned problems of R.O.W. operation, and could visualize my radio equipment lying in the mud at the bottom of the lake. These problems proved not to be all that formidable. No exotic encapsulation procedures were found necessary. In fact, the wing joint was sealed with the time-honored foam tape method without admitting a drop of H_2O. Telescoping NyRod pushrods solved the leak problem at the pushrod holes. The battery pack and receiver were safeguarded simply by wrapping them in polyethlene plastic, and the entire equipment installation was covered by a sheet of the same material tucked in around the edges like a blanket. Not a drop of water has been found inside the plane even after some vigorous test flying sessions. No exterior finish problems have been encountered, although a lighter-than-average dope finish was employed.

The initial flight attempts were made off a large reservoir amply stocked with fish, fishermen, and waterskiers. The water surface was rather rough due to both the speed boats and a moderate wind. The model was started and set in the water. Full throttle was signalled and off she went directly into the wind. The model tracked nicely, but turns were sluggish due to the weathervane effect in the strong wind. The model was planing on the steps almost immediately and was about to take-off when interrupted by waves from a passing boat. The folly of trying to fly from rough water had become apparent. The main problem here seems to be the power loss due to spray splashed into the propeller disc by the float tips as they hit wavelets. The solution to the problem is fly from smooth water – the glassier the better. Small ripples won't hurt, but strong currents and wakes from boats will keep you on the surface – the S.5 makes a beautiful airboat under those conditions. With proper water conditions, take-offs are truly breathtaking. The model tracks straight and true, and a little up elevator is all that is needed once she's up on the step. Altitude is gained rapidly despite the minimal wing area, and the airplane, once airborne, handles much like a Goodyear racer. I would describe it as a "groovy" flier. and it makes beautiful pylon turns just what we need for our model Schneider Cup event.

Although the wing has no dihedral, the model is very stable – this probably results from the lowering of the C.G. due to the float system hanging below the wing. Aileron control was just about right as designed – we need a little more lateral control power due again to the floats and their contribution to the roll moment of inertia. Elevator action was smooth with the pushrod set in the outer hole of a standard long control horn. The only trim required during the initial test hop was a bit of right aileron to compensate for motor torque – I had optimistically installed the engine initially without offset. (The plans show the correct thrust line.)

The model lands much like a Goodyear racer. The glide path is fairly steep, but a lot of ground (excuse me, water) can be covered in the landing approach, so this requires some practice. The stability induced by the low C.G. due to the undercarriage is a big help during landing. There are no serious handling problems in the nearly stalled condition because of this. The model merely mushes, but it can make a big splash if you don't maintain flying speed required for a smooth flare-out onto the water.

All of this requires practice and the pilot must adapt to the peculiarities of any new model - especially one which embodies many new design innovations. The S.5 is really a beauty in the air the muffler emits a very realistic approximation to the Napier Lion engine. and the pylon turns must be seen to be appreciated. The floats don't seem to have much effect on speed. We should have known that – floats didn't slow up the full-size Schneider racers very much! The model is fast enough and responsive enough to give even a seasoned Goodyear addict a thrill. The model had not been timed at the time of this writing, between 60 and 80 mph just about right for a safe yet exciting racing event. If all of the above has wetted (pun intended) your appetite, then you may want to study the construction details to determine the special problems which must be met in building a scale, racing-type seaplane model.

CONSTRUCTION NOTES

I beleive you'll find the plans for the S.5 will answer most of your questions on building procedures. The design features follow present state-of-the-art fairly closely. There are a few unconventional twists which I'll try to point out in the following notes. Incidentally, if you intend to build the model as a competition scale ship, I suggest you acquire Profile Publications No. 39, "The Supermarine S.4 S.6B" which contains a wealth of information on the S.5 but, alas, no wing or stab profiles. I obtained these from the three-view drawings in the Harleyford edition, "Spitfire The Story of a Famous Fighter." I found the historical notes describing the evolution of the Supermarine Schneider racers into the Spitfire really fascinating, and highly recommend the book.

