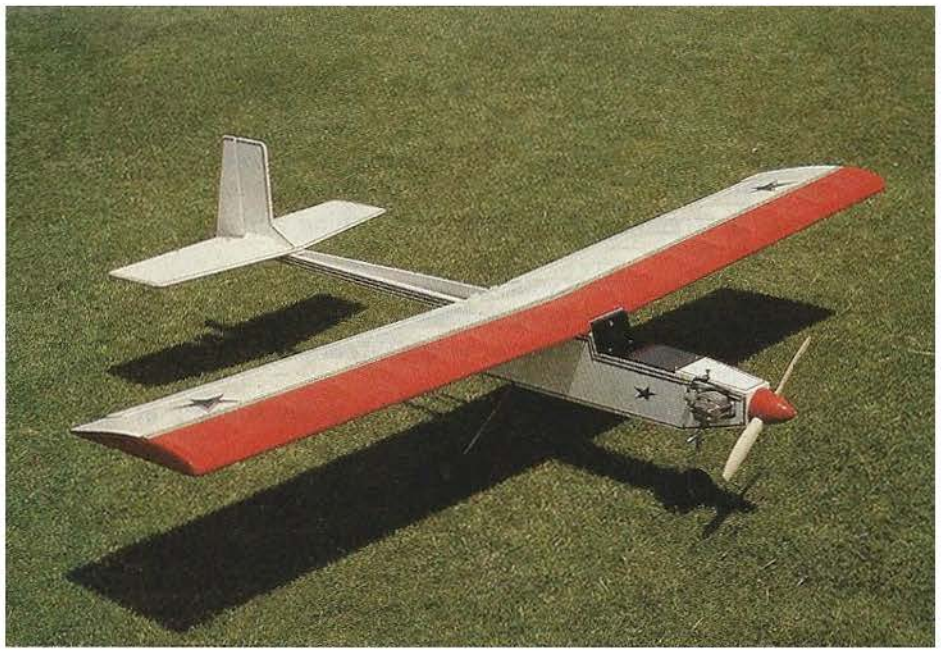


ASTERION

A great .20-.25 size aileron trainer/sport flier

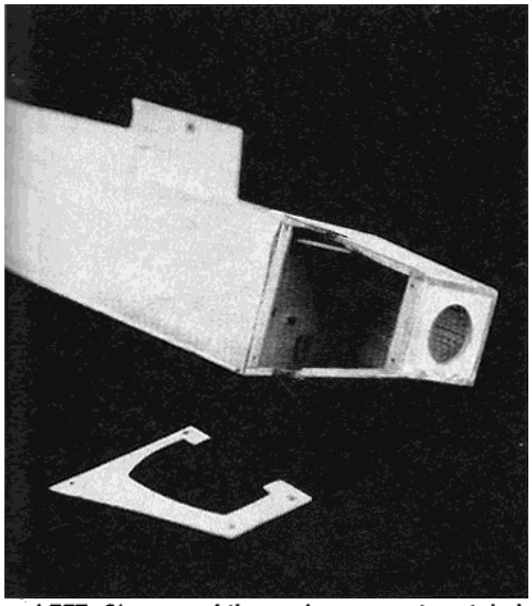
By Paul Denson

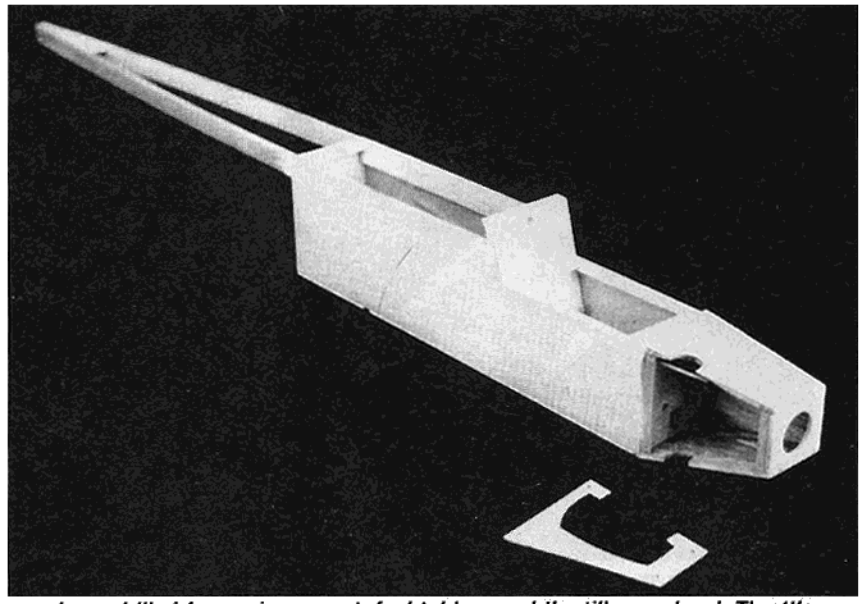
As-ter'-ion (Gk *Asterismos* Constellation - *Aster* a Star) Asterion is a star in the constellation Canes Venatici. According to Greek mythology, Canes Venatici, the two hunting dogs are held on leash by Bootes, who is the son of Jupiter and Callisto. The dogs are in pursuit of the great bear, Ursa Major.

