PTEROWA

Here's something to really make them look next time you go to the flying fiel A 59in. span R/C flying wing design fo 0.8-1cc. motors and 2-3 function R/C

THIS model started life by accident. Three years ago, construction of a scale model of the Westland Hill Pterodactyl Mk. IV was commenced. It rapidly became apparent that experience in flying a similar machine would be of benefit, particularly since a silver-grey finish loses itself against the usual cloud background.

Furthermore, in my eagerness not to build a projectile, the Pterodactyl wing structure was turning out too light for a 19-powered model. At this stage there were two outer wing halves with a total span of about 60 in., if joined.

The 'if joined' bit was soon settled, for the complete machine would go straight in the car boot at this size.

Previous free-flight flying wings had shown that one of the weakest points was likely to be the trailing edge centre section, and use of 0.8mm ply, shaped to ease the stress in this area has proved successful. This also provides a main anchor point for the fin and engine nacelle.

A Cox Babe Bee or Golden Bee motor provides adequate power for this lightweight – all up weight is 26 oz. This is equipped with two servos on a four-channel outfit using a 225 mAH power pack. The engine is shown mounted as a 'puller' but Pteroway has frequently been flown as a pusher. There are two points to be watched if you fly it as a pusher:

(a) Do not let the C.G. go further back than shown, $\pm \frac{1}{2}$ in.
(b) You are likely to suffer from range problems if the prop chews the trailing aerial off!

Consecutive loops and slow rolls are readily possible with this amount of power, but Pteroway has flown as a tandem twin, which provides a much crisper performance, although the glide suffers. Pteroway is currently being re-engined with a throttled O.S. Pet and all up weight of this Mk. 2 version is 34 oz.

If you do not wish to install an engine, just leave it off and slope-soar Pteroway – a small amount of tail (sorry, rear-end) ballast might be necessary to bring the C.G. to the correct position.

Construction

Use soft balsa for all ribs except root ones.

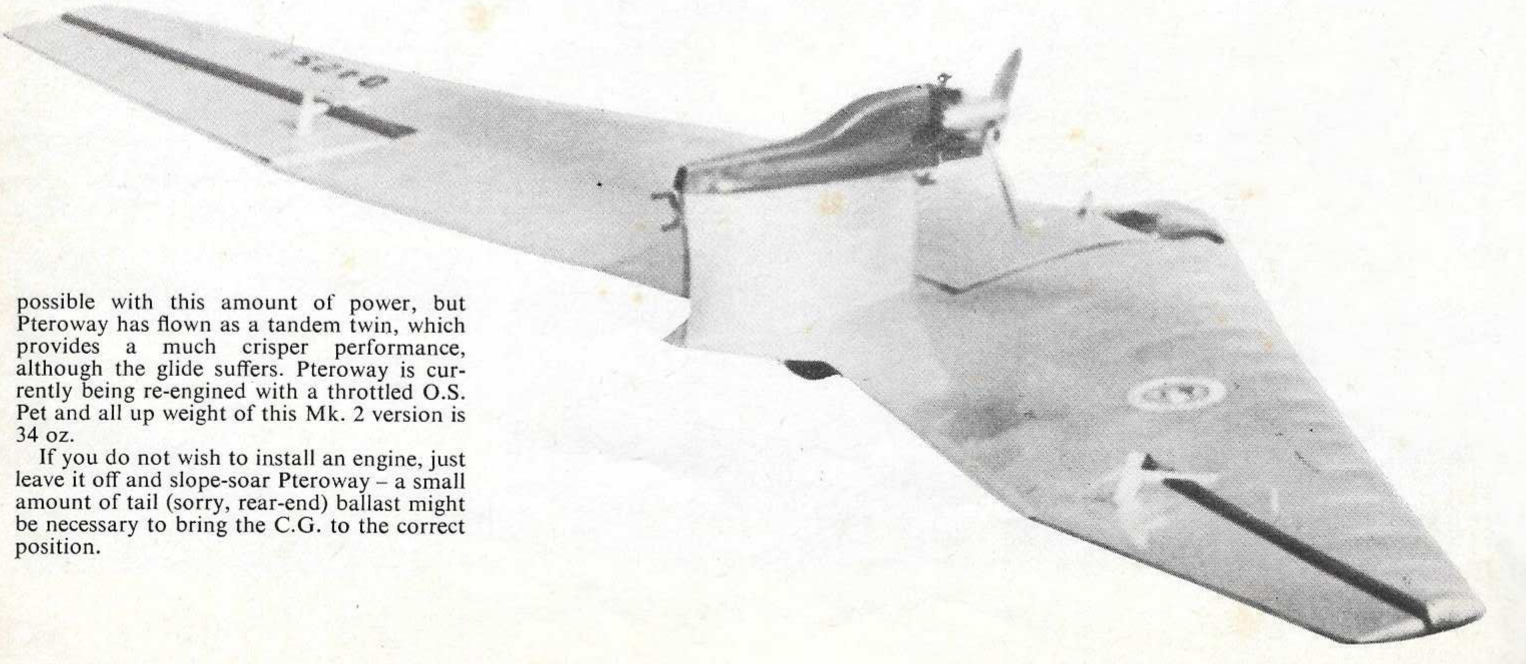
The sandwich method of cutting ribs cannot be applied here as the taper is too great.