It is best to begin construction with the fuselage crutch. The wing layout can be completed while this dries. Notice that only standard 36" material lengths are required. Pin the motor mounts to the plan, noting that right and left are different to give the required right thrust. Taper the ends of the two 3/8" x 3/16" crutch longerons as indicated in the top view. Glue these together at the tail, and pin to the plan progressively as you install the 3/8" x 3/16" cross members -- be careful to note the vertical locations of the cross members as shown in the side view. Finally, bend the longerons around the motor mounts and secure them at the forward end with a small C-clamp while the glue sets up. Former F-1 can be glued in at this time since it does not extend below the crutch. Incidentally, it seems to be perfectly safe to use Titebond or Wilhold type glues for the bulk of the structural work if your finish is applied with sufficient care so that water cannot contact the joint. Use epoxy glue at the motor mounts and other critical joints.

While the crutch is drying, cut out the wing ribs and start the wing construction. This goes very rapidly, since the wing has no dihedral and standard length materials can be used without splices. First, pin a ¼" sq. scrap balsa riser over the front spar position on the wing drawing. Pin the bottom front 1/8" x 1/4" spruce spar to the riser strip out to the last W-3 ribs in the right and left tips. Block the ends of the spar up 7/16" from the building surface. Pin down the 1/16" x 2" balsa trailing edge bottom planking after tapering a strip about 1/4" wide at the rear edge to a knife edge to accept the top planking. Taper the ends of the two rear spars (1/8" x 1/4" spruce) between W-4 and tip (3 inches on each end) from 1/8" to 1/32" thickness at the tips. Keeping the tapered portion facing toward the inside of the structure, glue one of the rear spars to the forward edge of the bottom rear planking. Pin out to the last W-3 rib on each tip and block up the tips ¼" from the plan. Now install all of the ribs and follow with the top spars. Notch the 3/8" square leading edge and make the two leading edge tip pieces from scrap 3/8" sheet. Glue the entire assembly to the leading edges of the ribs. Now add the front and rear mounting blocks for the float struts and wing attachment bolts. These are cut from 3/8" spruce sheet and are shaped to fit between the ribs and between the top and bottom planking. Add the top rear balsa planking. The basic wing structure is now complete and should be allowed to dry while you continue with the fuselage. The construction photos show all of the operations. Refer to these if you need to check any of the steps.

After cutting all formers, remove the crutch from the plan and glue them in place being careful to maintain vertical alignment. Do not drill the hole in F-2 for the wing dowel until the wing – fuselage mating is undertaken. Add the 3/16" square stringers and former F-7. Cut the wing saddles from 1/8" plywood and glue in place. These must curve slightly, and this can be facilitated by moistening the surfaces. Fit the motor and drill the mounting holes. Test fit your muffler system – if you don't trust the power output of your .19, it may be necessary to dispense with the muffler. The baffles may be ground out of the Tatone "peace pipe" muffler if you desire only to use it as a manifold to channel exhaust gases away from the plane. You may have to file the muffler passage in F-1 to fit your engine-muffler combination. It is best not to cut the hole for the 3/8" O.D. brass exhaust pipe extension until you know exactly how your engine will set. The tank holes in F-1 and F-2 are for a 4 ounce Sullivan RST-4. Change these as required to fit your tank. The RST-4 was used in the original, since it takes up less radio compartment space than the longer cylindrical tanks. Install the chin blocks and the soft balsa filler block at the aft end of the fuselage and plank the lower half of the fuselage with 3/32" balsa strips. Glue the 1" x 1" balsa head-rest to the tops of F-3 and F-4 after tapering to 1/4" width at the aft end. Note the triangular 3/32" sheet fillers between the dorsal and the tops of the last two formers.

Glue the 1/16" balsa cooling baffle between F-1 and F-2. Cut the stabilizer and rudder parts from 1/4" medium balsa sheet. The stabilizer ribs may be simulated as indicated on the plan. Super MonoKote covering material really works in this application, and I think you will be very pleased with the scale appearance. The edge of the MonoKote should be trimmed to lap about 1/64" over the joint with the fuselage crutch. This will anchor the covering to eliminate the possibility of water soaking into the unpainted balsa under the MonoKote. Mount the stabilizer to the crutch using epoxy glue - check the alignment carefully using the trammeling method. Hinge the fin and rudder and epoxy to the fuselage and, again, watch the alignment carefully.