Asterion was designed as a .20 4-stroke version of its big brother the Square Rigger (RCM June '83). With the growing popularity of the 4-stroke engines, we decided to build the plane around the O.S. FS-.20 4-stroke engine. It has also been flown with the K&B Sportster .20, the O.S. .20 FP, and the O.S. Max .25 FSR. The latter three engines are 2-strokes.

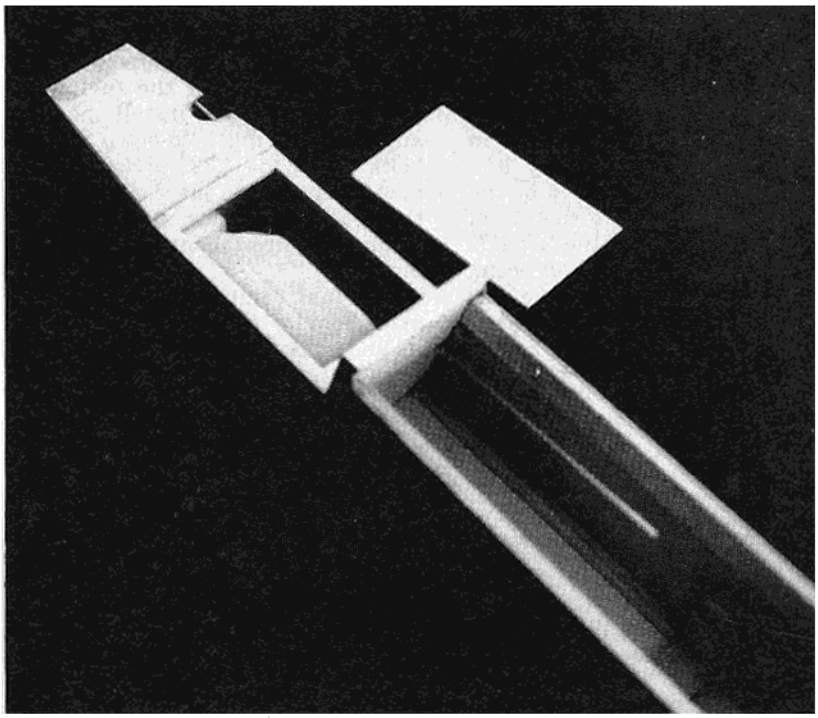
ASTERION
Designed By:
Paul F. Denson
TYPE AIRCRAFT
Sport — Aileron Trainer
WINGSPAN
53 Inches
WING CHORD
8½ Inches
TOTAL WING AREA
454 Sq. In.
WING LOCATION
High Wing
AIRFOIL
Clark Y
WING PLANFORM
Constant Chord
DIHEDRAL EACH TIP
1⅛ Inches
OVERALL FUSELAGE LENGTH
36¼ Inches
RADIO COMPARTMENT SIZE
(L) 9" x (W) 2¼" x (H) 3"
STABILIZER SPAN
18 Inches
STABILIZER CHORD (incl. elev.)
5½ Inches (Avg.)
STABILIZER AREA
99 Sq. In.
STAB AIRFOIL SECTION
Flat
STABILIZER LOCATION
Top of Fuselage
VERTICAL FIN HEIGHT
6.0 Inches
VERTICAL FIN WIDTH (incl. rud.)
4½ Inches (Avg.)
REC. ENGINE SIZE
.20-.26 4-stroke/.20-.25 2-stroke
FUEL TANK SIZE
6 Oz.
LANDING GEAR
Tricycle
REC. NO. OF CHANNELS
4
CONTROL FUNCTIONS
Rud./Nose Gear, Elev., Throt., Ail.
BASIC MATERIALS USED IN CONSTRUCTION

