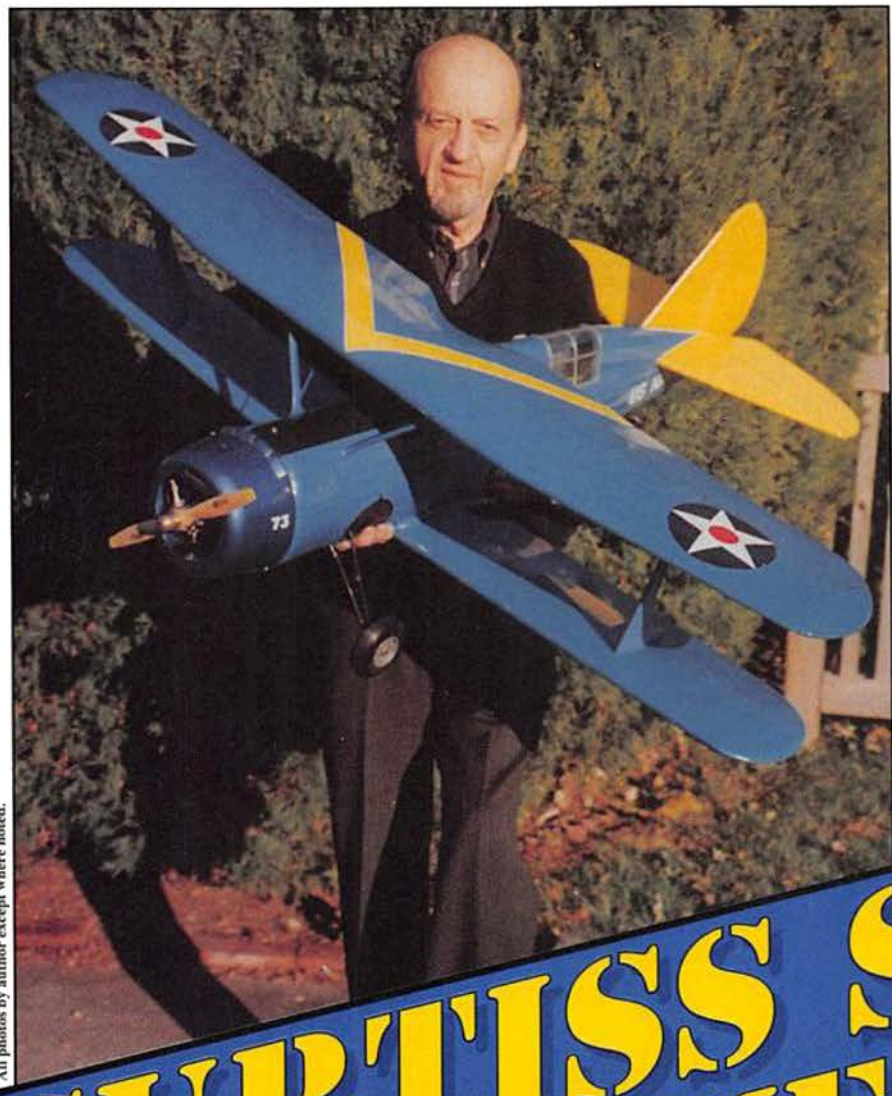
A Classic 30's Biplane

By Albert Isaacson



All photos by author except where noted.

My Dreams Took Wing

After paying off the mortgage and funding your children's education, what did you do? What I did was to fulfill a dream I've had for 50 years.

In 1941, at the age of nineteen, I bought a very expensive kit made by Cleveland. It was a Curtiss SBC-4 Helldiver, rubber powered, with a span of 25-1/4". The wheels retracted up into the fuselage, and its pretend 500 lb. bomb swung down from under the belly on a trapeze.

My inquisitive younger brother was 10 years old at the time, so I could not leave it in our apartment in 1943 when I entered military service. For safekeeping, I hung it in the front window of my parents' store. Two months later, my mother wrote to me in Mississippi, to tell me that someone had thrown a brick through our 8' plate glass window and had stolen

CURTISS SBC-4 HELLDIVER

Photo taken in 1942 of my original SBC-4 model built from Cleveland kit.

CURTISS SBC-4 HELLDIVER

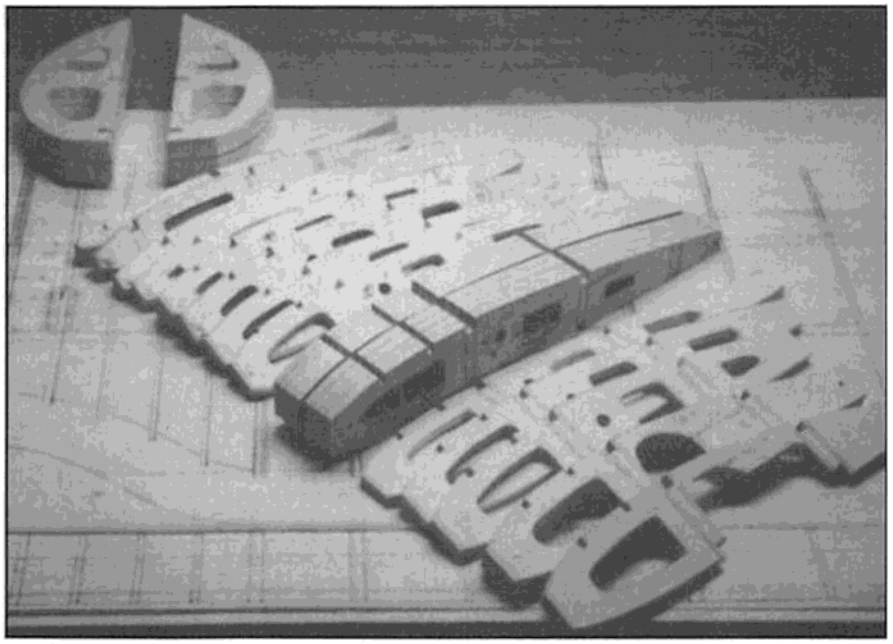
Designed by:
Albert Isaacson
TYPE AIRCRAFT
Sport Scale
WINGSPAN
55-1/2 Inches
WING CHORD
10-3/8 Inches
TOTAL WING AREA
910 Sq. In.
WING LOCATION
Biplane
AIRFOIL
Flat Bottom
WING PLANFORM
Top: Double Taper
Bottom: Constant Chord
DIHEDRAL, EACH TIP
Top: 0" — Bottom: 1-3/4"
OVERALL FUSELAGE LENGTH
43-1/4 Inches
RADIO COMPARTMENT SIZE
Ample
STABILIZER SPAN
23-1/4 Inches
STABILIZER CHORD (inc. elev.)
7-1/4" (Avg.)
STABILIZER AREA
170 Sq. In.
STAB AIRFOIL SECTION
Symmetrical
STABILIZER LOCATION
Top of Fuselage
VERTICAL FIN HEIGHT
10 Inches
VERTICAL FIN WIDTH (inc. rud.)
8-1/2" (Avg.)
REC. ENGINE SIZE
.46 2-stroke
FUEL TANK SIZE
10 Oz.
LANDING GEAR
Conventional
REC. NO. OF CHANNELS
4
CONTROL FUNCTIONS
Rud., Elev., Throt., Ail.
C.G. (from L.E.)
4-5/8"-4-3/4" from L.E. of Top Wing
ELEVATOR THROWS
1" up — 1" down
AILERON THROWS
3/4" up — 3/4" down
RUDDER THROWS
1-3/4" left — 1-3/4" right
SIDETHRUST
1° right
DOWNTHRUST/UPTHRUST
1-1/2° down
BASIC MATERIALS USED IN CONSTRUCTION
Fuselage ..... Balsa, Ply, & Spruce
Wing ..... Balsa, Ply, & Spruce
Empennage ..... Balsa & Ply
Wt. Ready To Fly .138 Oz. (8 Lbs. 10 Oz.)
Wing Loading ..... 21.8 Oz./Sq. Ft.