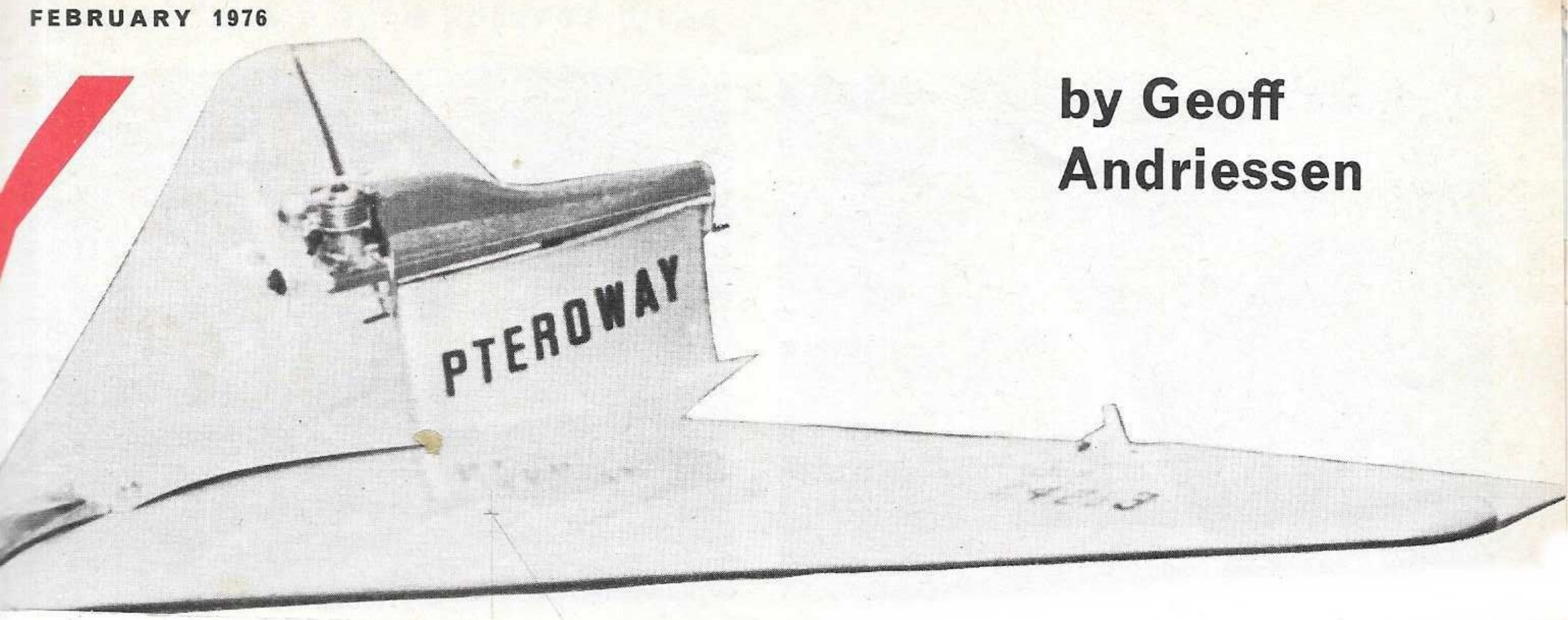
Build a half-wing at a time by using the trailing edge and lower spars to jig the ribs out to W7 into position. Then add the leading edge and upper spars. Note that the rear spars are spruce and the front spars are hard balsa. Next, glue the 1/16 in. medium web to the rear mainspars outboard of rib W8A, W8B.

