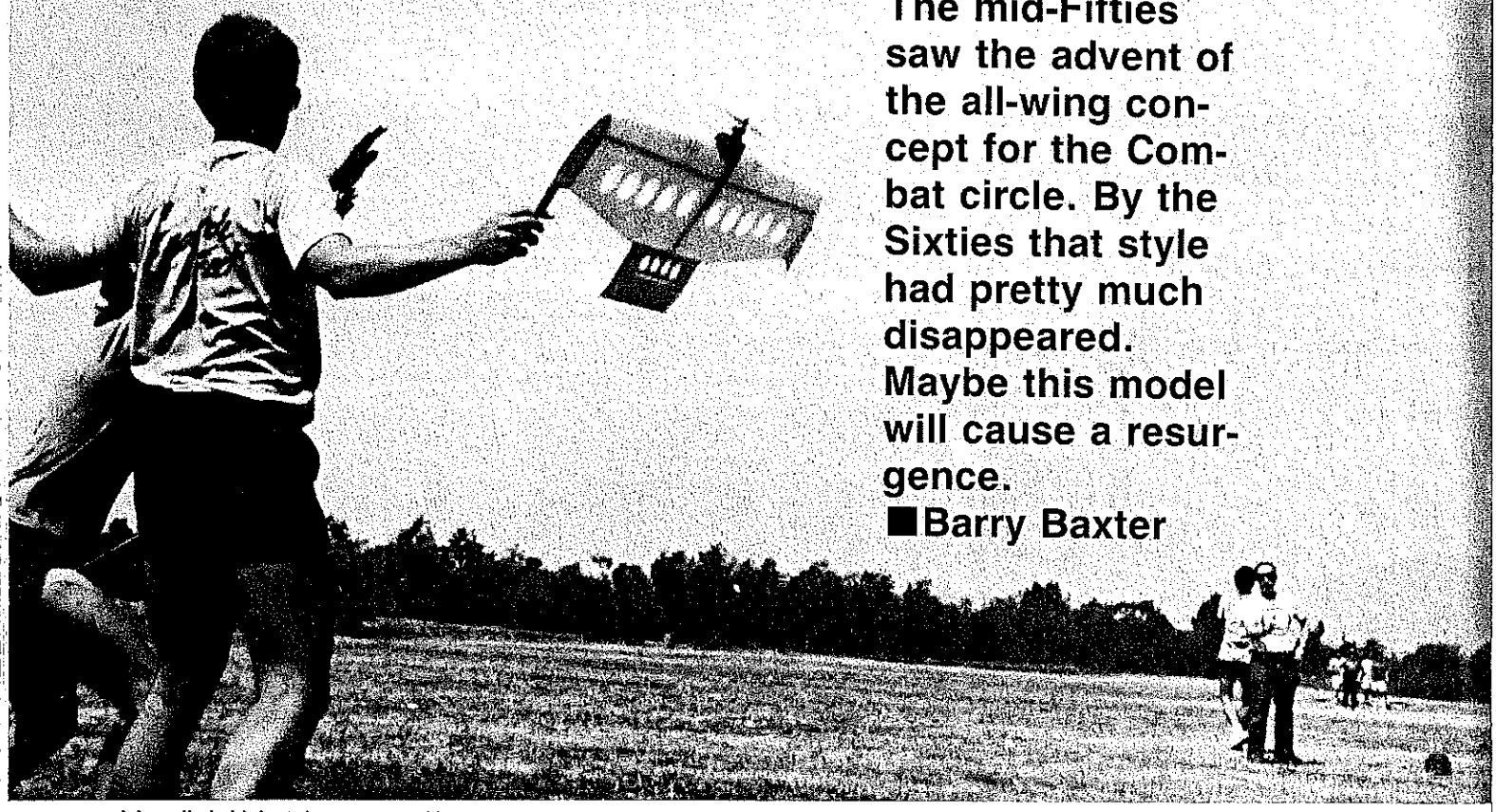
Bird of Prey

The mid-Fifties saw the advent of the all-wing concept for the Combat circle. By the Sixties that style had pretty much disappeared. Maybe this model will cause a resurgence.

