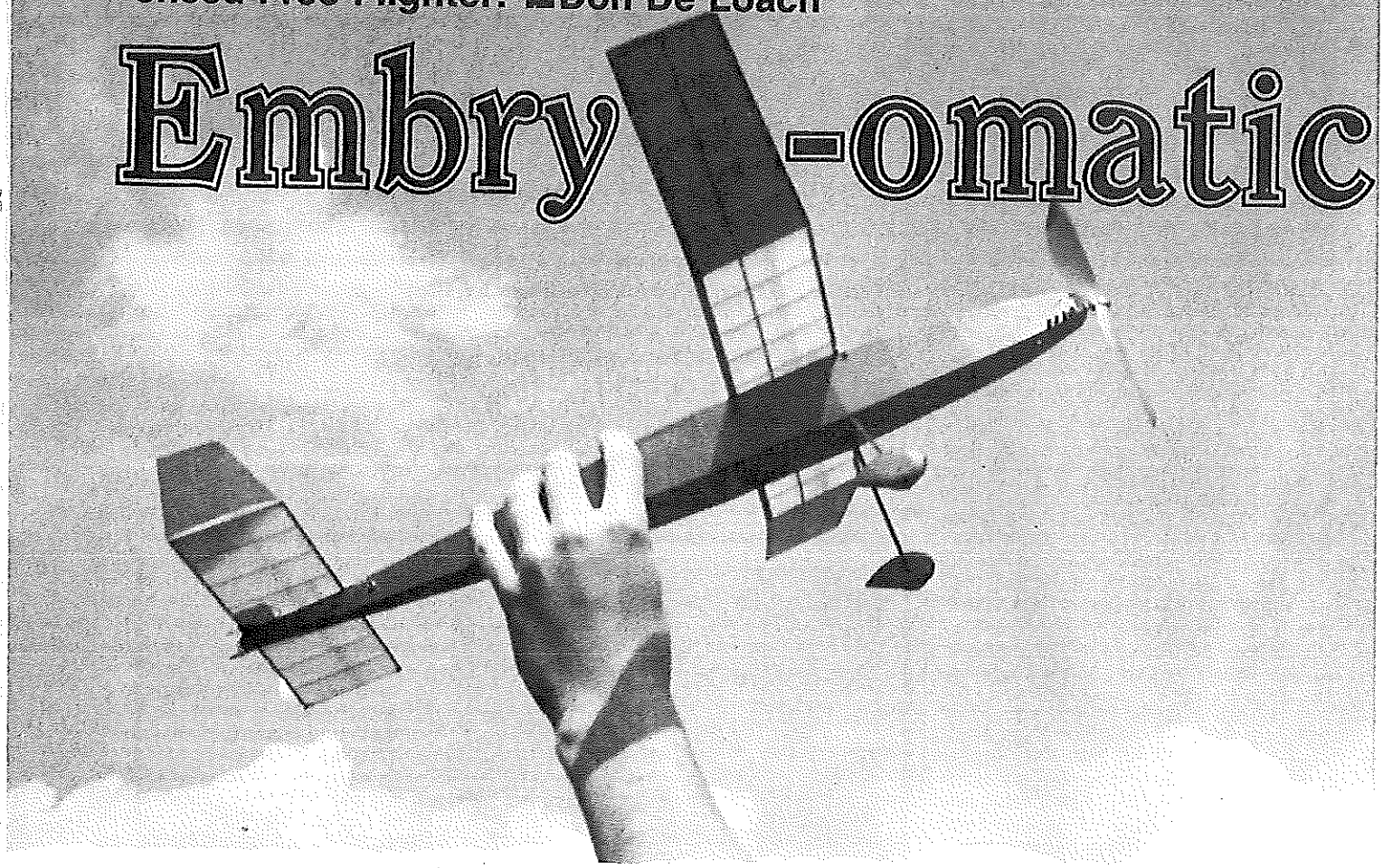
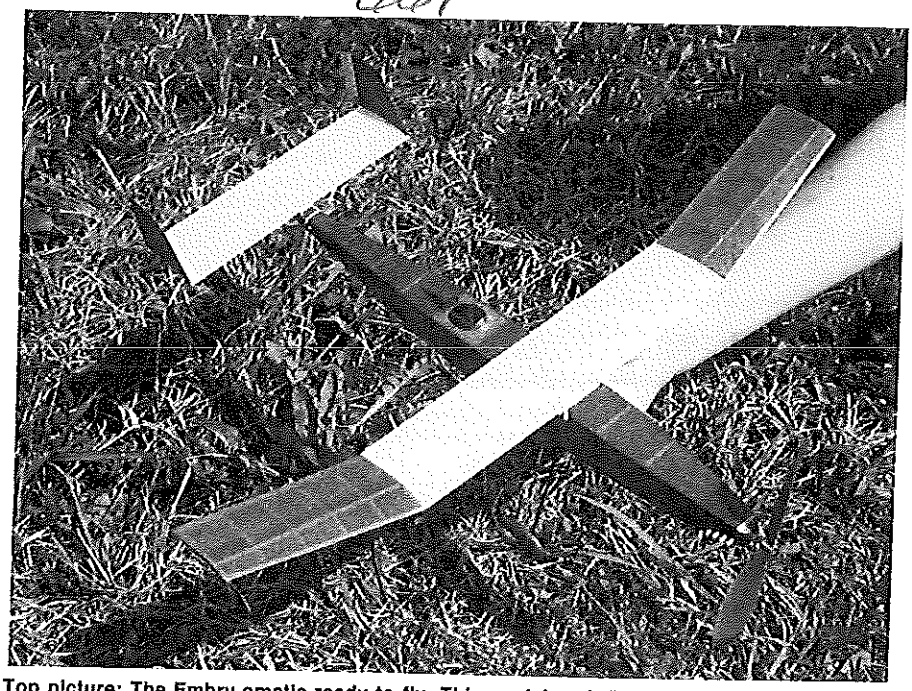
This rubber-powered FF Embryo sews it all up. It's extremely easy to build and fly, yet its performance will impress even the experienced Free Flighter. ■Don De Loach