nothing but my airplane, leaving me with only a few photos and memories. I vowed that someday I would build another.

In 1980, still dreaming about my stolen Helldiver, I wrote to Cleveland Models for a set of plans and put them away in my basement. Ten years later, when I started the process of retiring from business, I began planning for a radio controlled version of the Helldiver. I had the plans enlarged to twice their size, but I then changed the wings chord-wise and in span by adding 4-1/2" to the top wing and 4" to the bottom wing; and, in addition, by adding 7% to the size of the tail surfaces.

All the bottom wing ribs are alike so I rough cut and stacked them. The rib plan was photocopied and rubber cemented to the pile. They were all pinned together with 3/16" dowels and cut out and notched with a fine toothed blade in my band saw. The lightening cutouts were done on my table

Bottom wing ribs after cutting. Stacked and pinned together with dowels.



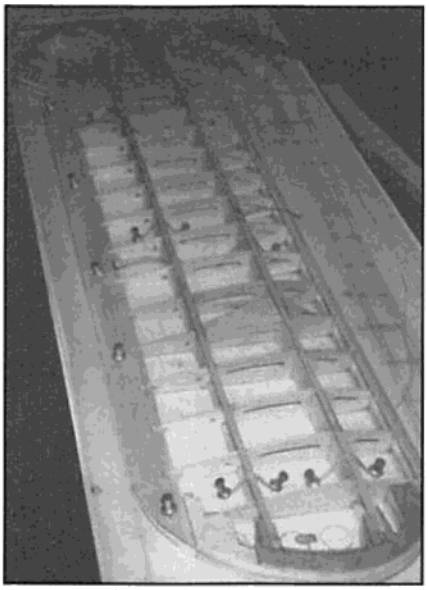
Rubber cement joins paired ribs. Photocopied plan paper peeled off after cutting.

jig saw. After all the cutting was done, the paper was easily peeled off

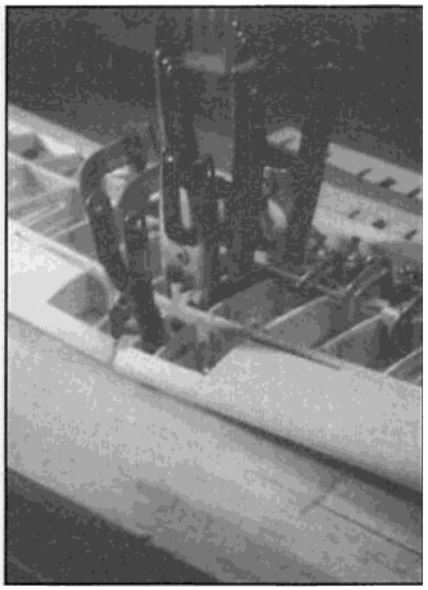
CONSTRUCTION

Bottom Wing:

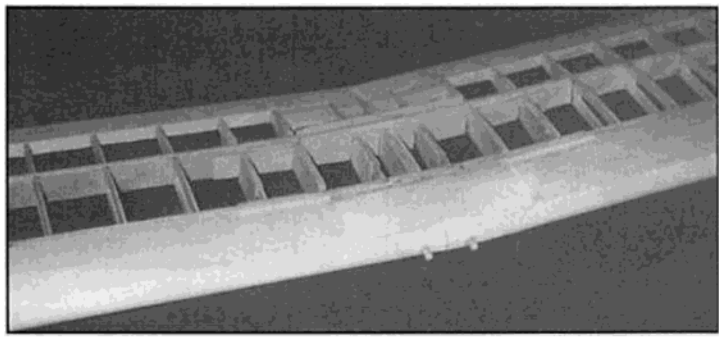
The 52" bottom wing was built on the plan in the conventional way, in two halves. The root ribs are laminates of 1/16" balsa between two pieces of 1/32" ply. The third rib on each wing half has a 3/32" balsa core and 1/16" ply on each side. All other ribs are 3/32" balsa, except those on both sides of the interplane struts which are 1/8" balsa. The front spar is 3/16" spruce top and bottom, while the rear spar is 3/16" sq. balsa, and both have 1/16" balsa webs on each side extending out one rib past the interplane strut anchor points. Wing halves were placed on a flat surface with 1-3/4" blocks under the tip ribs for the proper dihedral. Root ribs were cemented in, using a square to be sure they were vertical. When set, I brought the two halves together and

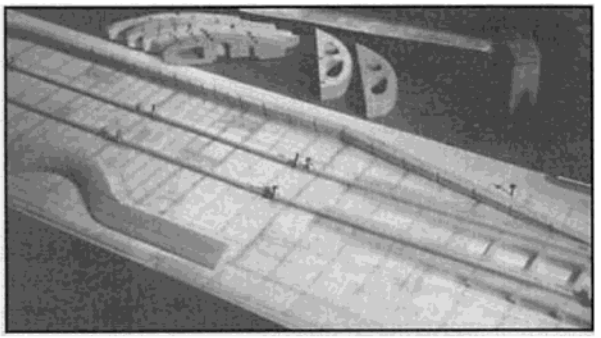


Right half of bottom wing being constructed on plan.