■Barry Baxter



Adrenalin is high at the moment of launch. The author is at the controls, while the launching crew is unidentified. Note the streamer line trailing behind the plane. Let's hope it doesn't tangle with the launch crew! Also note another airborne plane in the distance trailing its streamer. The holes in the fantail seen on this model are an optional method of establishing the correct center-of-gravity. Photo by Mike Keville.

IN THE 35 or so years since its inception, Combat has never quite overcome its reputation as a fad-ridden event, sort of an eccentric second cousin. Ironically, many of these fads were begun by good pilots who were squeezing the utmost out of mediocre designs.

Expert fliers could get away with features that violated sound aerodynamic principles—some, in fact, were used mainly for show; but as bellwethers for the rank-and-file Combat modelers, their choices were quickly imitated. Though most of these fads didn't hurt the model's performance, they certainly didn't help much, either. Several of the less innocent features, however, bred a spate of bad designs.

Innovation and experimentation were the bywords of the Fifties. Countless designs were tried and modified, and designers freely borrowed features from other airplanes.

In the early part of the decade, square-box-fuselage planes such as the Hotter'n'-That, Zilch Expendable, and All-American became popular. Several more box-fuselage designs cropped up, culminating with the Super Combat Streak and Bill Netzeband's Jerkline Special. These models flew very well, but lost favor because they took longer to build and were somewhat flimsier than the short profile or flying wing designs.

Mid-decade, Bill Netzeband and Don Still got the ball rolling in the direction of flying wings with the Half Fast and the No-Body. Still winning contests into the early Sixties, the Half Fast was probably the most successful of the flying wing designs. It fostered such clones as the Wow, the Orbit Ace, and the Nose Cone. Although it was a largish model (465-sq.-in. area) and difficult to build, the NoBody inspired spin-offs of its own, the T-Square, Omega, and Bandit among them.

An even larger flying wing design, the 525-sq.-in. Reactor, was too expensive for serious consideration by the average modeler. The kit sold for $4.95 at a time when the going rate for Combat models was $2.95 to $3.95.

Flying wing models turned in creditable performances in the Combat circles of the Fifties, consistently winning and placing at the Nats. When they fell out of favor in the early Sixties, it was due more to the fact that they didn't look like the then-trendy twin-boom stabilator designs than because of any deficiencies in the air.

The twin-boom stabilator owed much of its popularity to the influence of Riley Wooten, one of the big trendmakers of the day. Riley probably could have won the Nats with a Ringmaster! His Quicker spawned the development of the Renegade and Hornet with their short noses and long box-fuselage tails.

Riley's design started out as the plank-winged Nothin'. As its tail design evolved, it became the Quicker and eventually the VooDoo, with its twin tail booms and stabilator. The Quicker remained a top-line model into the early Sixties, when the Voo-Doo was kitted. These two models were probably the most successful Combat kits ever produced.

As it happened, Riley's airfoil had what I think was a basic flaw. Because it lacked between-the-ribs support for the covering, the airfoil gave inconsistent performance. Designed at 14.5% thickness, the airfoil as

produced often seemed closer to 10%; it probably averaged about 12%. Despite this shortcoming, Riley's design was very successful in many different fliers' hands.

Plans for most of the above-mentioned models are available through the author. Send an SASE to Barry Baxter, 6490 Sonora Way, Cypress, CA 90630 for a complete listing.

After the VooDoo's success, designs with two booms and a stabilator became the fad of the hour. Then, Bill Carpenter used three booms on his Swoop—and anything with two booms was suddenly passe. By supporting the center of the stabilator where the pushrod was attached, thereby removing some of the flex from the control system, the triple boom offered an obvious structural advantage.

But when the monoboom came along, the triple boom in turn was quickly eclipsed. Though it offered no particular aerodynamic advantage, the single-boom structure did shorten building time. Those outboard booms had always been a nuisance to cover.