Embry-omatic





Top picture: The Embry-omatic ready to fly. This model took first place in Embryo (Sr.), by achieving two maxes and a third flight of 98 sec. at the 1989 NFFS U.S. Outdoor Campionships. Not bad for a brand-new, still roughly trimmed airplane at its first contest. At present, the model is tweaked to the point where it maxes on almost every flight. Above: Top view of Embry-omatic showing the exhaust pipes, wheel pants, and open cockpit with windscreen and headrest, all of which earn bonus points under the FAC (Flying Aces Club) Embryo rules.

EMBRYO ENDURANCE is a fun and laid-back event that appeals to all ages, beginner and expert alike. Much like Bostonian, another popular fun event, Embryo has recently gained a renewed following due in large part to its promotion by both the NFFS and the Flying Aces Club. The event originated on the West Coast back in the mid-Sixties, with the rules listed below. With some slight changes, these rules are still in use today.

1. The event is for rubber-powered models with not more than 50 sq. in. of wing area for monoplanes, or 70 sq. in. for biplanes. Stabilizer area is not to exceed 50% of the wing area.

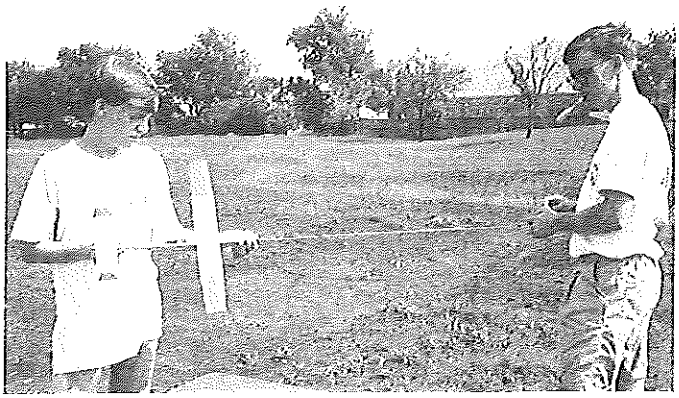
2. Fuselage volume is to enclose a space 1.25 x 1.50 x 3 in. or larger.