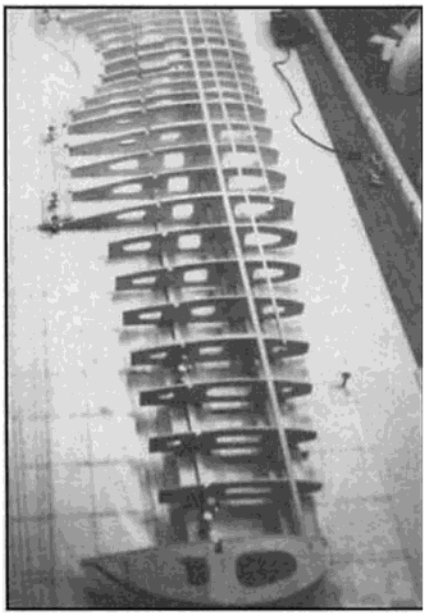


Bottom wing, propped up for dihedral and being joined at root ribs.

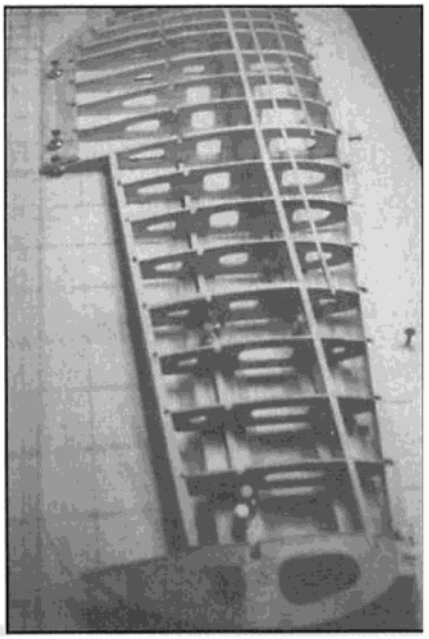




LEFT: Leading edge dowels, and at trailing edge, pine blocks for hold-down bolts. RIGHT: Shimmed 1" wide ramps give outer third of top wing 5/8" dihedral.



Rear spar shimmed at tip ends to provide washout to top wing.



Leading edge and aileron spar installed.

glued and clamped them until dry. I then installed the 1/8" ply doublers on each side of each spar. It was necessary to trim several of the center section ribs where they met the spars to permit the doubler to slip fully into place. I sheeted the top front from the leading edge to the front spar and out to the second rib from the tip.

Two 3/16" dowels were installed through the leading edge, leaving 1/4" protruding. The rear of the dowels was extended back into the front spar. I soaked both with thin CA. In front of the trailing edge between the root ribs and the third ribs are pine blocks which I drilled for the 1/4-20 nylon hold-down bolts.

Top Wing:

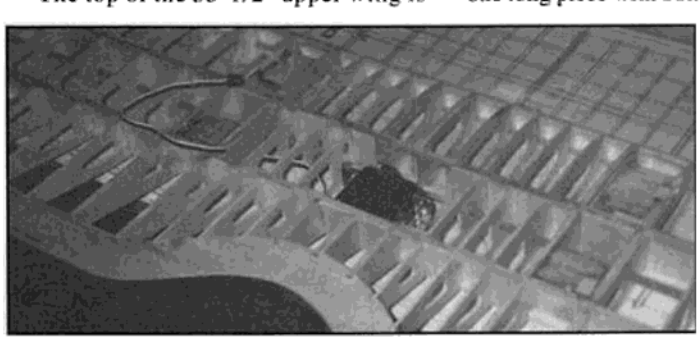
The top of the 55-1/2" upper wing is straight, as is the bottom of the center section. The underside of each outer third of the top wing has a 5/8" dihedral. I was able to pair up the roughly cut matching left and right side ribs. Once they were paired, I again rubber cemented the rib plan to each stack and cut them on the line as I had done with the bottom wing ribs. To get the 5/8" dihedral, four ramps, each 1" wide, were built on the plan over the spars and shimmed to raise the end ribs by that amount. Rib locations were transferred by setting a square on the plan and marking the position for each one on the ramps. Both spars are 3/16" sq. spruce top and bottom.

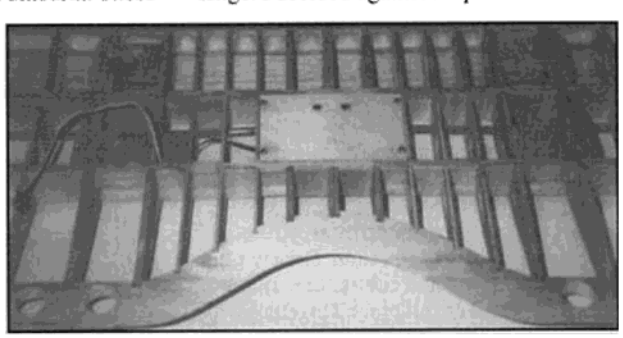
I joined together the three pieces I needed for the bottom of each spar, making one long piece with built-in dihedral. These were then pinned to the table and ramps, then I glued the ribs on, taking care to keep them all perfectly vertical. At this point, the ends of the rear spar were shimmed up to give approximately 1-1/2° of washout. After splicing the top 3/16" spruce spars to get the length needed, it was cemented in place. The leading edge, trailing edge, aileron spars, and wingtips were then added. The spars were webbed with 1/16" balsa on both sides to just past the interplane anchor point at rib #13, and on alternate sides from there on out. This wing was also sheeted from the leading edge to the front spar. The Futaba aileron servo was installed, lying on its side, in the center section opening, on brackets bent from 1/16" aluminum.

