SCALE MATTERS

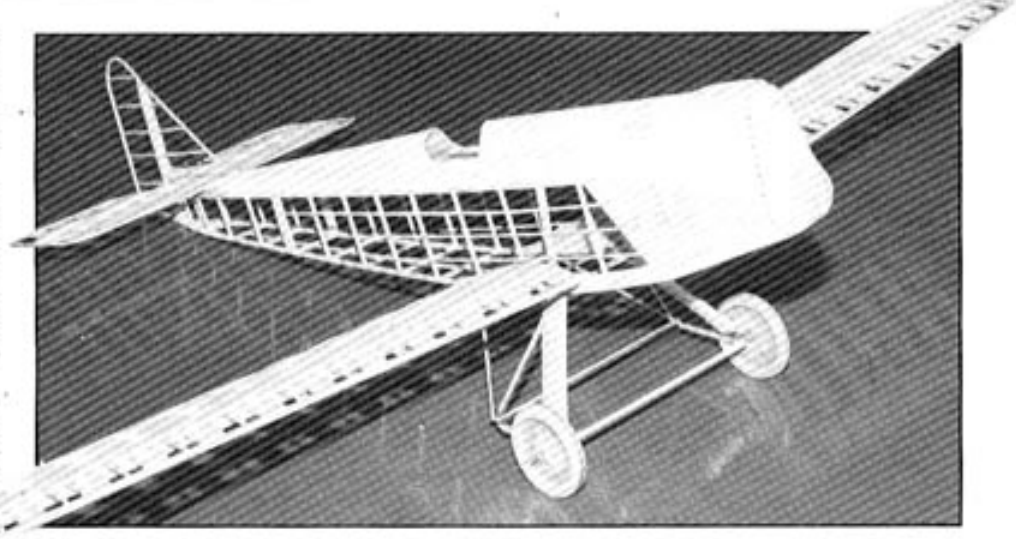
Avro Avian Monoplane

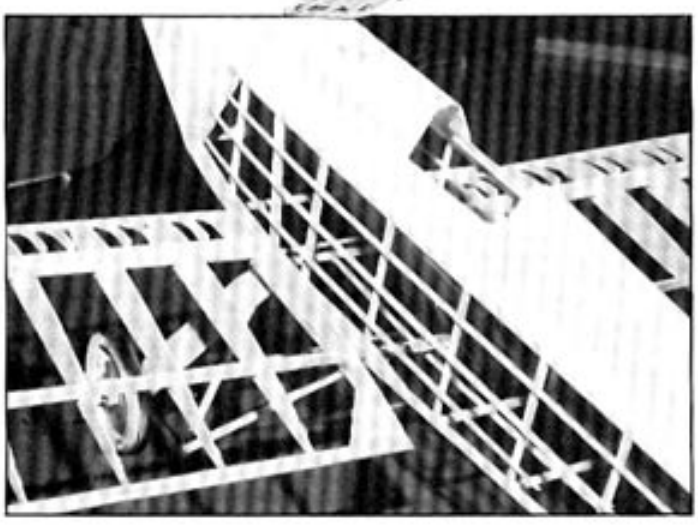
Bill Dennis' introduction to indoor scale...

AFTER YEARS of attending indoor scale meetings as a spectator, I decided recently it was time I had a go myself. I had built an Andrew Moorhouse 'Luton Minor' some time ago, but this is my first serious attempt.

I decided Peanut was too small for my limited skills, and people appeared to be having great difficulties with CO_2 indoors, so I settled on the open rubber scale class – these always seem to have the most pleasing performance. I chose the 'Avian' because it is mostly very simple, with not too much structure and I built it large in an effort to keep the wing loading down.

I then thought it would be a good idea to relate my experiences, as a beginner, and your editor agreed to feature the plan so that others could have a go and learn from my mistakes; there were one or two...





Above, at this stage – not a warp in sight – take note of Bill's hints on jigging during construction! Left, simple and effective 'wing joiners' are made from fine gauge aluminium tube and 20swg piano wire dowels, note lower stringers tapering to nothing at mid-fuselage.

Materials

To build this model you will need some items not available from your local R/C model shop, namely plastic propeller, basswood, Jap tissue and narrow strip rubber, all of which can be obtained from *SAMS*, 2 The Drive, Blackmore End, Wheathampstead, Herts.

I used no special indoor wood, light 'shop' balsa is adequate for the larger model. What *was not* adequate was the quality of my wood grading, which erred on the heavy side. For example, having cut a spar from light wood, it would seem in isolation to be very weak, so I replaced it with something stronger! However, when the structure was complete I could see how each piece imparted strength to the whole and it was obvious that it was much stronger and heavier than necessary, contributing to the generally excessive 'avoirdupois'. I should have known better since I had 'phoned Alan Callaghan beforehand and he had advised me to use the lightest wood everywhere, except for the wing leading edge and longerons, so beware! My realistic target weight was 45g – it finished up at 62g.