3. The wing and tail are to be built up and covered on both sides with Japanese tissue or the equivalent.

4. The model must R.O.G. off a card table top, *unassisted* from a three-point rest.

5. Landing gear legs must be in conventional configuration and have ¾-in.-dia. wheels or larger. (Example: Two wheels on one landing gear is prohibited, etc.)

6. No folding or feathering props, but de-



Left: The author (right) winds while his brother Matt holds the model. With 25 in. of ⅛-in. tan rubber, Embry-omatic is at its best. The author strongly advises installing a dethermalizer on this model because of its high performance capability. Right: She's off, without a push! Note the card table R.O.G. required in the Embryo rules. The model is quite powerful and zooms up quickly. Brother Matt is critiquing the launch.

thermalizers are allowed.

7. Unlimited attempts to make three official rise-off-table flights are allowed, with a two-minute max.

8. The highest flight total plus bonus points wins. Flyoffs are staged to break ties.

In addition to these rules, the Flying Aces Club has devised a bonus system for Embryo. Five seconds are added for a raised cabin or a windscreen with open cockpit and headrest, three seconds for three-dimensional wheel pants, and one second for three-dimensional exhaust pipes. These bonus seconds (a maximum of nine) are added to the three-flight total for the final score.

The Embry-omatic blends both ends of the spectrum. This model looks great and is also a superb flier. If properly built and trimmed, it'll amaze you with its "big model" flight characteristics. The airplane climbs off the table easily and shoots up vertically, like a rocket, for several seconds. After a motor run of well over a minute, the Embry-omatic reaches an altitude of several hundred feet (nearly a max) before it starts its glide.

If this little treatise on the model's performance hasn't steered you toward the workshop, I don't know what will. If you're a beginner, don't let my description of the airplane's performance daunt you. As a quick glance at the plan will show, the Embry-omatic is very simple and straightforward in construction and just as easy to fly. Almost anyone can build this model and achieve excellent results. Go for it!

Construction

Before you begin building, be sure you have the proper materials. The wood, especially, *must* be of top quality. Champion Model Products and Old Timer Model Supply (addresses at end of the article) sell first-rate wood for this type of model. The Embry-omatic uses medium and lightweight 1/16-sq. balsa for the fuselage structure, medium to hard balsa for the wing and stabilizer leading and trailing edges, and light 1/16 and 1/32 sheet balsa everywhere else. Don't make the model so light that you sacrifice strength; it needs to be robust to withstand the rigors of the wind and other outdoor flying hazards. Now let's get building!

Fuselage. Build two identical sides using your favorite method. A resin glue such as Titebond is recommended for its lasting strength.

While the fuselage sides are drying, make the wing and stabilizer rib templates from 1/64 ply. Cut out the ribs from lightweight balsa.

By this time the fuselage sides will be dry. Because of its curved profile, the fuselage must be completed off the board. Cut the top and bottom crosspieces using the top view on the plan as a guide. Install these parts one by one, doing your best to keep the fuselage aligned. Medium Hot Stuff or another CyA (cyanoacrylate) glue should be used during this operation because of its quick adhesion. Take your time, and it'll come out right.

Once the fuselage structure is completed, bend the landing gear from 1/32 music wire and install it on the balsa crosspiece as per the plan. Again, use CyA glue for this operation.