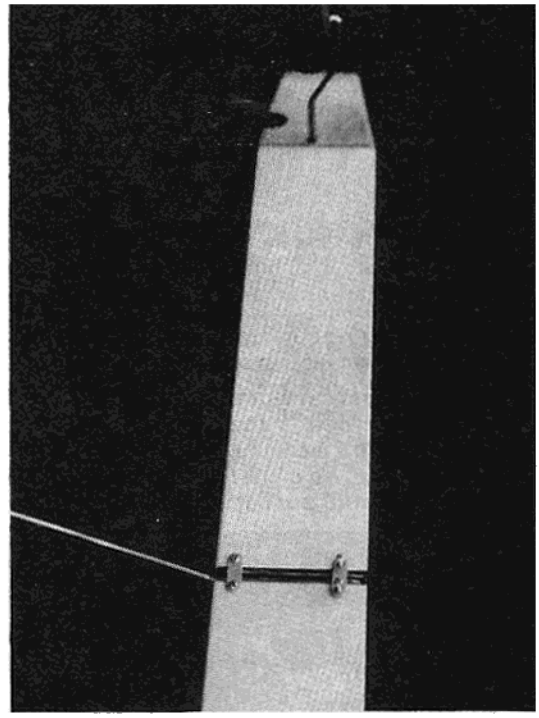
Fuselage	Balsa, Ply., Spruce
Wing	Balsa, Ply., Spruce
Empennage	Balsa, Spruce
Wt. Ready To Fly	55 Oz. (3 Lb. 7 Oz.)
Wing Loading	17.44 Oz./Sq. Ft.





LEFT: Close-up of the engine compartment, holes have been drilled for engine mount, fuel tubing, and the tiller pushrod. Throttle pushrod housing shown exiting from the upper corner of the firewall. Engine cover is shown in the foreground. RIGHT: Cut-outs shown in the top and bottom pieces of the cowl are for the choke pushrod of the O.S. FS-20 4-stroke engine. The plans were modified after the first prototype was built to include a small spacer between the booms at the empennage end so there would be room enough to tighten the bolts on the studs that bind the empennage to the fuselage.





LEFT: Overhead view of the fuselage shows the side mounted tank, the throttle pushrod housing, and the 1/4" landing gear trunion blocks. The fuel tank compartment hatch is shown to the right of the fuselage. RIGHT: The main landing gear is held in place on the fuselage with metal landing gear straps. The nose gear was bent from 1/8" music wire and does not have the coil spring associated with commercial gear.

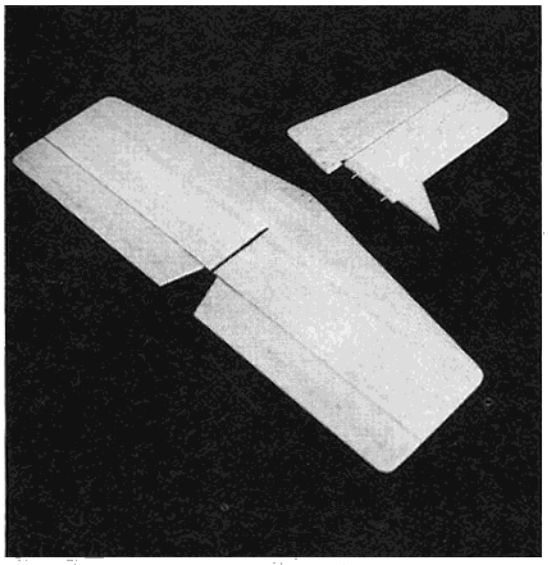
Originally, it was our intention to take a plane with us on extended vacation in our RV so the Asterion was designed to be taken down completely and to be reassembled with very little fuss. Space is at a premium in RV's and by the time we got around to finding room for the plane, there was absolutely no room for all the accessories so it was reluctantly deemed necessary to leave it all at home.

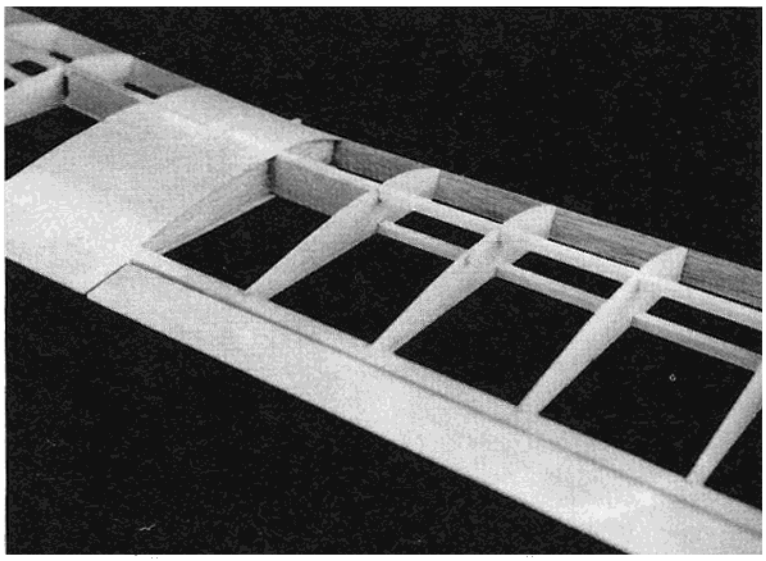
The Square Rigger was a plane that was easy to build and just as easy to fly. It was designed to be an aileron trainer. The Asterion has exactly the same function. It flies gently enough to be used as a trainer and builds just as easily. All of the parts for the fuselage were cut from stock and it was completely assembled in one afternoon. The wing is designed with strip ailerons which have the simplest type of hookup to the servos. The empennage is all sheet balsa. Other than some carpentry, the only real model airplane building is involved with the wing.