A three-view, article and photos appeared in the Autumn 1985 'R/C Scale Aircraft Quarterly' – a limited number of back issues are available and 1/24th scale drawings are available at £1.80 plus 50p postage from *Aeromodeller Plans Service* – please quote plan number 3068.

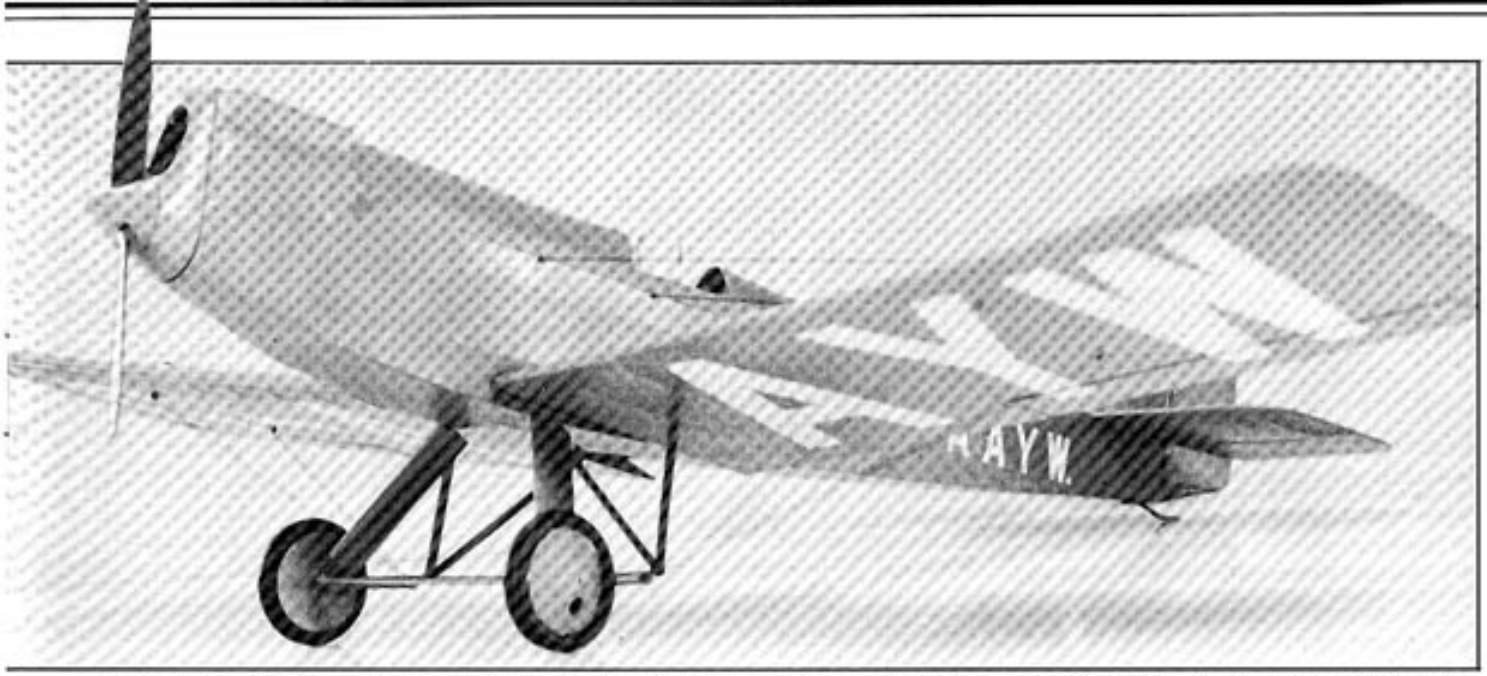
Fuselage

I began with this component and quickly came across my first difficulty, namely that of keeping the structure accurate and true. On an outdoor model, fuselage longerons are large enough to keep their shape, but when dealing with 1/16in sq balsa, I found that they were very easily distorted from their intended path by badly fitting spacers. This is especially noticeable when the fuselage lines are straight, as in the 'Avian'.

My first attempt at a fuselage side frame, built in my usual way, ended up like a wavy banana, so out it went. However, the following method worked very well. First I cut two pieces of ¼in sheet with straight edges and pinned them on the plan following the outer edges of the straight sections of the upper and lower longerons. These were cut to length and held against the sheet with scraps pressed up to the inside edge. It goes without saying, of course, that no pins are hammered through any part of the structure!