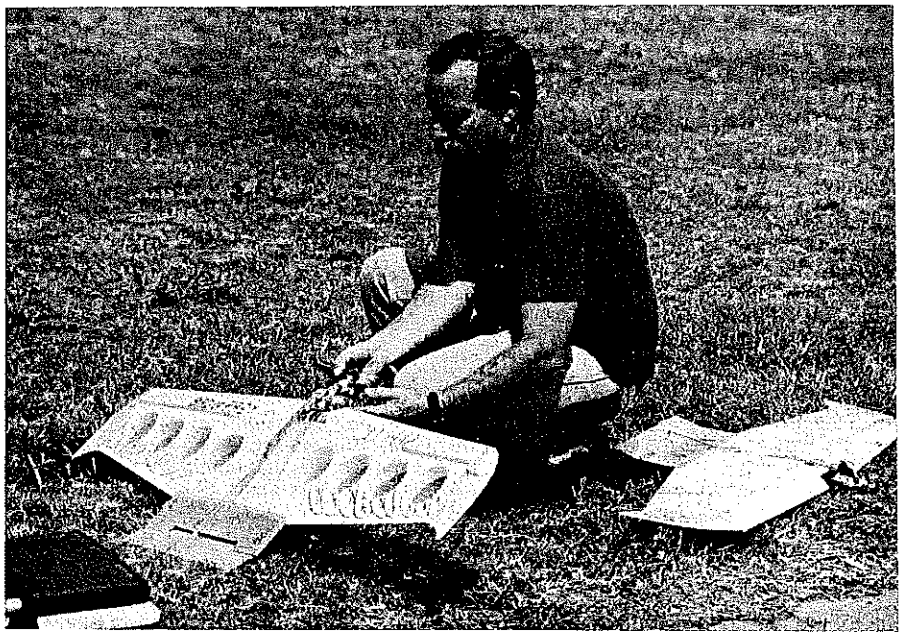
The monoboom's popularity has held strong since the late Sixties, and with the advent of foam and Fas-Cal Combat ships have come to look basically alike. Though their flight characteristics vary with the use of different wing planforms and airfoil sections, for the casual observer these differences are hard to detect. The spectator at a contest today can easily become confused as to who's flying what. Even the judges have been fooled.

"Whose airplane is that?" "I don't know, what color is his streamer?" Foam clones have taken over today's Combat circle.

Not all of Riley Wooten's designs, it should be noted, were worthy of imitation. Riley's superb flying skills, however, transformed even a few of his more mediocre designs into contest winners. This started fads in some very questionable directions.

One of Riley's more uninspired designs, I think, was the Guided Missile. Its diamond airfoil was without a doubt the worst such design ever foisted on the Combat community. The Exterminator, the Demon, and the Diamond were just a few of the models that adopted this misbegotten airfoil. Incredibly, a few fliers managed to rack up wins with these ships. Makes one wonder what they could've done with a *good* airplane!

Though the diamond airfoil does have the advantage of being easy to build straight, aerodynamically it's a disaster. The center of pressure of the wing jumps from the high point of the camber to the leading edge and back, making a smooth transition impossible. Models equipped with diamond airfoils with sharp leading edges, such as the Dumas Diamond, were particularly awkward fliers. With their poor stalling characteristics, these planes required approximately 50° of the circle to perform a loop. When an airfoil of this design begins to turn and the angle of attack increases, it's little better than a flat-plate airfoil.