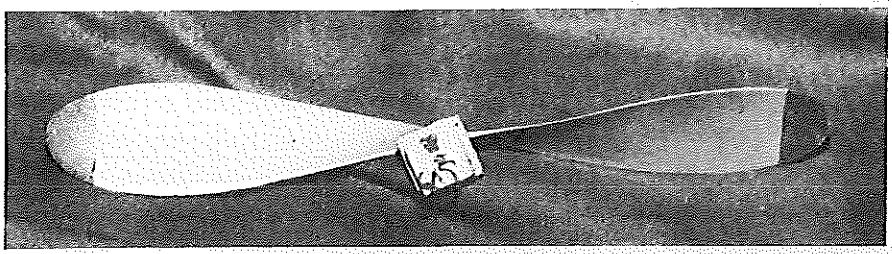
Make a tight-fitting nose block from hard balsa. Thoroughly sand the entire fuselage to remove all imperfections, then set it aside for covering later.

Wing. The leading and trailing edges must be fairly hard and very straight, so only high-quality wood should be used. Cover the plans with waxed paper or plastic wrap, then pin down the leading and trailing edges over the plan. Position and glue in each rib, making sure it's straight and snug.

The author hand launching Embry-omatic during a sequence of low-power test flights to adjust trim. It's important to have a bright, contrasting color scheme, as the airplane gets very small as it reaches its max altitude.

While the glue is drying the stabilizer may be built in the same manner, except that the spar may be added while the structure is still pinned to the plan.

Once the ribs are dry, the wing is ready



A good prop is the heart of any Embryo model. Pictured here is a Peck 7-in. prop mounted on its nose block. It's an excellent choice for Embryos and is very simple for beginners. Note the reverse S-hooks, which are essential for preventing the rubber from climbing the hook.

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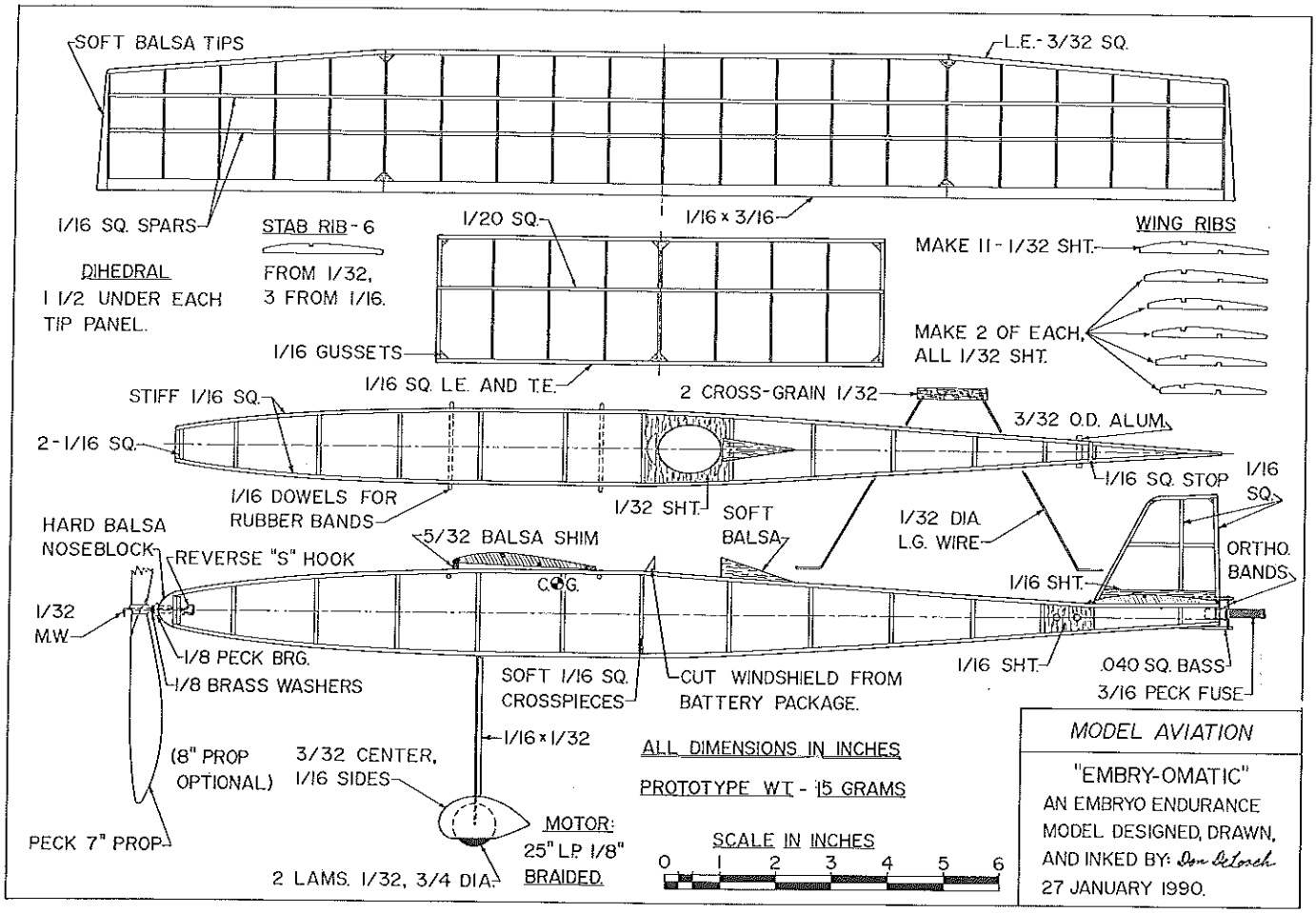