The curved portion of the lower longeron is held to shape with pins either side and reinforced with 1/16in sheet – if you do not do this, it will try to straighten itself when removed from the plan, with the upper longeron bending downward. Spacers are cut and the ends lightly sanded to get a *perfect* fit and glued in place with sufficient but not excessive PVA type glue. Finally, the second side is built over the first in the time honoured way – again, the sheet jigs ensure both sides are the same.

I found it even more difficult to assemble the sides accurately, so the sheet jig idea was extended. The fuselage tapers in straight lines from the front of the cockpit to the tailplane and again straight edged pieces of sheet were pinned down, this time along the inside edges of the longerons on the plan view. You can now easily cut two identical sets of accurate spacers, one of which is pinned in place *dry* between the jigs. Next, one of the jigs is removed and one side glued in place – inverted – against the spacers. The jig is replaced against the outside edge and the side kept vertical with several balsa right angled triangles.



The jig left along the other edge ensures that you do not accidentally push any spacers across. When all is set, the process is repeated for the other side and the lower spacers added, and with a little luck you should now have a perfectly accurate rear fuselage. I decided I could not hope to pull in the sides at the stern post without introducing distortion, so I cracked them and joined them in straight lines. Later I added some 1/16in sheet to each one and sanded it to the correct planform.

The curved forward section is more tricky, but not too difficult, especially if you have matched the longerons properly. Again I used balsa triangles to keep the sides vertical and in the right place over the plan while the spacers were glued in. The front sheeted portion of the fuselage tapers in a straight line, these are joined with a temporary former.

Adding the nose former presents a bit of a problem since the fuselage sides taper to nothing at this point. Two temporary jig pieces are tack-glued to the sides, leaning inwards at the correct angles and F1 is glued to these. The area under the nose is filled with ⅛in sheet and sanded to shape – note that the taper is straight here also.

Next I came to the top decking which turned out to be the biggest problem of the model. I soon realised that any attempt at plotting out formers and sheeting over them would end in tears, so I decided to try and make it from tissue paper machè. In cross section there are two distinct curvatures which merge towards the rear. The dividing line was drawn on the side view and tapered balsa blocks produced to suit, from soft ½in sheet.

The lower block was lightly spot glued to the top of the fuselage, and lines drawn on the plan view surface to show where the change of curvature starts. Using knife and sanding block, the lower curvature was carved in, using the photographs as a guide; the upper blocks were shaped before glueing in place. The fillet was made with *Polyfilla* applied with the back of a spoon to get the correct radius.

The former was doped and sanded, then glued to a baseboard. I could have made a plaster mould but what I had to hand was fibreglass and I used a combination of one layer of *Modelspan* plus two of matt. Use a suitable release agent – I used *Vaseline* and it doesn't work!

The decking was laid up with three layers of lightweight *Modelspan* soaked in diluted PVA. This proved a very quick method but there were problems. Several blemishes appeared which needed filling and it was heavy at 6 grams – with dire consequences in terms of nose ballast. On reflection, another method would be to produce the former block and cut it up to give a series of perfectly accurate cross sections for the production of formers. These could be reduced by 1/32in and glued in place, and finally sheeted over with 1/32in balsa panels; it may not be as easy but certainly much lighter. Alternatively, use *very* soft block and hollow out...

The four aluminium tubes for the wing dowels and undercarriage are firmly glued in place, followed by the side and bottom stringers, for which only basswood is suitable. Glue these to the outside of the fuselage and taper them to 1/32in or less at each end – they are very resilient and will not pull in under the covering.

Finally finish filling in the upper nose area and produce a noseblock, incorporating side and downthrust when drilling for the bearing tube. Glue some scraps of balsa block to the port side of the nose and sand them to the correct shapes, using the sketch, three-view and photographs as a guide. These will be partially overlaid with litho plate, overlapping at the rear to give a realistic effect.

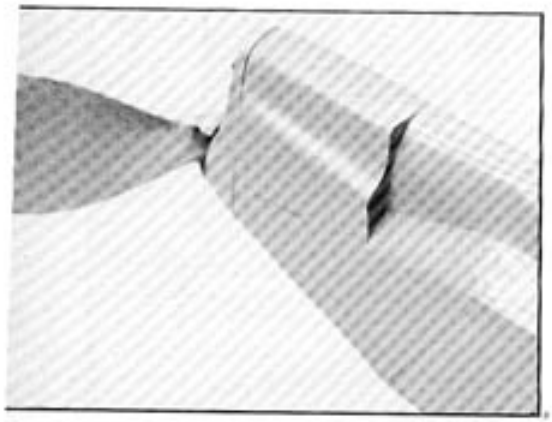
Flying surfaces

Both wings and tail use laminated outlines. I used three laminations of 1/16in × 1/32in soft balsa, but two of basswood would be better – the latter would need soaking in diluted ammonia solution to facilitate bending. Basswood is stronger and more resilient to pulling-in of unsupported areas, which proved to be a problem.