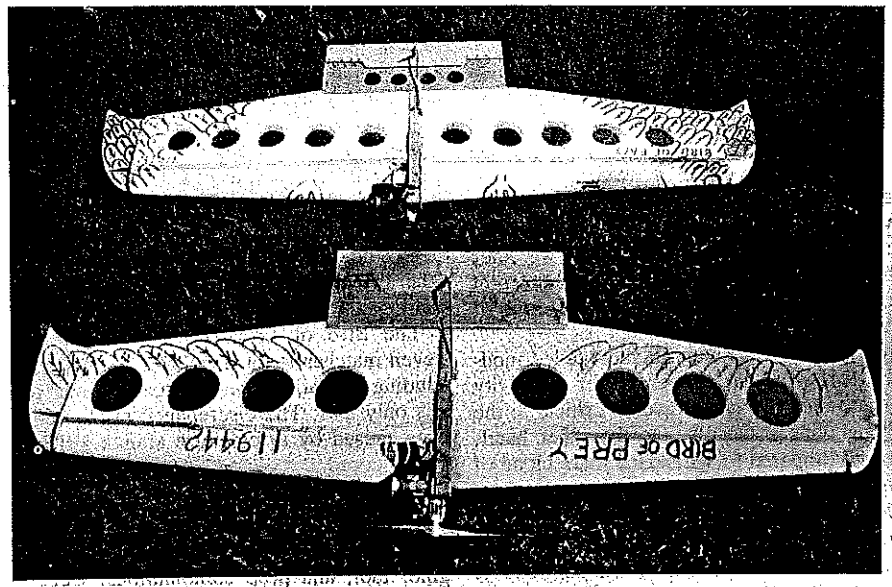
The author servicing one of his Birds of Prey in preparation for another match. These airplanes are very easy and fast to build. The wing is all-foam, but because of its sharp taper it would best be left to experienced foam cutters. Phil Cartier of Corehouse Supplies carries cores that will adapt to Bird of Prey. Any covering will work quite well. Photo by Russ Wilcox.

Airfoils on today's designs range from very good to rather bad. One of the more commonly used of the poorer designs has a very blunt, almost round leading edge with the apex at about the 15-20% chord mark. Though these airfoils will turn well, they'll also slow down more in the process. They have a higher stall angle, but the drag increases at a much higher rate. In fact the very high drag that such airfoils induce will slow a plane down several miles an hour in level flight.

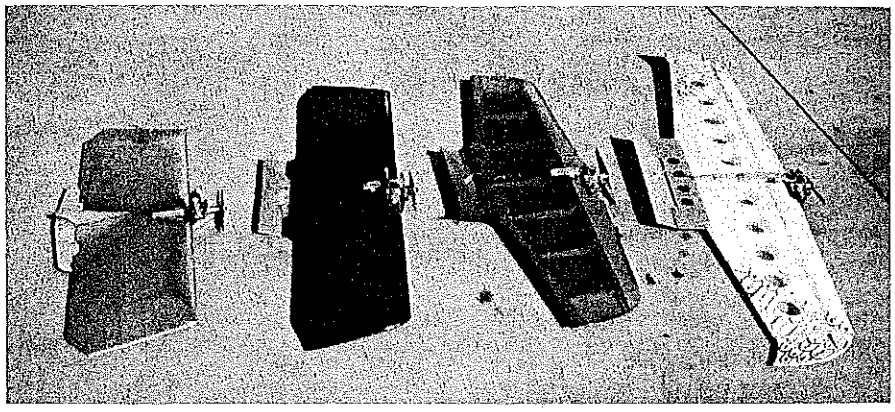
With a drag coefficient of approximately 0.0020, the blunt, flat "English" airfoil suffers from the same disadvantage. By contrast, an elliptical leading edge with a 30% high point has a drag coefficient of 0.00012. Since the coefficient of lift is almost identical on the three shapes, fliers looking for speed with no loss of maneuverability would benefit from using the elliptical leading edge airfoil. The NACA 0009, 0012, and 0015 airfoils are outstanding examples of this type of airfoil.

After experimenting with different airfoil thicknesses, I've determined that anything over 15% produces too much drag. Although Stunt models use the thicker airfoils, these airplanes differ from Combat models in two significant respects: speed and wing loading.

Stunt models are designed with a wing loading of approximately 12 oz./sq. ft. for stability and wind performance. They're



A pair of the author's Birds. Note the double-tapered wings. The angled wing tips enhance aerodynamic efficiency. The outboard wing is cut an inch shorter. A stock Fox MK IV engine will work quite well. Heavier power plants such as a K&B 5.8 or Supertigre S-36 also give excellent performance without unduly affecting the center-of-gravity. Photo by the author.