Add W8B followed by W8A to W14 and the tip. Glue $\frac{1}{8}$ in. sheet as shown between W10 and W11A first making a suitable exit hole for the nylon cables.

Join the wing halves, giving dihedral equivalent to 3 in. under each tip. This is not thought to be at all critical and was chosen mainly for appearance's sake, however, it works well with no tendency to 'Dutch-rolling'. This term is used to describe a form of oscillation about the roll axis which can occur in the case of a flying wing, with too much dihedral. Glue leading edge, trailing edge, rear mainspars (upper and lower) and front mainspar (upper). If, at this stage, you can join the front lower mainspars and leave room for your receiver, do so.

The trailing edge is shaped at the root to enable a straight piece of $\frac{3}{8}$ in. balsa to join the trailing edges. Cut an upper and lower piece of 0.8mm ply with the grain running in the direction shown, glue in position, the upper one first, (I use clothes pegs to hold the ply where it crosses the trailing edges). Take care to ensure an angled edge as shown between the profile of the ply and the trailing edge, for this will give a much stronger





by Geoff Andriessen

assembly by transferring the stress gradually from ply to balsa. Now add the lower 0.8mm ply trailing edge reinforcement.

At this stage, complete the fuselage – there is not much of it! I used Sprengbrook Micro-loc servos and so a 'floor' was required to screw the clips to. This consisted simply of a piece of 1 in. × $\frac{1}{4}$ in. balsa, 12 in. long. Scrap soft balsa and $\frac{1}{4}$ in. square were then used to construct a pleasing shape. Do not be carried away with your sanding here, remember to leave enough angles to catch hold of for hand launching!

It is now convenient to install the control system. This is a mechanical decoder like virtually all others in use for flying wings and butterfly tails. It has the merit of being light and simple and furthermore, it is cheap, inexpensive and doesn't cost much!

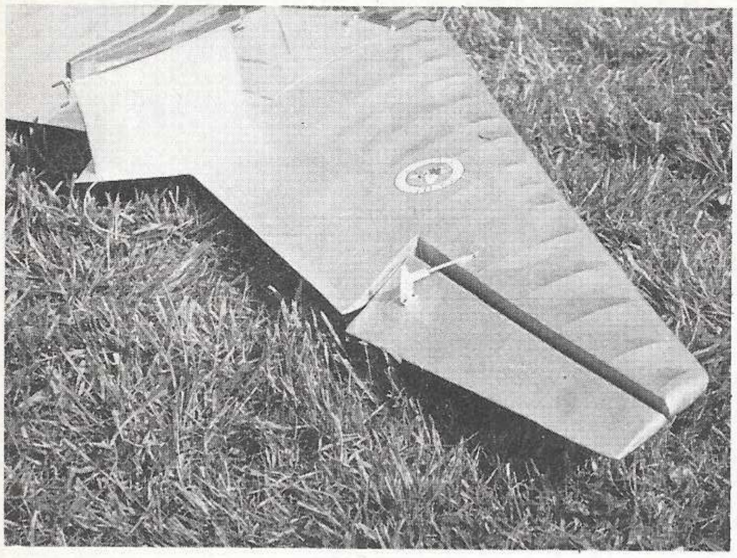
Ordinary Micro-Mold bellcranks are used and basically one is carried on another, with the aileron servo feeding one and the elevator servo the other. As the plan shows, this also provides the necessary 90° change of direction to feed the elevon cable.