Remove the wing structure from the plan, and taper the leading edge strip to receive the front planking. Install the tips and aileron system. Install the 3/32" aluminum tubing for the bracing wire. These should be just flush with the 1/16" x 3/16" balsa capstrips, and they should be anchored with epoxy glue so they can't break loose – the wire rigging is functional on this model. Cut the ailerons from 1/2" soft balsa sheet. When planed to final shape these will be just as light as the built-up variety. You will notice that the ailerons are about two sections longer than scale. I feared that scale ailerons would be inadequate due to the large roll moment of inertia but don't attach them permanently to the wing until after covering. This is a bit unconventional and requires some explanation - it is necessary to seal the wing completely against water seepage, and this can be done handily using Super MonoKote. The aluminum MonoKote is just the right color and texture to represent the natural aluminum scale wing and stabilizer surfaces. (You may also use the time-honored silk-and-dope method if you prefer.) Make slots between the upper rear 1/16" planking and the spar for mylar hinges before covering. You will notice that there is an open space in the wing structure between the ribs in the aileron cutouts – this area is sealed by wrapping the bottom MonoKote sheet over this opening and sealing all edges. The top covering laps over this to make a waterproof seam. Cover the ailerons with MonoKote; locate the previously made slots for hinges, and install the hinges with epoxy. The hinge strips must be perforated before assembly to ensure a reliable bond. Make pin holes through the top and bottom covering into the 3/32" bracing anchor tubes for later installtion of the wire bracing.

Now match the wing to the fuselage and locate the proper position in F-2 for the wing retainer dowel. Set the wing into position and trammel carefully to get perfect alignment. Now drill through the wing bolt holes into the 1/8" ply nut plate already installed in the fuselage across the top of the crutch longerons and against former F-3. Install Du-Bro WB-2 wing bolts. The fuselage construction is completed by installing Nylon (NyRod or R/C Craft telescoping pushrods) elevator and rudder pushrods. The outer tubes are sealed into bulkhead F-6 with G.E. Clearseal, or contact cement, to eliminate any possibility of moisture seeping into the fuselage through the push-rod exit holes in the outer skin.

Plank the upper half of the fuselage with 3/32" strips. Chamfer the strips where they mate with the rudder and dorsal fin. The cheek cowls are formed by planking between F-1 and F-2 and soft block continuation to the rear. Check your muffler clearance as you proceed. Add the 1/2" top cowl block and seal the engine cooling compartment behind the motor cylinder with dope and Clearseal so that any water ingested with the cooling air will not enter the fuselage interior. The scale exhaust holes for the vertical cylinder bank are used to vent the cooling compartment. Notice these are on the left side only. They seem to provide an adequate flow of cooling air, and no overheating problems have been experienced with this arrangement. The engine cowling may be carved from balsa blocks or you may make a fiberglass version if you feel ambitious. If you use the hollowed block method, be sure to reinforce the inside with a layer of light fiberglass cloth and resin. The cowl is held in place by two 1" bolts threaded into hardwood blocks glued into the corners formed by the intersection of the motor mounts with bulkhead F-1. The wing fillets are carved from balsa strips glued to the fuselage, or you may prefer to use Sig Epoxylite or similar light molding compounds.

Carefully sand the fuselage to final contour. Go easy on the planking - you need to sand off only about 1/32" of balsa to reach the finished contour. Be especially careful near the bulkheads, since there is a tendency to sand through rapidly at these points. If you desire, you may cover the fuselage with silk or silkspan prior to application of the finish undercoats. Before applying the final coat of paint, the fuselage scale radiator tubing must be installed. These are not applied until after the bulk of the paint is applied to prevent dope build-up around the simulated cooling tubes. The best way to install the radiators is to lay out a strip of scotch tape (½" width) sticky side up over the plan view of the radiators. Carefully stick the 1/32" square balsa strips to the tape at the proper positions. (1/32" balsa strips of adequate length will be found at the model railroad counter of your hobby shop.) Next, carefully apply a fine bead of glue to each strip and then lay the whole ball of wax into position on the side of the fuselage. Before the glue sets completely, pull off the tape and remove any excess glue using a small balsa scrap for a scraper. Be sure that the last coats of dope are well plasticized to eliminate splitting of the finish at the high-stress points created by the small radius of curvature of the thin balsa strips. Refer to Profile No. 39 for scale color and trim details. I found Aerogloss Metallic Blue dope to be just about the right color for the fuselage and fin. The engine fairings and struts are finished in aluminum. The red and white trim on the rudder really sets the whole thing off to advantage.