Four examples of the evolution of the Bird of Prey. From left to right: Melamij dating from 1959, the 1984 Phoenix, 1987 Doombat, and Bird of Prey. This latest bird has grown to 565 sq. in. Balance is critical in this type of airplane. If it's overly touchy and hunts, it's tail-heavy. If it's sluggish in the turns, it's nose-heavy. Properly balanced, it screams. Photo by the author.

also engineered to fly approximately 5.2 sec. per lap. By contrast, a Combat model has a wing loading of about 6 oz./sq. ft., and generally averages about 2.3 sec. per lap at a 10-ft. altitude. The thicker airfoils seen in many of the Stunt models are used not for the sake of the additional lift they provide, but for the high drag that slows the airplane down to the desired lap time.

In experimenting with a 9% airfoil on a Slow Combat ship, based on a 1958 Bill Judge design called Woody with a sharp leading edge, I found that the 9% thickness had several drawbacks. Cornering ability suffered, for example. But after changing the leading edge to an elliptical section, I ran into the opposite problem: The airplane turned *too* well. The airfoil was too thin to maintain adequate strength in that particular installation, and I couldn't keep the wing together. Though I haven't had time to continue the experiments, there is clearly much untapped potential in a thinner wing.

The unusual wing tips on this model are functional as well as stylish. Airflow at the tip of an airfoil will move outboard across the wing in an attempt to curve around the tip from the high pressure area under the wing to the low pressure above it. The tip angle keeps the pressure on the proper side of the airfoil, reducing tip drag and increasing lift. The optimum tip angle is approximately 15°.

In our own decade, we've seen Northrop Aircraft's revival of its 1940s flying wing as a viable bombing platform. As we enter the 1990s, I think that the time is also right for bringing back the Combat wing as a viable streamer weapon!

One caveat: As with all short-tailed models, achieving the proper center-of-gravity location and elevator travel is critical to the flying wing's success. On the other hand, when compared to a standard foam clone of comparable size, a flying wing has the advantages of somewhat less drag and a quicker initial turn. I call this "snap"; *MA* Combat writer Charlie Johnson dubs it "flickability."

This phenomenon is caused by the much greater proximity of the moment arms of the model to the center of mass. The farther the engine and/or tail from the center-of-gravity, the longer they take to overcome the increased inertia and begin moving. Since the longer moments have literally farther to move, it takes more time for the plane to rotate, and again to stop rotating.

All other things being equal (wing loading, airfoil, etc.), once the turn is established the turning radius of a flying wing will be equal to that of a standard foam clone. However, the flying wing will be a few degrees ahead by dint of having begun the turn more promptly. This ability to snap into a turn is one of the hallmarks of the design.

The flying wing excels at "point-and-shoot" flying. If that's your style, the wing is definitely the way to go. On the other hand, if you like to stand toe-to-toe, duking it out, flying multiple loops and eights, with a flying wing you may as well be shouting into the wind: You'd be giving up many of the flying wing's particular advantages.

The Model

Loosely based on the Klingon Battle Cruiser from Star Trek, the Bird of Prey also retains features of my 1959 flying wing, Melamij. It has the same airfoil, balanced elevator, and wing tip design that I developed for the original model. The Melamij won the 1960 Rocky Mountain Regional and Wyoming State Championships.

The obvious changes incorporated in the Prey are the tapered wing with a higher aspect ratio, and the significantly larger size. The airplane has grown to 565 sq. in., including the fantail.

The Bird of Prey scored five kills in seven matches at the 1988 Money Nats, including defeating the eventual winner for his only loss. The discrepancy in the count was caused by a forfeiture after a kill had been scored.

I won't indicate the prototype's speed with the particular engine and prop setup used. Speed will vary with individual engine, fuel, and prop combinations. Generally I use stock Fox MK IVs with Taipan 8 x 6 props. Although some of the hotter airplanes pass me in the straight runs, few of them outrun me.