Now the servo access panel was cut and fitted and the cabane mounting blocks drilled. Sullivan Gold-N-Rods were fed through holes drilled in the ribs before the wing was completed. They were attached to the bellcranks installed between ribs #12 and #13, and aligned with the center of each aileron. Between ribs #6 and #7 are the laminated pine block attachment points for the tops of the cabane struts. The interplane struts are a five layer affair with a 1/16" ply core sandwiched between two 1/32" plys and then topped on each side with 1/8" balsa. They were then sanded to an airfoil shape. Mounting brackets were fashioned from 1/16" aluminum that slip into slots in the ply center core at the ends of each strut and were locked in place with CA and toothpick dowels. The bottom brackets have tabs that fit into grooves left between the anchor block and rib #13 to keep the strut from twisting. There are additional tabs at right angles drilled for 4-40 machine screws that go through the wing anchor blocks to blind nuts.

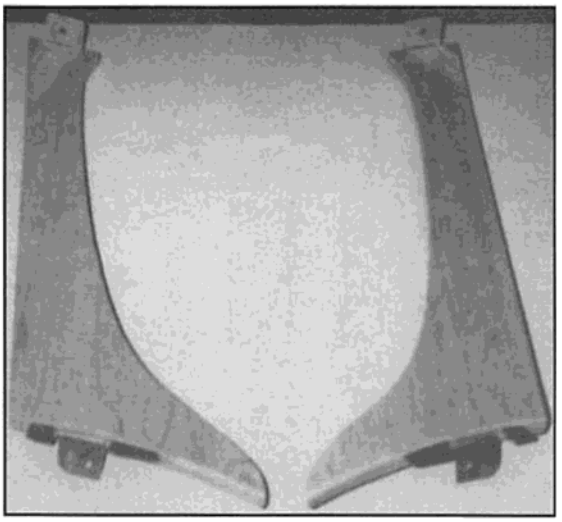
Fuselage:

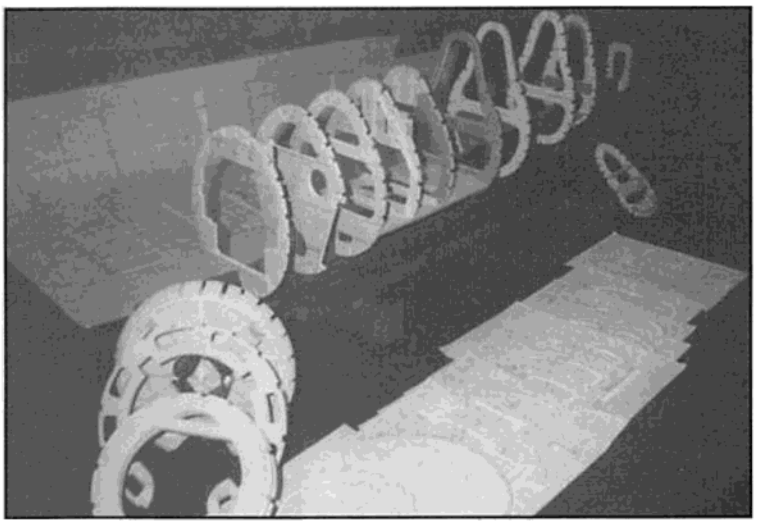
The assembly of the fuselage was a challenge. I decided against a square box center



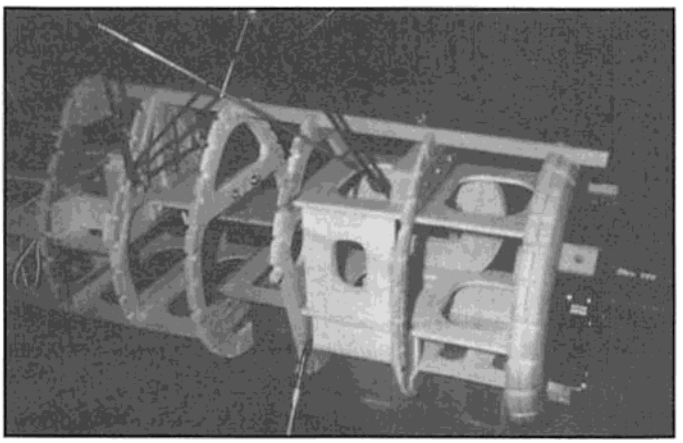


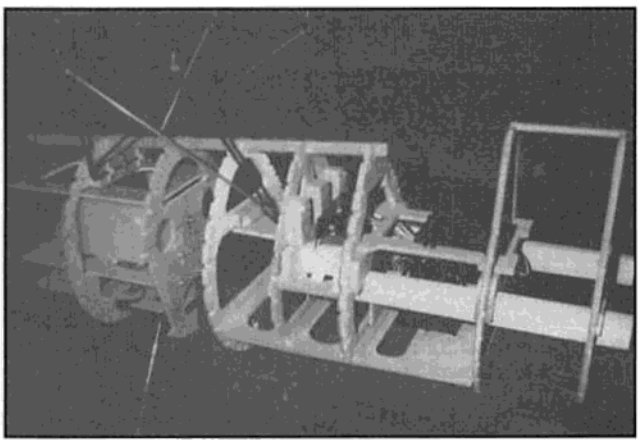
LEFT: Bottom of top wing with cabane support blocks installed. Aileron servo mounted flat. RIGHT: 1/32" ply cover for access to aileron servo. Note lightening holes in trailing edge.





LEFT: Interplane struts before sanding to airfoil shape. Aluminum tabs attach to wings. RIGHT: Formers test fit to 1/4" lattice. Battery and fuel tank platforms lie on flat areas.



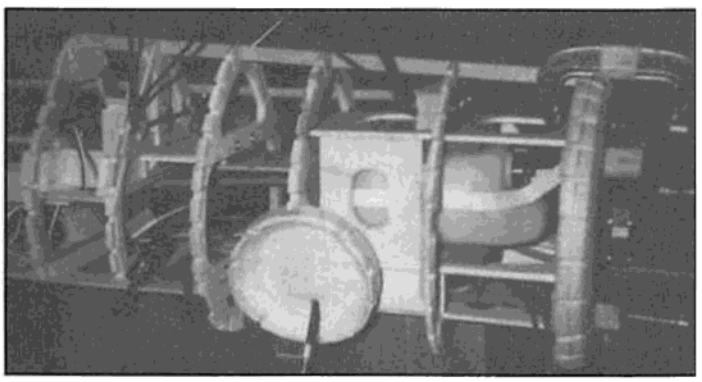


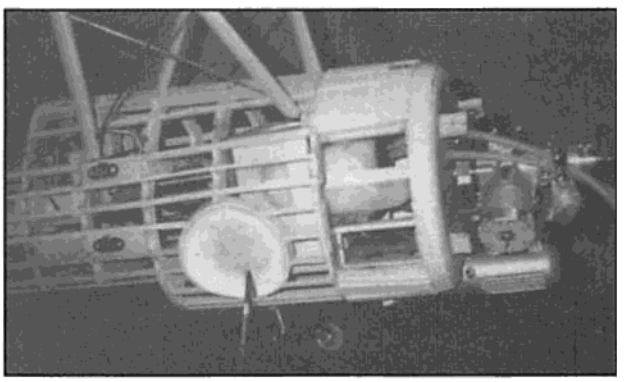
LEFT: Spruce stringers tie fire wall to first five formers. RIGHT: Two 1/4" x 1/2" balsa blocks added for stiffening. Rudder and elevator servos in cockpit area with radio receiver just forward. Cabane and landing gear mounting bolts shown here.