Construction

Fuselage:

The acquiring of odd dimension lumber for model airplanes used to be a problem. If the hobby shop didn't have it, you were stuck unless you happened to be a master carpenter. Today, the building supply house is





LEFT: The two studs located on the bottom of the fin pass through the ply triangle located between the booms. Two nuts and washers hold the empennage in place. The fin is epoxied into the slot cut in the stabilizer. RIGHT: Top center of finished wing, the center section is covered with 1/16" sheet balsa, the spars are 1/4" square spruce, and the webbing between the spars has not yet been added.

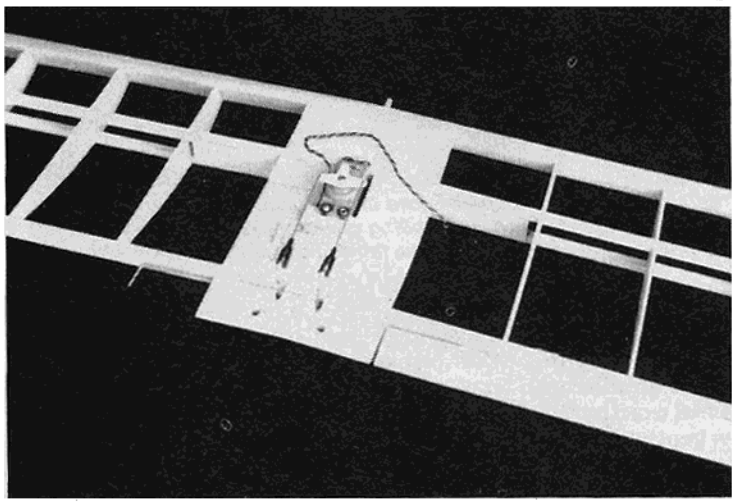
generally a rule rather than an exception in most cities and they will, if you ask nicely, make cuts in the lumber you purchase from them. If you or a friend have a powersaw, you are home free. The two booms are the only pieces the hobby shop will not have. We cut them from the edge of a 1" x 4" four feet long. We keep clear pine lumber in our shop because we cut all our longerons, stringers, and spars.

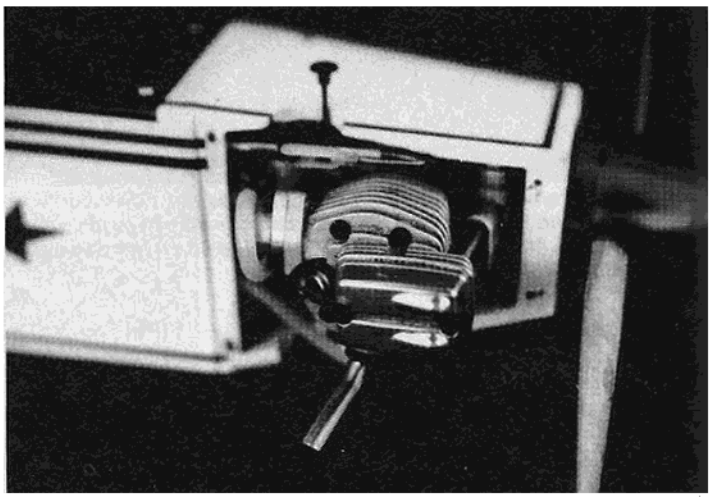
The two fuselage sides are cut from 1/32" aircraft ply. The left side extends from the trailing edge of the wing to the cowl ring. The right side runs from the TE of the wing to the front edge of the firewall. The right side of the engine compartment, from the firewall forward to the cowl ring, is covered with a piece of 1/32" ply which is removable. All of the formers except for the firewall are cut from 1/8" lite ply. The firewall is 3/16" aircraft ply. The bottom of the fuselage is made from two pieces of 1/8" lite ply.

Cover your plans with waxpaper or plastic kitchen wrap then pin one of the booms to the plans. Add the top and bottom 1/4" sq. balsa longerons. Glue all formers and the firewall in place, making sure they are perpendicular to the surface of the plans. Add former 1-A to the top of former-1. When dry, add the left side balsa longerons and the left side boom, glue in place. When the glue has completely cured, erect the fuselage over the top view of the plans. Fashion a tail post from a scrap of 1/4" square balsa then bring the tail ends of the booms together and cement in place. Add the 1/4" square spacer against the front surface of the rear bulkhead. Next, add the landing gear trunion blocks which you fashioned from 1/4" plywood (see A-A on the plans for details).