for finishing and setting in the dihedral. First, cut off each wing tip at the proper location and remove it from the plan. Give the panels a light sanding, and create a nice bevel on the leading and trailing edge joints. Block up each tip to the proper angle as per the plan, and carefully glue with Titebond. Allow an hour or so for drying, then remove from the work surface. Install the two spars and gussets. Sand lightly to remove any imperfections, and set aside.

The fins are the last items to be built before the model can be covered. Use very light 1/16 balsa and Titebond glue. You may also want to build a small subrudder at this point. I omitted it on my prototype, but I plan to add one in the near future. It will assist the model in making a smoother takeoff, and probably improve the appearance.

Covering. As with most rubber-powered models, Japanese tissue is the material of choice. For those who've never used this material, it's light, strong, easy to work with, and a fine quality covering for the money. Peck, Micro-X, Champion, and Old Timer all carry it in several colors for about 75 cents a sheet.

Nitrate dope is best for adhering the tissue to the airframe. Cover the simple pieces first, starting with the fuselage and fins, then moving on to the stabilizer and wings as you gain experience. The airfoiled sides of the wing and stab are the toughest to cover flawlessly. Take your time on these surfaces, and work carefully. Remember

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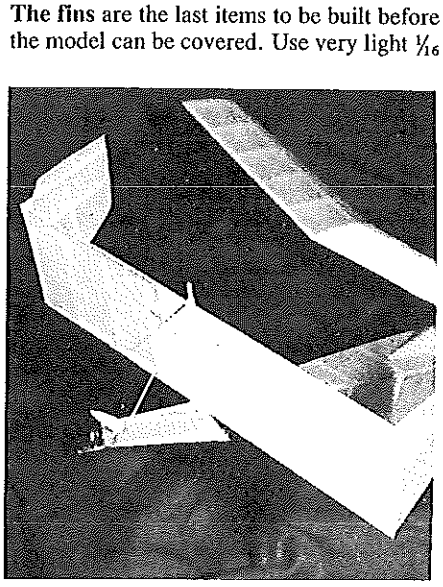