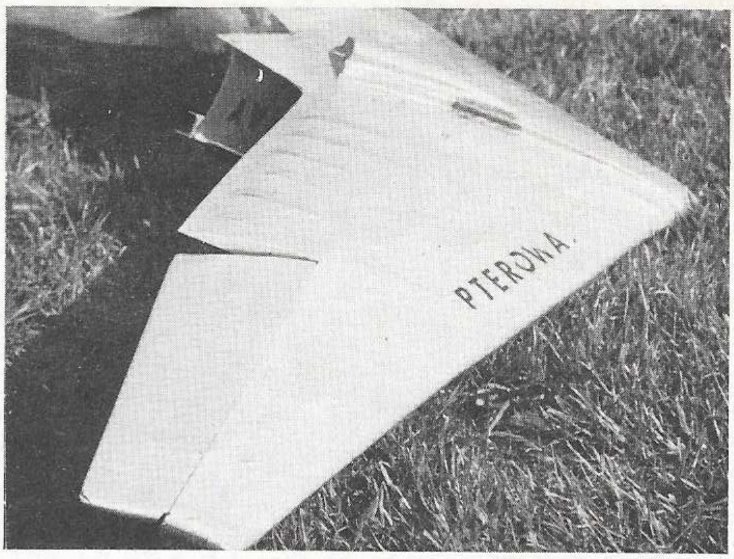
Make up the linkage support plate to fit between the root ribs from 2mm ply, and re-inforce the $\frac{1}{8}$ in. root ribs with 0.8mm ply in this area. Similarly, if using a servo mounting plate or bearers for your servo, fit and re-inforce the root ribs at stressed points. Do not over strengthen, remember this is a light model and is capable of thistledown landings.

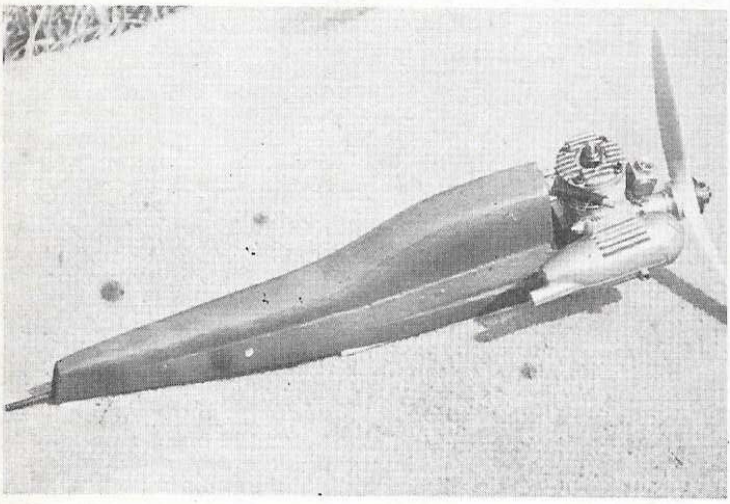
Assemble the linkages on the support plate, ensure that they operate freely and glue the support plate in place. Follow with servo mounts.