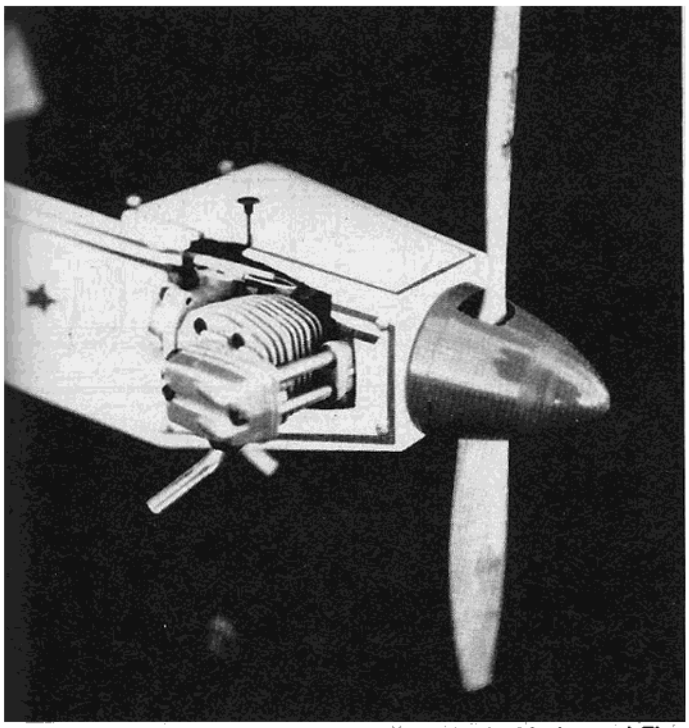
Turn the fuselage over and add the two 1/8" lite ply cross braces which support the ends of the fuel tank compartment hatch. Install the 1/4" aircraft ply wing hold-down anchor block. Now, the 1/32" plywood sides may be epoxied in place. Cut and fit the 3/8" triangular stock located behind the firewall and epoxy it in place.

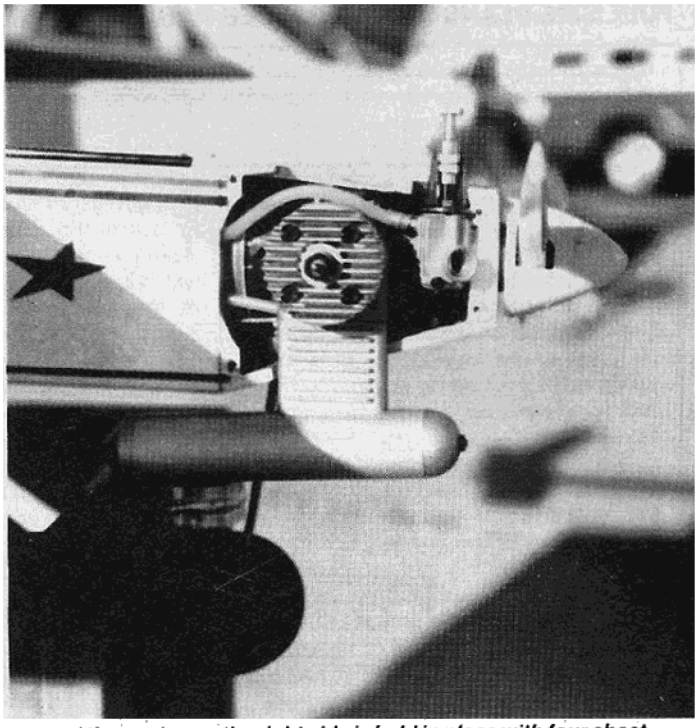
The fuel compartment hatch is made from 1/8" lite ply and has a lip on its underside which locates under the cross brace as shown on the plans. Two screws through the forward cross brace holds the hatch in place. Add the 1/8" lite ply triangular filler between the booms at the empennage end. Also at this time, glue the 1/8" lite ply





LEFT: The aileron servo is located in a cut-out in the bottom surface of the center section of the wing. Pushrods and clevises are run to a standard aileron horn set. One aileron is omitted to show the aileron horn. RIGHT: Between the O.S. FS-20 engine and the black choke pushrod, is located the throttle pushrod with the 180° bend. It goes forward past the throttle arm then doubles back on itself where the clevis makes contact.





LEFT: It takes a bit of cutting to get the engine inside the cowl. The plate around the engine on the right side is held in place with four sheet metal screws. RIGHT: Asterion with K&B Sportster .20 with one of the quietest mufflers we have ever used. Exhaust oil and gases are exited downward. With a short piece of plastic tubing and a clamp on the outlet, the plane hardly ever requires wiping down after a day of flying.

fuselage bottom pieces in place. Temporarily set the fuselage aside; the left side will stick out into space, but that is okay for now.