structure around which to mount the formers and, instead, I used a 1/4" x 5" piece of pine lattice, 40" long, to which I had laminated two strips of 1/16" ply. The location of each former was drawn on the plywood, and then this lattice/ply structure was notched to the exact width and depth needed to hold each of the formers upright and in perfect alignment. Once the base was added to the lattice so that it would stand on its own, the formers were inserted in the cutouts, and the platforms for the fuel tank, battery, servos, and wing area were glued in place. These platforms were all cut from 1/8" ply with large cutouts to lighten them. After the addition of some spruce stringers at key locations, the rest was relatively easy. Two 1/4" x 1/2" balsa sticks were added, running along the inside between formers 4A and 6A to resist any twisting movement of the fuselage. Scrap balsa blocks were added to the sides of the fuel tank compartment for strength and to support the tank cushioning material. In the area between the fire wall and the first former, I fitted a removable panel, held in place by two 1/2"-#2 screws which gives me access to both the tank and the battery should it be necessary. To make it easier to pull the tank out, I taped a 1/2" wide ribbon around the tank and left the ends hanging free.

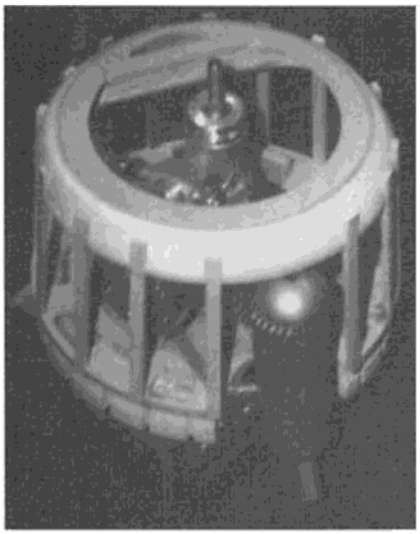
The radio receiver sits just forward of the rudder and elevator servos and is accessible through the front cockpit. The cockpit frames were fashioned from K&S brass and acetate sheet. The right side of the fuselage above the lower wing has external receptacles for the top wing servo plug and the recharging plug. The on-off switch is at the same location.

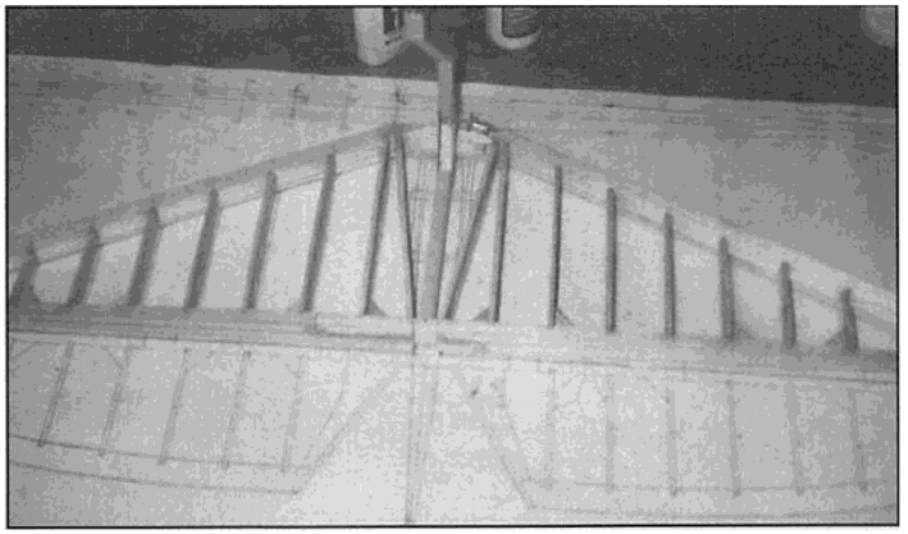
The landing gear is bent from 5/32" music wire and is partially covered with K&S brass tubing to build up its thickness. I slipped 3/16", 1/4", and 5/16" tubing over the wire and bent and drilled the ends of the 5/16" tubing for the axles to accept the



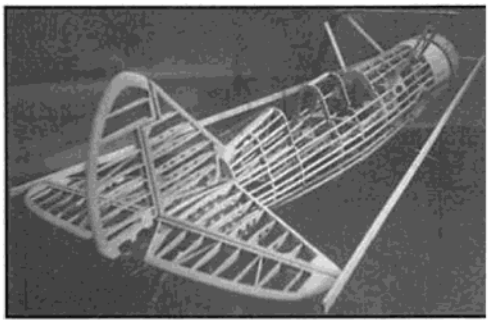


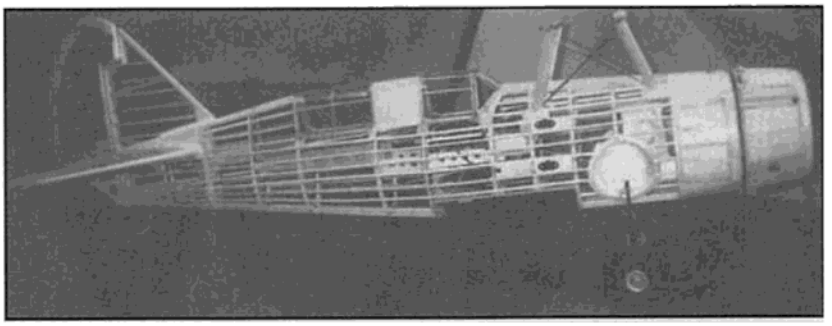
LEFT: Balsa filler blocks added to sides of tank compartment for dummy wheel recess. 1/2" wide ribbon around tank aids removal of tank if necessary. RIGHT: Push-pull on-off switch, aileron, and recharge receptacles are on right side. Battery and tank compartment hatch is shown.