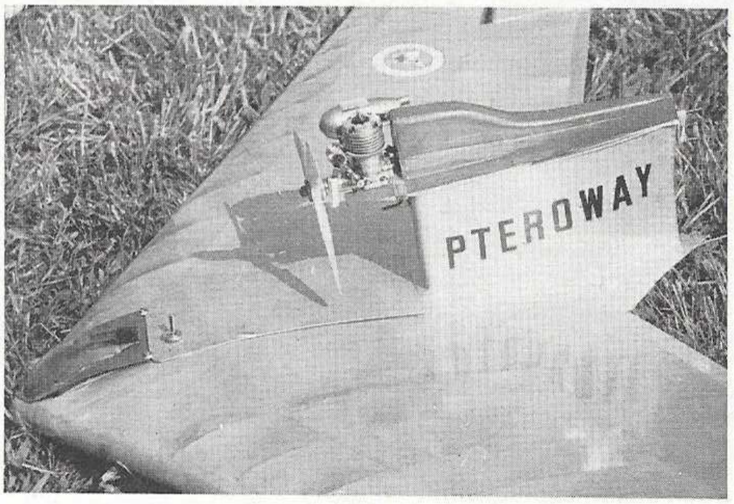
Now install small diameter nylon in nylon cables at the approximate position shown, taking care to obtain an easy curve. I found it best to do this by marking the curve in felt tip pen on top of the ribs and I then used a sharp point and a round file to make each hole, then threading the cable through each time. When fully through, check that the inner is adequately free and then glue the outer in position at each rib with PVA (except the foot rib and the exit to the control horn). This will not only secure the cable but will also strengthen the structure.

At this point, the 1/16 in. medium 'capping' for the root ribs (it is $1\frac{1}{2}$ in. wide but I do not know what else to call it) may be glued on. These extend from the leading edge to fair in the ply trailing edge reinforcement. This will complete the undersurface and will leave an









Top: two views detailing large outboard control surface. Note that the surface is hinged at the bottom surface of the wing. Above left: detail of detachable power pod showing O.S. Pet motor installed. Power pod seen in position on fin above. Note radio access.

uncovered hole 2 in. wide at the root of the wing. Most of this will be covered by two hatches (0.8mm ply again).

The remaining area is occupied by the fin/engine mount and there are two versions of this:

MK. 1

(a) A simple $\frac{1}{4}$ in. medium sheet fin with nacelle seat. This is to carry a Golden Bee or Babe Bee with or without extender tank. No throttle.

MK. 2

(b) A built up fin to form a nacelle seat but incorporating a 3rd channel servo for throttle control.

The first version (a) is largely self-explanatory, cut to shape from two or more pieces of medium balsa making sure that the grain is vertical and that the shape of the lower edge corresponds with the internal contours of the fuselage bottom. When glued, add 1/16 in. either side of fin on top of the fuselage to fair in to the root rib 'capping', cut the 1mm ply nacelle seat with the grain running crossways and glue on. Add pegs after covering.

The nacelle is made from a 3 or 4mm ply bulkhead with a hollowed out soft block balsa pod. Alternatively, this could of course be built up from sheet.

Whichever method is used to thoroughly fuel proof the pod and fin (I used PVA) before covering. The original fin had to be replaced after $2\frac{1}{2}$ years of intensive flying purely because of the amount of oil in it.

If you want to use the engine as a pusher, less soakage should result, but remember the uncanny habit of the Cox Babe Bee to start in the reverse direction. As a pusher, position the nacelle so that the propeller just misses the trailing edge of the fin and check the C.G. Use any suitable two or three blade propeller.

As a tractor with the Babe Bee I use a 5 in. × 3 in. three-blade prop. to obtain the necessary clearance.

Fin type 'b' is designed to take an O.S. Pet 099 and provides sufficient clearance for a 6 in. × 4 in. Tornado three-blader.

The nacelle in this case is built up around $\frac{1}{4}$ in. × $\frac{3}{8}$ in. engine bearers, a tank between them, ply bulkhead and, again, a hollowed out and built up balsa pod.

The throttle servo is situated within the thickness of the fin. The push-rod should be equiped with all nylon clevis at each end to provide 'knock off ability' in conjunction with the rubber band fixings for the nacelle.

Commence Mk. 2 fin construction by cutting out the 0.8mm sides of the fin (taking care to keep the grain vertical). Glue these to the leading edge of 1 in. × $\frac{5}{8}$ in. balsa and when dry add former 'c' (with 1/16 in. ply facing if using a clip mounted servo) and the trailing edge.

Sand the leading edge to a streamline shape and check that the fin sits squarely in the fuselage. Glue in position, add the 0.8mm cap which forms the seat for the nacelle and finally fit the pegs for rubber band fixing.