The float struts are cut from .032" aluminum sheet, drilled for the sheet metal mounting screws and then bent as indicated in the front view. To achieve scale strut contour and to provide necessary resiliency, 1/32" ply doublers are epoxied to each side of the aluminum core. The floats are attached to the mounting pads on the struts using ¼" pan head sheet metal screws. Don't tighten these completely until the wire rigging is in place. Be sure to position the floats with precision. They must be parallel to the fuselage centerline. The float step must be right on the C.G. to provide adequate longitudinal control for take-off rotation. It may be necessary, in some cases, to adjust the float position fore and aft and also to adjust the model angle of attack relative to the floats to secure good take-off characteristics. This is one area of seaplane modeling which needs more research. Instructions provided with the Gee Bee floats represent a good starting point. You will notice that the struts seem awfully flexible. They were designed to be as light as possible, and require wire bracing as did the struts on the full sized airplane to adequately support the pontoons. The float main cross braces are made from .060" wire as shown in the drawings. A drop of epoxy glue on the mounting screws before final tightening will ensure a reliable installation. Wing bracing wires are from lengths of .025" wire. Here we had to depart from scale a little. However, only the purist should be bothered by this slight scale deviation.

Rig the underside of the wing first. Take a length of wire and measure off enough to go from the wing attach tubing to the front strut attach point, add about an inch extra, and make a 180 degree bend. Make this just sharp enough that the loop can be inserted into the 3/32" aluminum tubing in the wing. The loop protrudes slightly through the upper skin to provide an attachment point for the removable wing-to-fuselage bracing. The two wires now protruding from the wing bottom are bent toward the float attach points. Make "U" shaped hooks in the ends to slip over the as yet untightened sheet metal screws at the float. Do not pull the wire too tight, and be sure to keep close watch on the float alignment as the rigging proceeds. The plans and Profile No. 39 will answer any questions on the bracing geometry. When rigging is completed you will note the floats are solidly aligned to the fuselage despite the lightweight struts. The top wing brace wires are removable to allow wing detachment. Measure the wires and make small open loops at one end. Pass these through the attach loops already formed by the bottom brace wires, and close the loops by squeezing with needle nose pliers. You may use small springs at the fuselage end to secure the bracing wire to wire attach loops on the cheek cowls as shown on the plans.

The radio equipment is mounted on a 1/32" ply sheet which is glued and sealed against the 3/16" square fuselage stringers. The Micro Avionics servo mounting clips really facilitate installation. Glue in spruce cross members for mounting Orbit, Kraft, or other servos of this type. The receiver switch is operated by a short piece of 1/16" wire which protrudes through a small hole in the fuselage side. After installation, a glob of Clearseal on the inside wall surrounding the wire where it passes through the wall effectively seals the hole yet allows the wire to slip in and out to operate the switch. I like this better than the unsightly baby bottle nipples or rubber balloon external switch seals used on many model seaplanes.

Cockpit details are (unfortunately) up to you. I installed 3/16" Tatone instruments, but had to guess at the layout. A Williams Bros. 1.5" = 1' standard pilot head can be painted up to look just like one of the famous Supermarine racing pilots. The receiver antenna wire passes up through a small hole into the cockpit and remains there coiled out of sight until the model is flown – Schneider racers carried no radio equipment, of course.

Most of the important pointers on flying the model have already been covered. If you have been careful and built the model without excess weight you should experience little difficulty with flying. Considerable research remains to be done on improving take-off and landing performance. I believe that the surface has just been scratched when it comes to model seaplane float design. I am sure you will be pleased with the handling characteristics of the model both in the air and on the water. I think there is great potential in a Schneider Cup model racing event. This will promote some interesting developments along new and really appealing lines as already suggested. If you are inspired to design your own Schneider racer, you will find no end of interesting prototypes. For example, if you don't go in for wire bracing, then build the Supermarine S.4 which was one of the first completely cantilever airplane designs (had flutter problems, though).

If you are a biplane enthusiast, or a flying boat buff, then go back into the earlier days of Schneider racing. There are many gorgeous biplane designs. For example, the 1925 race was won by Jimmy Doolittle flying the beautiful R3C Curtiss biplane.

I may build this one next. □

From
RCModeler
Feb. 1974