LEFT: Cowl framed up showing exit air holes in rear and balsa/spruce stringers. Brass sleeve soldered to needle valve permits adjustments through hole in finished cowl. RIGHT: Horizontal stabilizer built on plan.





LEFT: Completed tail being mounted to fuselage. Measuring sticks are used to square assembly. RIGHT: Tail fairings are scrap balsa and Lite Spackle.

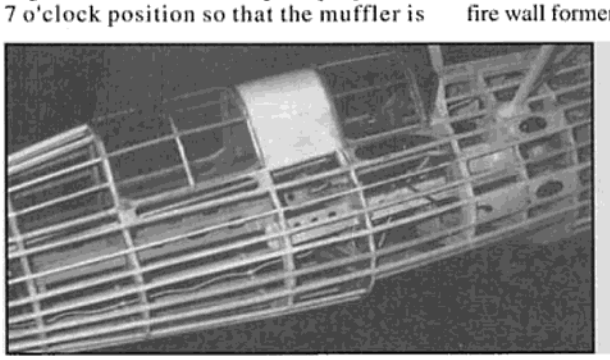
3-1/2" Skylite wheels. Attached to former 3A is the round depression that gives the appearance that it would house the wheel if it could be retracted. The cabanes are 1/8" music wire shrouded with balsa which has been sanded to an airfoil shape. The diagonal cross bracing is 1/16" music wire. The top of each cabane end slips into a hole in the hardwood blocks mounted in the underside of the top wing. Each of the cabane ends also has an altered Fahnstock clip soldered to it, that is then screwed into the same hardwood blocks.

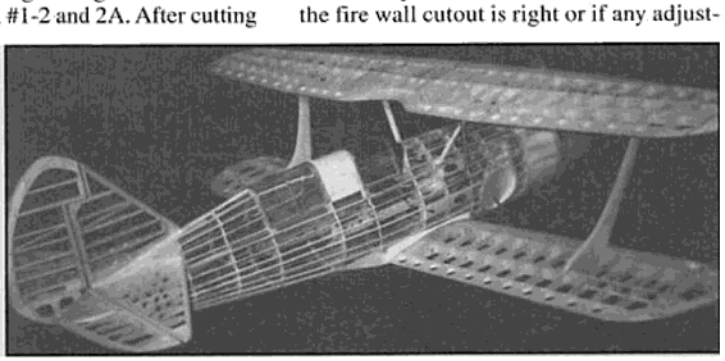
The cowling was made up of ply laminates at the rear, and ply and balsa at the front, with spruce and balsa stringers around the perimeter. Spaces between stringers were filled with 1/8" balsa sheet and the entire structure was sanded smooth. The engine is canted with the glow plug at the 7 o'clock position so that the muffler is almost completely hidden on the underside of the cowling and fuselage fire wall area. There are access holes for the hot shot starter and for needle valve adjustments. There are also four hardwood cowl support brackets with 4-40 blind nuts which receive the four screws installed in the cowling. These brackets were glued into slots cut through the entire fire wall.

My power choice was the Royal Long Stroke .46. It is not overpowering, but it does an adequate job. If you choose some other engine, you may have to increase or decrease the front to back depth of the cowl, which should not be difficult to do. You must leave at least a 1/8" clearance behind the prop. In order to provide additional exits for air leaving the cowl, install four opened cowl flaps at the top rear.

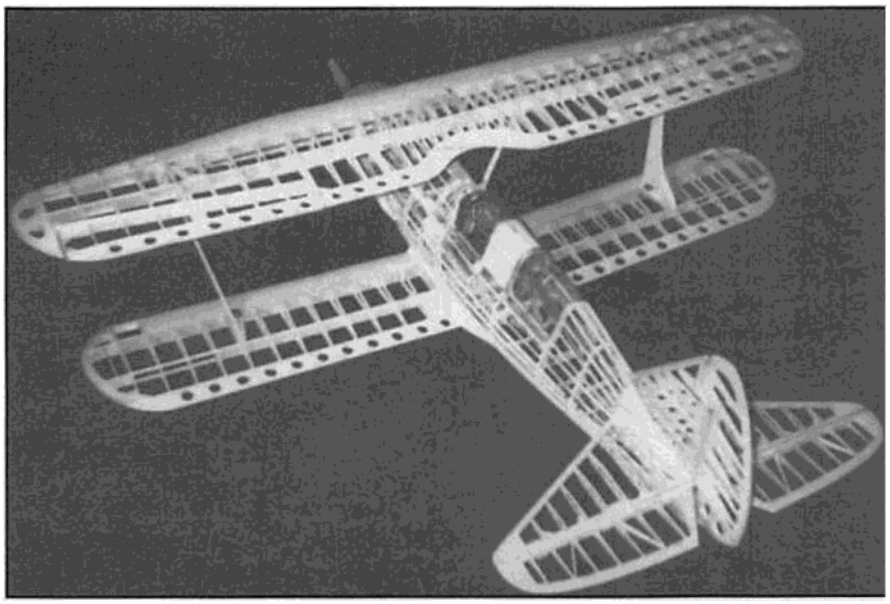
Assemble and glue together the three fire wall formers, #1-2 and 2A. After cutting out the four 1/4" x 5/8" slots for the cowl mounting blocks, glue the 1-1/8" long spruce blocks in place. Attach the engine to the engine mount and position it on the fire wall so that the muffler will be at the 6 o'clock location. With the fire wall (engine lightly attached) lying horizontally on a level table, take **several** very careful measurements using a square and ruler to find the exact dead center of the prop shaft in relation to the fire wall. Mark the fire wall for the location of the four holes you will need to drill to attach the engine mount. 4-40 blind nuts will be installed on the backside of the fire wall. Install small washers on the 4-40 screws between the engine mount and the fire wall to act as shims to give the needed side and down thrust. You may need several attempts to get this right.

Now try the muffler and check to see if the fire wall cutout is right or if any adjust-





LEFT: Cockpit frames are K&S brass with acetate sheet windows. RIGHT: All assembled before covering to check angle of incidence for each wing.