Whichever version is made, it is a good scheme to use 'wing-seating' tape between nacelle and fin. This will cut vibration down and, in the Mk. 2 version, will improve the throttling characteristics.

The elevons are built up using 1/16 in. and $\frac{1}{8}$ in. sheet with 1mm ply to take the control horn. These are hinged to the main wing with Solarfilm after covering.

Finishing was done using *Solarfilm* for weight reasons, and also because the ribs would probably buckle with either heavily doped tissue or nylon. I used silver grey as explained earlier, but a brighter colour would aid identification of heading.

After covering, stick garnet or emery paper on to provide a launching grip in the position shown. Contact cement is a suitable adhesive, particularly if the Solarfilm is slightly roughened first.

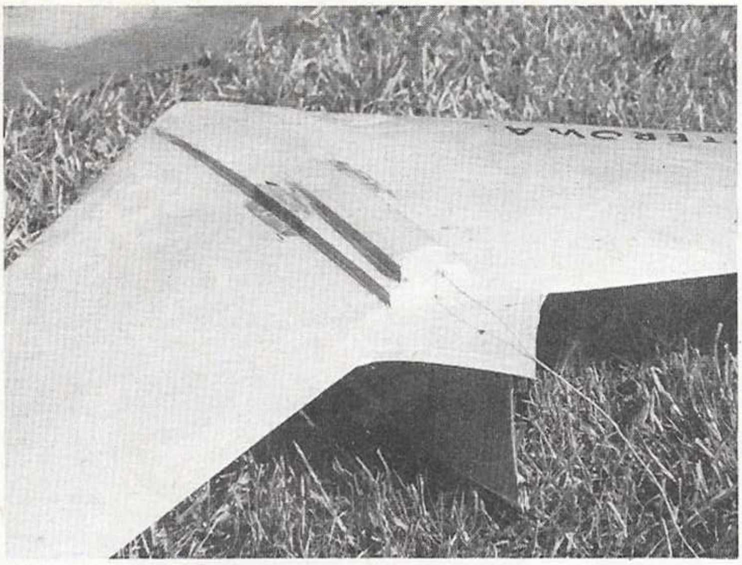
Flying

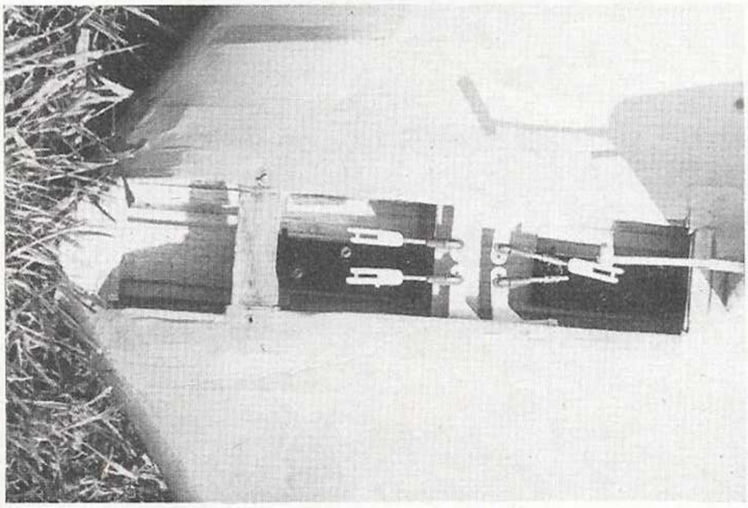
Ensure that the C.G. lies within a tolerance of plus or minus $\frac{1}{2}$ in. from the position shown. Set the elevons $\frac{1}{4}$ in. to $\frac{3}{8}$ in. up relative to the trailing edge. Up and down elevator should give a throw of plus or minus $\frac{1}{2}$ in. from this point.