Heavier engines like the K&B 5.8s and Supertigre S-36 also work well in the Prey. With a model of this size, the extra weight of such engines has little effect on flight characteristics.

Construction. Begin by cutting out all the parts, then build the center wing ribs. I use two ⅜-in. balsa center ribs as opposed to one ¾-in. rib. Simply gluing the two ribs together creates greater strength than a single rib affords. Although it's optional, gluing a layer of graphite between the ribs provides further reinforcement.

I originally built four wing center sections. Although I've had to replace the wings many times, the original center sections and fantails are alive and well.

Glue on the engine mounts, doubler, bellcrank mount, and dowels. Install the control assembly, and don't forget to install the engine restraint cable. I use CyA (cyanoacrylate) on all wood parts and Titebond on the foam cores.

A number of designs feature engine mounts that butt against the spars. Since it concentrates stress at the spar/engine-mount junction, this setup causes countless breakages. By continuing the mounts behind the spars, I've eliminated that problem with the Bird of Prey. Though it's a slightly heavier arrangement, it's also considerably stronger.

If you're into foam cutting, cut the wing panels using the templates on the plans. If you lack experience in cutting foam cores, this isn't the one to start with. Since its sharp taper makes it more difficult to cut than the average core, it's definitely not for the beginner.

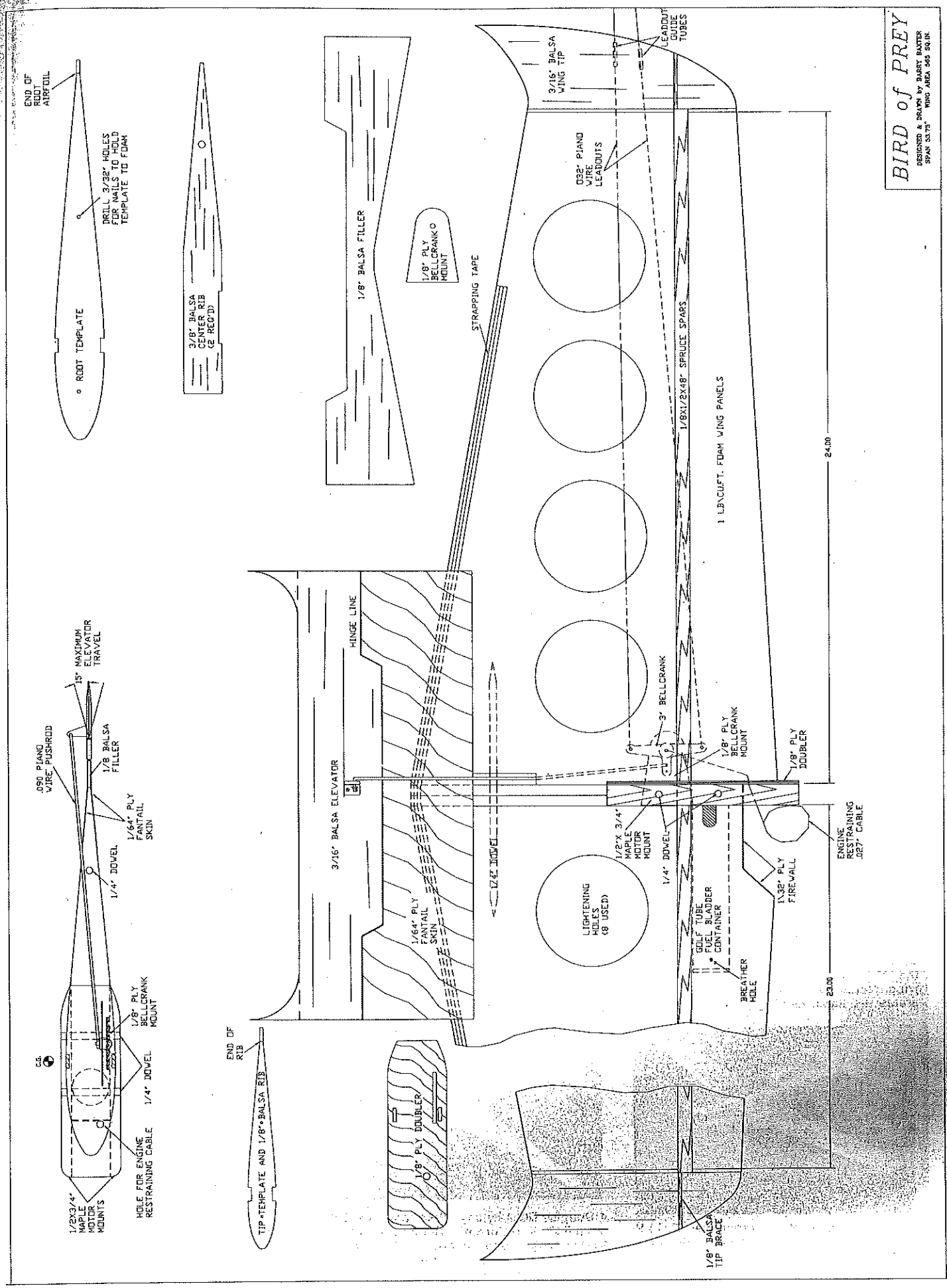
Phil Cartier of the Corehouse supplies cores for his Gotcha 500 which are very similar to the type used here. These work very well; I use and recommend them. They're available from Corehouse, 760 Waltonville Rd., Hummelstown, PA 17036.