Empennage:

Cut all parts for the tail surfaces from 3/16" sheet balsa, glue the three parts of the stabilizer together over the plans. There should be a small part left from the boom material. Cut to shape and add this 3/16" x 1/2" piece to the bottom of the fin. Drill a 3/32" hole vertically through the pine and up into the balsa fin. Screw a long 4/40 machine screw up into this hole allowing it to stick out at the bottom approximately 3/8". Put a drop of CA on the threads where they enter the wood, then cut off the head of the machine screw. It is now a stud which will help hold the empennage to the booms.

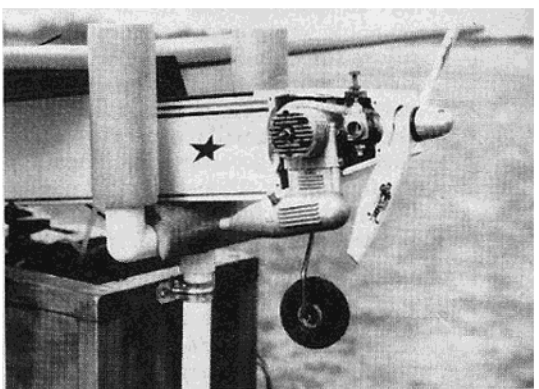
Wing:

If you have built a wing or two, you will find Asterion to be quite simple. Using the rib and tip plate guides on the plans, cut three templates from 1/32" aircraft ply (heavy cardboard or aluminum will work just as well). Do not cut the notches for the spars until you have cut all ribs from the proper stock. After cutting the ribs, they should be stacked and sanded. The patterns for the ribs on the plans were made by tracing around our templates. We attempted to account for the thickness of the line. It is suggested that after the ribs have been sanded to length they be placed in contact with the leading and trailing edge stock. If necessary, sand the surfaces of the ribs to match. Once this has been done, cut the spar notches in the templates, then cut the notches into all the ribs as necessary.

If you cannot find 3/8" x 1" aileron stock (we were unable to), you must fabricate this stock from standard sheet balsa. If you have a table saw, band saw or jig saw you can cut the stock from 3/8" x 1" sheet balsa. Otherwise it may be done with a plane, then a bit of sanding with a long sanding block to produce an acceptable set of ailerons. Pin the ailerons and the trailing edge stock together and sand them to match using a sanding block. The ribs are set into the front of the TE stock, therefore it is necessary to cut notches for the ribs. This is done with three layers of old hacksaw blades (see inset on plans). They are taped together with a piece of 1/8" square stock which acts as a depth gauge. The 3/32" ribs fit snugly into these notches.

Pin the bottom spars to the plans and temporarily put a few ribs in place in order to locate the position of the leading and trailing edges. Pin the LE and TE securely in place. Cut some 1/16" sheet to the proper length and cement the center section bottom sheeting in place for each wing half. The ribs are now placed in their proper position and glued in place with CA. **Note:** The two center ribs are not to be cemented at this time. Add the top spars and CA them in place. Glue and clamp the wing tips to the 3/16" outer wing ribs.

Leaving one wing half pinned to the board, elevate the other wing tip 2¼". Undoubtedly, the top spars will be too long for a proper fit. The ends of both top spars may have to be sanded so the leading and trailing edges will make tight contact. When all surfaces make good contact, epoxy the two halves together. (The center ribs are still unglued.) Assuming you have already cut out the two dihedral braces from 1/16" ply, prepare the aft one for insertion. Cut away 1/16" of each of the second ribs just behind the spar to



The O.S. Max .25 FSR makes the Asterion a screaming demon. To clear the corner of the fuselage, it was necessary to add an extension to the muffler. It is the center section of an aluminum turnbuckle. We enlarged the center with a rat-tail file so the longer muffler screws would pass clear. We left small pieces of the threaded sections in place to keep gases from escaping.

allow for the rear dihedral brace. Insert the dihedral brace into the openings you have just made and check the fit. It will rest on the bottom sheeting and goes up no higher than the top surface of the wing rib it passes through. The top sheeting will cover the dihedral braces. If everything fits, epoxy the dihedral brace to the back surfaces of both spars. When the epoxy has set up, remove the rib stock in front of the spars and insert the other dihedral brace. This will give you an extremely strong center section and glass tape will not be necessary. The two center ribs may be epoxied together at this time. When the epoxy sets up, cut the part of the rib forward of the spar to length and insert it between the leading edge and the dihedral brace. Do the same for the aft part of the wing. At this time, add the 1/16" top sheeting. This sheeting comes flush with the leading edge, the spars, and the trailing edge surfaces. Sand the whole wing carefully. Drill the hole for the wing hold-down dowel through the leading edge into the dihedral brace. Test the fit, but do not epoxy in place until the wing is covered.