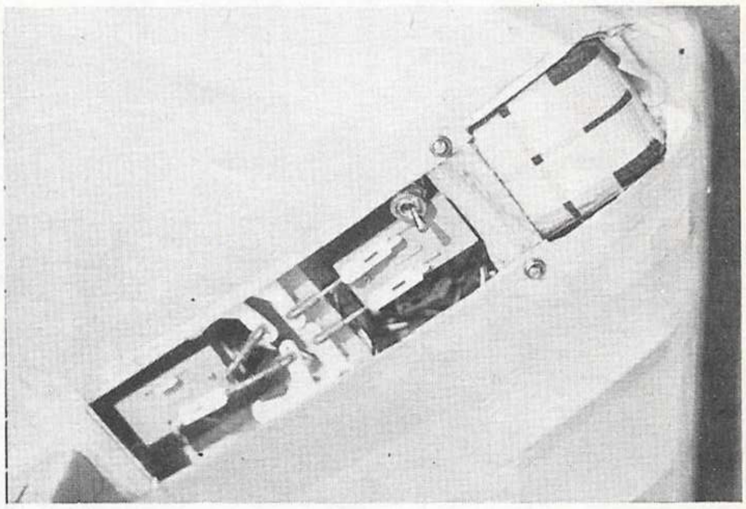
Left aileron to right aileron should give a similar differential throw. Check that your servos *are* going to turn the model in the appropriate direction. Combinations of full aileron and full elevator control should provide a maximum throw of 1 in. from the trim point: *i.e.*, full up and full left should raise the left elevon until the hinge angle is completely closed.

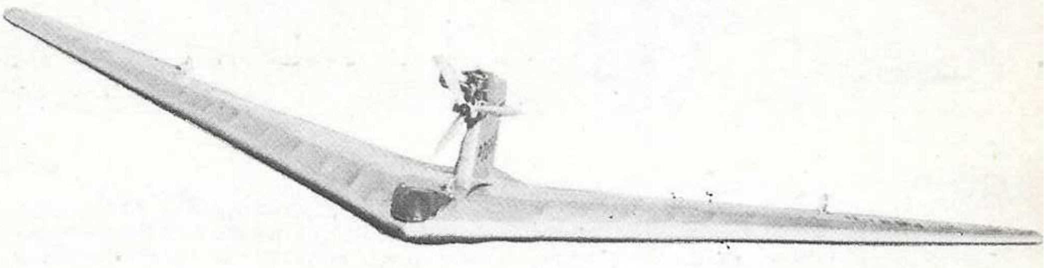
The Mk. 1 will float a considerable distance from a hand-launch, far enough to get the feel of the controls, if you wish, before a power flight. The Mk. 2, due to the extra 8 oz., does not float but still has a flat glide fairly fast but very controllable.

Under power, gain reasonable height before turning and do not let the machine too far away until you are used to the silhouette. I remember trying to control a delta many years ago with great lack of success. Both the control system and I were much slower than









Top left: detail of wing underside showing centre section contour used as hand grip for launching model. Top right: close up of fin showing buried throttle servo. Above: two views showing control linkage and radio installation.

the Cox 15 Olympic powered 3 ft. wingspan 'bomb'. After literally unearthing it, we worked out that an equilateral triangle looked the same heading in six different directions (not including the variations if it were edge-on).

The Mk. 1 Pteroway has been used as a trainer and is not over-sensitive to the controls. The reflex section gives a slight tendency to pull out of dives whilst not causing ballooning.

Fitted with a Cox Babe Bee, it will climb high enough to contact reasonable thermals and great is the astonishment of fellow flyers waiting to see it descend.

We have not tried a TD 051 in it - yet. With the nacelle arrangement shown, it is a few moments' work to try alternative power plants. Incidentally, there is no need to concern yourself with side or down thrust on this model, neither will have much effect since the engine is very near the centre of gravity and the centre of drag. More power will tend to keep the nose down slightly but the change of trim when using the throttle is negligible.

One last warning, flying Pteroway as a pusher without keeping the C.G. within the specified limits resulted in a normal powered flight with the usual rolls and loops until the engine cut. Then came a very floaty glide, followed immediately with a flat spin. If you have ever watched a sycamore seed falling, you will get the idea.

Just keep the C.G. right and happy flying.