Install the bladder tube in the outboard panel. Contrary to common practice, I put the breather hole at the end of the tube on the top of the wing, instead of on the bottom. That way, should a bladder blow I can retrieve four ounces of fuel if I want to; I don't have to dump it on the ground.

Cut the foam on the inboard panel to clear the control system and doubler. If using a commercial core, you'll need to widen the spar slot; be sure to widen it toward the rear. Cut the lightening holes before you install the panels. Since this is a tough job with the lead-out wires in the way, I heat up an appropriately sized tin can and melt the holes out of the wing cores.

Cut the outboard wing an inch shorter than the inboard one. This makes the outboard wing faster than the inboard one, which keeps the model light on the lines. The extra lift on the longer inboard wing will tend to turn the model toward the outside of the circle; whereas symmetrical

Continued on page 166


BIRD of PREY
DESIGNED & DRAWN by BARRY BAXTER
SPAN 53.75" WING AREA 565 SQ.IN.
END OF ROOT AIRFOIL
DRILL 3/32" HOLES FOR NAILS TO HOLD TEMPLATE TO FOAM
ROOT TEMPLATE
3/8" BALSA CENTER RIB (2 REQ'D)
1/8" BALSA FILLER
1/8" PLY BELLCRANK MOUNT
STRAPPING TAPE
3/16" BALSA WING TIP
LEADOUT GUIDE TUBES
.032" PIANO WIRE LEADOUTS
1/8X1/2X48" SPRUCE SPARS
1 LB/CU.FT. FOAM WING PANELS
24.00
23.00
MAXIMUM ELEVATOR TRAVEL
15°
.090 PIANO WIRE PUSHROD
1/8 BALSA FILLER
1/64" PLY FANTAIL SKIN
1/4" DOWEL
1/8" PLY BELLCRANK MOUNT
1/4" DOWEL
HOLE FOR ENGINE RESTRAINING CABLE
1/2X3/4" MAPLE MOTOR MOUNTS
C.G.
3/16" BALSA ELEVATOR
HINGE LINE
1/64" PLY FANTAIL SKIN
1/8" PLY DOUBLER
END OF RIB
TIP TEMPLATE AND 1/8" BALSA RIB
3" BELLCRANK
1/8" PLY BELLCRANK MOUNT
1/8" PLY DOUBLER
1/2" DOWEL
1/2"X 3/4" MAPLE MOTOR MOUNT
1/4" DOWEL
LIGHTENING HOLES (8 USED)
GOLF TUBE FUEL BLADDER CONTAINER
BREATHER HOLE
1/32" PLY FIREWALL
ENGINE RESTRAINING .027" CABLE
1/8" BALSA TIP BRACE