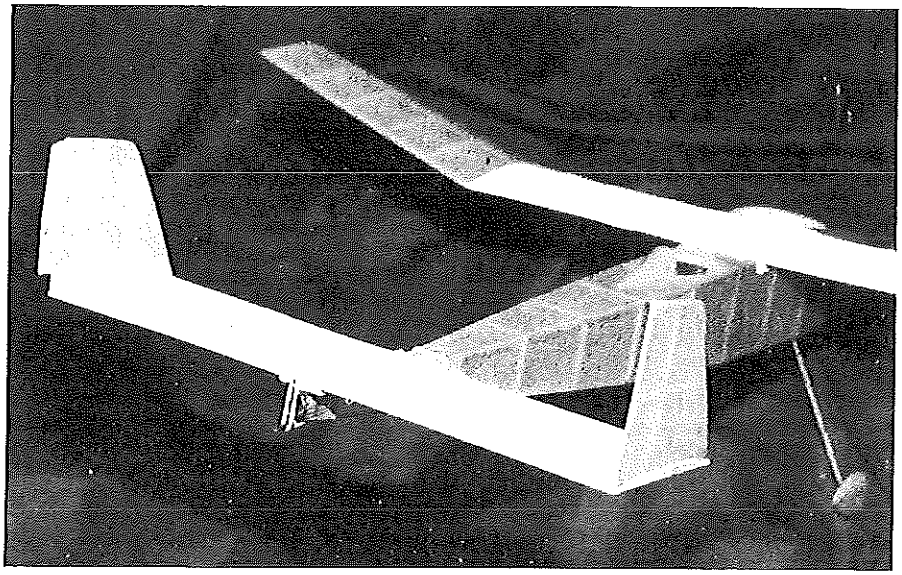

Left: The stabilizer in its dethermalized position. The tail pops up to a 60° angle using carpet thread as a restrictor. The stab rear mount is 1/32 ply. Note the all-important "if found" label attached under the stab. Right: The tail in its flight position. It's held down by small dental bands. This prototype required a small *up*-elevator trim shim just visible under the trailing edge. Be sure the tail is straight and level before flying.

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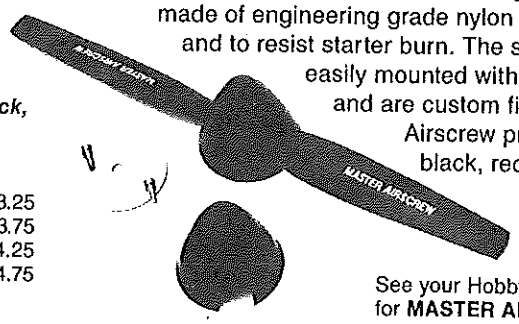

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Embry-omatic/De Loach

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dope is applied.

Once the tissue is properly shrunk and all warps are removed, the surfaces can be doped with a 50/50 mixture of dope and thinner, *well plasticized* with castor oil or TCP (tri-creosol phosphate; four drops per ounce of dope/thinner).

Assembly. Glue a 1/32 balsa shim under the wing leading edge for correct incidence, as shown on the plan. You'll notice that the wing is rubber-banded (#10 rubberbands) in place rather than glued on. You may glue it if you prefer, but a pop-off wing surely does help on those inevitable rough landings.

The DT (dethermalizer) is also optional, although I strongly recommend installing one. Don't let the model's small size, or its Embryo status, fool you into underestimating its performance potential—and consequent need for a dethermalizer. Like any gutsy flier, this model will follow wherever a good thermal leads—in other words, OOS (out-of-sight). Another reason for a dethermalizer is that it enables you to adjust the decalage with small shims under the trailing edge of the stabilizer. I rest my case.

Before rigging the stabilizer to the fuselage, the rudders and subrudder (if you're building one) must be glued in place.

Embellishing the model with wheel pants (make sure the wheels rotate freely inside), cockpit details (windscreen and headrest), and exhaust pipes (made from aluminum tubing and CyA'd in place) greatly improves the appearance. The exhaust pipes are not shown on the plans, but their exact placement is unimportant. As described earlier, detailing the model will also earn you bonus points.

Bend a shaft for a seven-inch Peck gray plastic prop, using a reverse S-hook made from 1/32 music wire.

Flying. It's best to start with the motor you'll most probably end up with. Use a 25-in. loop of 1/8-in. rubber, as noted on the plan. If your model was built light, as it should have been, this motor should give excellent results.