Next, cut the opening in the center bottom sheeting for the aileron servo. We cemented pine strips at each end of the servo opening so that the screws will anchor into harder wood. Sand the trailing edge spar to match the wing ribs.

Cut the ailerons to length and sand the ends square. The excess material is to be used on the wing tips and in the center section. Cut the outboard sections to length and cement to the trailing edge spars. (All of the following is on the bottom of the wing, so turn it over.) Next, cut the center section to length and sand a slight bevel to the inboard ends. Put them in place against the trailing edge spar and check that they fair into the trailing edge. Using a rat tail file, cut grooves in both the trailing edge spar and the center aileron filler so the uprights of the aileron torque wires can move freely back and forth. Next, cut a round groove in the front surface of the aileron center filler for the aileron torque wires and the tubing in which they rotate.

Now is the time to check for fit. Lay the torque wires in place on the trailing edge spar with the uprights in the notches. Place the center filler in place over the torque wires and secure with masking tape. Move the uprights back and forth checking the up and down movement of the outer ends of the wire. If everything moves freely, the pieces may be epoxied in place. Be

very careful that you do not get any epoxy on the torque wires. As soon as the epoxy has set up, check carefully for movement. Bevel the front surface of each aileron, cut slots for hinges, and drill a hole for the outer end of the aileron torque wire. Put the ailerons in position and check the movement. If everything is okay, the pushrods and clevises may be measured, cut, and connected between the servo and the aileron horn fittings.

Clean-up:

If we remember correctly, we left you with the sides on the fuselage, one terminating at the firewall and the other one flapping in the breeze out ahead of the firewall. Let's start working on what goes in front of the firewall. If your engine mount does not have a hole for the nose gear (when mounted 90°) it will be necessary to drill it. Whether you use a standard front nose gear wire, or a straight wire (as we used), it makes no difference. Using blind mounting nuts, attach the engine mount to the firewall. Slide the landing gear wire through the tiller, then through the bottom half of the engine mount, up through a wheel collar and into the hole in the top half of the engine mount. Tighten all set screws. Using the tiller as a guide, drill the hole in the firewall for the steering pushrod. Place the engine on the mount and check to see that a prop and spinner will clear the end of the portion of the side that extends in front of the firewall. Drill holes for the engine in the engine mount.

Using 1/8" balsa and 1/32" ply laminated together, make the bottom, top, and one side of the cowl. Form up the three sides of the engine cowl around the cowl ring. Cement this in place, sand, then try to fit the engine in place. Try, we say, because without a bit of cutting it will not fit. The top of the cowl and the bottom will have to be partially cut away to allow clearance for the needle valve and choke mechanism. We used our Dremel tool and a sanding sleeve to cut this material away.

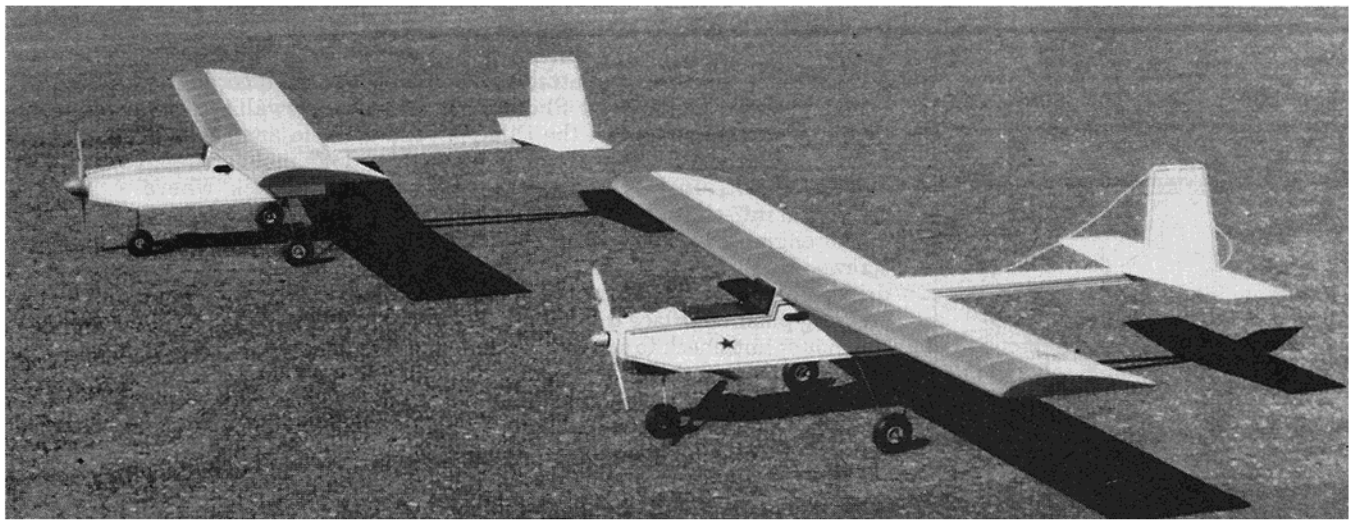
The prop shaft should now pass through the cowl ring and the engine should fit in place on the engine mount. At this time holes should be drilled in the firewall for passage of the throttle pushrod and the tubing from the fuel tank.