A pretty picture from this angle. As can be seen here, I made use of many lightening holes.

ment is necessary. You do want at least a 1/8" airspace between muffler and wood. Fill any opening in underside of fuselage with scrap balsa.

It is recommended that the center of the fuel tank be at about the center of the needle valve. Mine is higher but it works fine. The tank floor panel can be lowered by about 1/4" by making the necessary changes on former #2A, #3, and #3A.

My model required the addition of about six ounces of lead to the cowl to bring the C.G. to 4-3/4" back from the leading edge of the top wing.

Tail:

The horizontal stabilizer and the vertical fin were built on the plans and joined together to make a solid unit before being attached to the fuselage. Scrap balsa was used for the fairing between the tail and fuselage and UGL 222 Lite Spackling paste filled in minor depressions. Rudder and elevator pushrods are 3/16" dia. dowels. The tail wheel wire is mounted to former #8 and has a nose wheel steering arm attached to it. Each end of the arm is connected to a 3/16" x 1" stiff spring that holds the wheel centered but permits it to pivot as the airplane turns on the ground. The stabilizer is set at 0° incidence.

Additional Details:

To mate the lower wing to the fuselage, I made up a balsa filler strip 3/8" wide for each side of the fuselage recess. These strips were then shaped to conform to the camber of the top of the wing. After the bottom wing was at 2-1/4" positive incidence, I made up fairing of scrap balsa and UGL 222 Lite Spackle. The 3/16" leading edge dowels in the bottom wing were inserted into holes in former #4, and the trailing edge was held in place by nylon bolts that screw into CA hardened pine blocks tapped for the 1/4-20 threads. Some shaving of the forward cabane mounting blocks had to be done to drop the leading edge of the top wing a bit to give it 0° incidence.

Coverite's 21st Century fabric in light blue was used on the entire structure, except for the underside of the top wing which is dark blue and the tail which is all yellow. I hadn't covered a round fuselage in 50 years but it turned out very well. The Coverite was easy to work with and it shrank nicely. The wheel wells and the top of the fuselage from the windscreen to the cowl were sprayed with Krylon Flat Black Enamel. I used Top Flite Insignia Blue spray for the cowling and Sky Blue for the cabane and interplane struts.

Conclusion:

It was worth waiting 50 years to see the realization of my dreams. In 1991, I began drawing my own plans, more than twice the size of the original and of necessity, I changed everything on them in order to accommodate all the components needed to fly an R/C airplane. This was the start of a project that took more than 3-1/2 years to complete. I had never before attempted drawing plans and, in the early stages, I had some doubt about the outcome of the project.

Around this time I stopped by to see Ray

Materials List

Note: All balsa medium hard

Spruce

1 — 1/16" x 1/8" x 36"
4 — 1/8" sq. x 48"
6 — 3/16" sq. x 48"
1 — 1/4" sq. x 36"
1 — 1/8" x 1/2" x 48"
1 — 1/4" x 3/8" x 36"

Balsa

4 — 1/8" sq. x 48"
20 — 3/16" sq. x 48"
4 — 1/8" x 1/4" x 48"
4 — 1/8" x 3/8" x 48"
1 — 1/4" sq. x 48"
7 — 1/4" x 3/4" x 48"
1 — 5/16" x 3/4" x 48"
4 — 3/8" x 3/4" x 48"
4 — 5/16" x 1-1/4" x 36" (trailing edge)

Balsa Sheets

4 — 1/32" x 4" x 36"
4 —1/16" x 4" x 36"
8 — 3/32" x 4" x 36"
6 — 1/8" x 6" x 36"
2 — 1/4" x 6" x 36"

Birch Aircraft Grade Plywood

1 — 1/32" x 12" x 48"; and 1 — 1/32" x 6" x 48"
1 — 1/16" x 12" x 48"
1 — 1/8" x 12" x 12"-5 ply
1 — 1/4" x 12" x 12"-5 ply

Goldberg

1 — 8" x 12" sheet of 1/4" foam rubber
1 — 8" x 12" sheet of 1/8" foam rubber
4 — hooded exit guides
12 — 4-40 x 1" pan head screws
4 — 4-40 x 1" socket head screws
12 — 4-40 blind nuts

Great Planes

2 — 1/8" x 1/4" bolt-on axle shafts
4 — 1/8" landing straps
4 — 5/32" landing straps
1 — pushrod connector
1 — switch and charge jack mounting set
2 — 1/4" x 20" x 2" nylon wing bolts
2 — 2/56 x 30" pushrods
4 — 2/56 x 12" pushrods
8 — threaded steel clevises
2 — 3/16" x 36" wood dowels

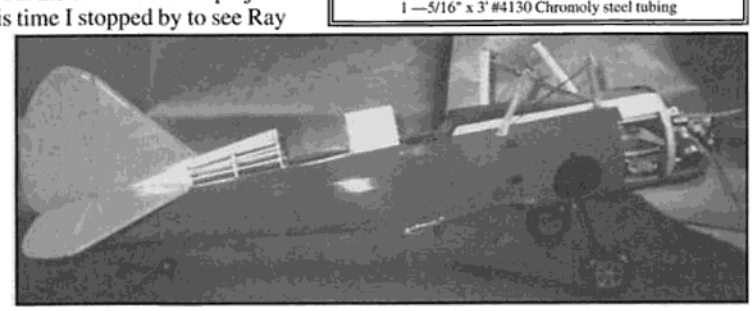
Sullivan

2 — 3-1/2" Skylite wheels
1 — 1-1/4" tail wheel

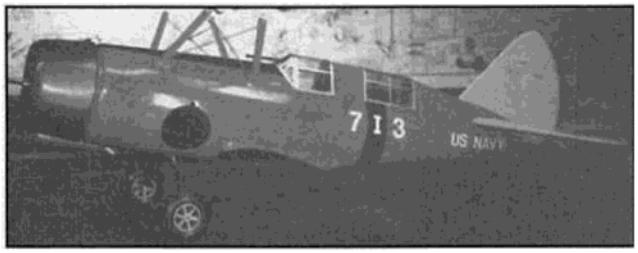
Du-Bro

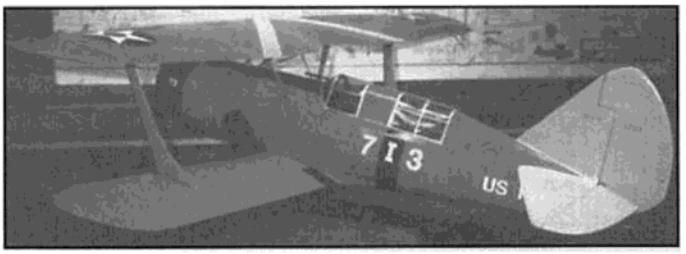
2 — 90° bellcrank
1 — pkg. nylon hinges
4 — 4-40 lock nuts
1 — 10 oz. square fuel tank
2 — 1/8" axle shaft collars