Install the motor, and balance the model at the CG (center-of-gravity) location marked on the plan. Add clay to the nose until balance is achieved.

Test glide the model over soft grass during the calm of early morning or evening. Adjust the stabilizer with shims until the airplane settles into a nice, floating glide. Induce a gentle right or left glide turn by adjusting the rudder accordingly.

When all is well, wind in about a hundred or so turns for your first powered flight. Gradually work your way up to more and more turns, making adjustments as necessary. You'll probably have to put in a little downthrust (I did) as power builds up. Also, you'll need to shim in a little right or left thrust so that the model will circle under power. Try both right and left thrust. One will work better than the other, as every model behaves differently. Once again, try everything to see what works best for you and your model.

The excitement really begins once the model is balanced, trimmed, and flying correctly. Now it's time to see just how Embry-omatically this airplane performs—and, believe me, perform is the word! With the new FAI Model Supply tan rubber, I'm able to crank in 2,500 turns, yielding a motor run of easily a minute and a half. With that kind of power, don't forget to light the DT fuse! Any questions about Embry-omatic may be addressed to the author at 3428 Bryn Mawr, Dallas, TX 75225.

Suppliers

Peck-Polymers, P.O. Box 2498, La Mesa, CA 92041 (tissue, props, glue)

Old Timer Model Supply, P.O. Box 7334, Van Nuys, CA 91409 (tissue, wood, wire, props)

Champion Model Products, 880 Carmen Court, La Verne, CA 91750 (wood, tissue, DT fuse, orthodonix bands, rubber lube)

FAI Model Supply, P.O. Box 3957, Torrance, CA 90510 (rubber)

Bob Wilder, 2010 Boston, Irving, TX 75061 (20:1 winder)

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Penaud/Hannan

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gan my own first constructions at Alleghany, in 1887." When Langley did learn of Pénaud's 1872 *l'Aeronaute* article, he adopted Pénaud's concepts in some of his own aerodrome models. One of Langley's planophore-type designs, identified as Aerodrome No. 11, is illustrated by both a drawing and a photograph in the *Memoir.*

Curiously, Langley seems to have employed twisted rubber for power in his earliest models. Perhaps he may have learned of it from some Francois Dandrieux butterflies, which were widely marketed as early as 1879. If so, this would be poetic justice indeed, since those butterflies were commercial adaptations of Pénaud's Helicopters. Two examples of the Dandrieux models were in the Smithsonian collection for many years. Might Langley have brought them there?

Although he constructed nearly 40 rubber-powered models before 1893 and experimented with a wide variety of configurations, Langley achieved only limited success. We can share his frustration as he recalled: "The wings in general were flat, but in some cases curved. The rubber was usually wound to about 100 turns, and trouble continually arose from its kinking and unequal unwinding, which often caused most erratic flights."

Langley also encountered frequent breakages. After reading of Pénaud's 13-second duration planophore flight he candidly wrote that "I have never obtained so good a result as this with any rubber motor." He then added, "The longest flights obtainable did not exceed six or eight seconds in time, nor 80 to 100 feet in distance, and were not only so brief, but owing to the spasmodic action of the rubber and other causes, so irregular that it was extremely difficult to obtain even the imperfect results which were actually deduced from them."

In what would certainly appear to have been a retrogressive move, Langley turned, during 1895, to models powered by rubber *in tension.* Not surprisingly, this gave poor results. The complex and weighty mechanisms of these models still exist in the Smithsonian collection.

Langley also considered and rejected power plants employing gunpowder, hot water, compressed air, electricity, and carbon dioxide before achieving some success with steam, and finally gasoline. His 1896 steam-powered Aerodrome, identified as No. 5, suggests a revised numbering system unrelated to the rubber-driven model series.

The Langley planophore type. During the 1920s Paul Garber, now historian emeritus and Ramsey Fellow of the National Air and Space Museum, was touring Langley's long-dormant shop building at the Smithsonian Institution. Among the paraphernalia was an old model of planophore configuration. Garber asked his es-

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