Before we go too much further in engine installation, you should give consideration to tank placement. We used a Sullivan 6 oz. slant tank and, because of the size of the fuel tank compartment, we had to mount it on its side. This makes bending the brass fuel lines slightly complicated, but otherwise it works out well.

For the throttle pushrod to properly pick up the throttle arm on the engine, the pushrod would have to run outside the fuselage. We drilled the hole for the pushrod in the upper right corner (from the cockpit) of the firewall. The pushrod runs forward from the servo along the right corner of the fuselage, exits the firewall and passes alongside the throttle arm. It goes on forward about 1½", makes a 180° turn upward and comes back where a clevis is screwed on and, in turn, fastens to the throttle arm. Look at the photo which shows this connection and it becomes very simple. This reverse connection gives you a lot of leeway in close places such as here and on the front wheel tiller arm.

The engine should fit into the compartment with no problems. Cut the cheek cowl from 1/32" ply using the template on the plans. It should fit around your engine, but, if it doesn't, a bit of trimming may be necessary. We added small hardwood strips front and back along this side of the engine compartment as anchors for the small 2 x 1/2" sheet metal screws that hold the cheek cowl in place.

Put the 3/16" dowel in place in the



center of the wing. Do not glue. Put strips of balsa the thickness of your chosen wing mounting tape along the top of the fuselage. Place the wing on top of the fuselage and mark where the dowel contacts the back of former 1-A. Remove the wing and drill a small pilot hole from this dot forward. From the front, drill a 3/16" hole. Enlarge this hole slightly with a rat tail file then push the dowel through the hole and see how the wing seats atop the fuselage. File out the hole as necessary so the wing fits flat on the balsa shims. Drill small holes down through the trailing edge of the wing in such a way that they penetrate the 1/4" ply wing hold-down anchor and have plenty of wood surrounding the hole. Drill out the holes in the wing anchor with a #7 drill, then thread the holes with a 1/4-20 tap.

The holes in the trailing edge of the wing should be enlarged to 1/4". While you are at this point, remove the pushrods from the aileron horns then check the movement of the ailerons. You may find it necessary to remove a small amount from the leading edge of the wing hold-down block for maximum movement of the ailerons.

Put the fuselage bottom up on your workbench and insert the landing gear wires you bent from 1/8" music wire into the holes in the trunion blocks. Push them down until they lie flat in the groove you left between the two pieces of bottom sheeting. You will need two flat metal (or nylon) landing gear anchor straps and four #2 x 1/2" sheet metal screws to keep the landing gear in place.

To keep the pushrod housings from showing when looking at the plane from the side, we ran them back to the empennage between the tail booms. The housings are cemented to the inside of the rear bulkhead and to the tail booms near where the inner pushrods exit. When the fuselage was painted, the pushrod housings were painted the same color and they do not show up at all. Slots, as seen on the plans, were cut from the bottom surface of the booms and the pushrod wires exit through these slots. The front pushrod wires were angled down a bit so they would arrive at the servo parallel to the servo tabs.

Flying:

The Asterion was designed for use with the O.S. FS-20 4-stroke engine; even so, we wanted to give some of our other .20 and .25 engines a chance for comparison and evaluation. We actually found relatively little difference between the .20's. Every one of them would make great engines for the relative newcomer to use in aileron planes. They will pull the Asterion through maneuvers such as the loop, roll, Split-S, and Immelmann. It is very easy to fly inverted with any of the .20 engines. Overall, we enjoyed the .20 4-stroke best for the minimum of noise and stinginess on fuel.

The O.S. Max .25 FSR is radically different. If you are well in control of your flying ability and want something with a lot of zip then try an Asterion with a .25 engne. WOW . . . on full throttle, you have a mean machine. Oh! does it go. We do not consider ourselves to be pattern fliers so we do not have the ability to put a plane through a full range of maneuvers but this plane gives us our Sunday Flyer thrill for the day.

Whether you are an expert or a novice fairly well along into ailerons, the Asterion is the plane for you. We have had a ball flying this peppy little plane and we have really enjoyed the simplicity of building it. It is extremely easy to take the plane down so it will fit into a small space and just as easy to reassemble it when you arrive at the field. A great plane for everyone but especially for the apartment dwellers, those of you who live in mobile home parks, and, if you can find the room for the accessories, a great one to take on vacation in your RV, motorhome, or trailer. We hope you enjoy your Asterion as much as we have ours. □

From RCModeler Dec. 1990