1 ea. — Coverite trim sheets 8" x 20" red and white
2 — 21st Century fabric — light blue 6' roll
1 — 21st Century fabric — dark blue 6' roll
1 — 21st Century fabric — yellow 6' roll
6 — K&S 1/8" x 1/8" x 12" brass angle
1 — K&S 1/8" x 12" brass tubing
1 — K&S 3/16" x 12" brass tubing
1 ea. — Music Wire 36" lengths of 1/16", 1/8", 5/32"
1 — C.B. 1/8" steering arm
Gap filling CA
30-minute epoxy
16 oz. yellow aliphatic wood glue
Thin Butyrate sheet to form cockpit (or similar plastic material)
4 — 3/16" x 1-1/4" long stiff springs
4 — 3/4" control horns
3 ft. — 3/32" fuel tubing
1 — Foremost bulkhead fuel line fitting
1 — 1/4" x 3' #4130 Chromoly steel tubing
1 —5/16" x 3' #4130 Chromoly steel tubing

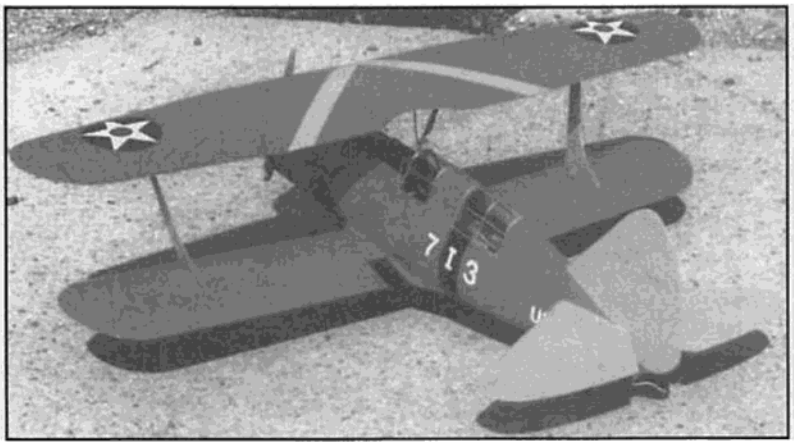


LEFT: Fuselage covering was begun with underside. Note that muffler will be almost totally concealed in cowl and fire wall area. RIGHT: 21st Century fabric and Krylon flat black used for top of forward fuselage and wheel wells.





LEFT: Top Flite (spray) Insignia Blue was used for cowl and Sky Blue for cabane and interplane struts. RIGHT: Covering finished and model assembled.



In full color in the sun. *Photo by Henry Prew.*

The author and his dream machine. *Photo by Henry Prew.*

Jacobelli at Ray's Hobby Shop in Uniondale, NY, and I told him of the difficulty I was having, given my lack of knowledge of aerodynamic principles. Of course, for years I had read numerous articles and several books on the subject, but still, I was a novice. Now I was uncertain as to whether the whole thing was worth the trouble

Ray asked, "Are you enjoying what you are doing?" "Of course, I am," I said, "but I don't know if it will work." Ray looked at me and said, "What difference does it make whether it works or not? If you are getting pleasure from what you are doing while you are pursuing your dream, don't quit." Well, I didn't quit.

When the plans were done and the building started, I began to question the adequacy of the Royal Long Stroke .46 engine. I had bought it and the Futaba radio early in the planning stage in order to complete my drawings. At that time, I felt I would have a 7-1/2 lb. airplane. As I completed the framing of each part, it was weighed, and I soon realized I was going to exceed my weight goal.

For years I had read George Myers' column in *Model Aviation* and I knew he lived on Long Island not far from my home. I called George and, during our conversation, he took the information I had on the airplane, fed it all into his computer, and he came to the conclusion that the engine should work just fine. He even determined how far the airplane would roll before lift-off, and the rate of climb using different props. When the covering was completed and I needed to locate the balance point (tricky with a partially swept back wing), George again used his computer to determine its location. Completed, but without fuel, the weight reached a little over 8-1/2 lbs.

I discussed finding a test pilot with friends. I wanted someone who regularly works with untested aircraft. After the amount of effort that went into building this, I did not want the first flight to be entrusted to even the best of the weekend fliers. I finished my project before the end of the year and the start of the holiday season, just when the weather was beginning to turn bad. It wasn't easy to find that special pilot on such short notice. Fortunately, at that time, I happened to meet Tom Hunt, who was known locally as an engineer, a designer of innovative aircraft, and a person with a reputation for being able to fly anything.

The Moment Of Truth:

Tom readily agreed to do the first flight and a date was set. At the field, Tom had to do some flying on an experimental aircraft he was developing, but by 9:15 he was ready for my Helldiver. I held my breath and aimed my camera. Tom's friend was set with the video camera. At our signal, Tom advanced the throttle, and almost immediately the tail came up and within 25' this 8-1/2 lb. beauty was airborne.

Only someone who has spent years designing and scratch-building an aircraft can know the rush of emotions that went through me at that moment. The joy of seeing it fly like a bird, the relief from the fear of seeing it destroyed, the thrill in watching it do barrel rolls, hammerheads, stall turns, and touch and go's cannot be expressed in words. After six minutes, Tom brought it down in a perfect landing to adjust the needle valve, and asked if I wanted him to take it up again. My feeling was that since it had flown even better than I dreamed it would, and came back without a scratch, or a dent, or a ding, I'd better not push my luck.

What do I do now? I'll just hang it up for the winter and look at it from time to time and relive that wonderful morning. Now that I know that it is exceptionally easy to fly, I'll have one of the men at my local field fly it in the spring. My 50 year old dream has come true and, who knows, maybe one day even I will be able to fly it.

"I lovingly dedicate this project to my understanding wife, Leatrice, who put up without my company for a good part of the 3-1/2 years it took to complete and who did all my editing and typing."