Cut formers to the inside outline shape, being careful to maintain the correct curvature, rub the edges with a candle to prevent sticking and pin down over some polythene sheet. Glue the strips together with plenty of thinned PVA and run them through a tissue, squeezing out excess glue. Then hold them against the formers with scraps of balsa that also have been 'glue-proofed' with the candle.

The main structures are quire straightforward, requiring no special techniques, except to reiterate the importance of good fits. Incorporate scraps of 1/64in ply between aileron spars etc to maintain a gap

Above and right, completed model enhanced by neat lettering – well worth the time spent. Photos show scale propeller, flying prop is cut down Peck 8 inch...



Above, litho plate is used for nose panelling (chat up your local print shop). Below right, wheel and rigging detail.

on final assembly. A major problem that cropped up during covering was that of pulling-in of unsupported surfaces, especially the wing tips. This will be eased if using basswood but it is very disappointing if it happens, so I would advise a little judicious reinforcement with 1/32in × 1/8in strips glued along the inside of the wing and tail tips.

I chose to make the wing 'knock-off' and haven't regretted it – don't be tempted to save a tiny amount of weight in this area. I know many experts can get away with one-piece models but the wings always come off mine, taking half the tissue on the fuselage with it. Glue the tubes in place in the position shown.

Undercarriage

There is a lot of wire in the undercarriage but I can't see much scope for reducing weight. You might get away with 24swg in places, but I don't think it is worth it – weight here on a low-winger adds to stability. Make the two main frames, spring them into their tubes and make some temporary balsa jigs glued to the lower fuselage to hold them at their correct angles. It is then an easy matter to bind and solder the other members.

I had hoped to make 'real' wheels with rubber tyres but these would have been 3 grams each and I was beginning to worry about weight at this stage, so I made them from balsa rings glued to a 1/32in ply disc. Put an 8 BA bolt through the centre, mount in an electric drill and turn them using a sanding block. A similar method is used for the spinner.

Covering

Models of this type are covered with Jap tissue – I got mine from Mike Woodhouse (see *Aeromodeller* July 1984) but it is also available from *SAMS*. If you have not used Jap before, you will find it has quite different properties to *Modelspan*, although they are not dissimilar in weight. Jap has a shiny finish and does not absorb dope to anything like the same extent as *Modelspan*, it is for this reason that it is ultimately lighter. In turn, this means that you cannot use the technique of attaching the tissue by brushing thinners through onto the previously doped structure, since it will not soak through so easily.

What you will have to do is apply the dope to the model and lay on the tissue while it is still wet, pulling it out so that it is as wrinkle-free as possible. Do not worry too much about getting it tight – it is more important not to induce warps. It is also essential to make sure that it adheres properly, so use a small brush to apply extra dope to local areas if necessary. If you do not do this, the tissue will pull away when being shrunk (see Dave Hipperson's 'Covering problems' in November *Aeromodeller*).

The other property of Jap tissue is that water shrinking is much more effective than dope. The method I used was to lightly steam the tissue over a kettle; you can always increase the degree of steaming if the tissue does not tauten but this is unlikely. I gave the model two coats of 50% dope/thinners but in retrospect I think this was a little over enthusiastic – 30/60 should be okay or even use non-shrinking banana oil. I did not bother to pin down the flying surfaces but held them near a fire (not close!) until the dope was dry. Use banana oil – not shrinking dope – on the top decking, or it will pull-in like mine did!

With the model covered, now is the time to add the details, although there are not many. The hooks for the rigging are bent from strips of litho plate ⅛in wide and epoxied in place. I also used litho plate for the panelling around the nose, since the weight does not matter here and it looks so much better. The various shapes were developed with tracing paper and transferred to the plate, cut out and annealed if necessary to facilitate bending. The upper port panel overlaps the balsa side formers to the rear, but falls short at the front where there is double curvature – the gap is filled with *Polyfilla*. By one of those happy coincidences, litho plates have a series of holes along the edge of the correct size and spacing to suit the exhaust holes and these were gratefully made use of.

The article accompanying the scale three-view describes the colour as being *Humbrol* 38 Lime Green with a dash of white added and there is a picture of an R/C model finished in this scheme on the cover. If you possess and can wield successfully, an airbrush then this stage will be easy. I rely on car aerosol paints for this kind of job and a very good match is *Dupli-colour* BL Applejack Green.

I found it useful to spray a first light coat of white primer; this makes it easier to get a good finish with fewer coats. When the green is sprayed, the tissue goes horribly slack but it tightens up again and looks very good...with an eggshell sheen.

The lettering really transforms this model. For the fuselage registration use *Trimfilm* white decal sheet, available from *Hannants of Lowestoft* (address: 56 London Road North, Lowestoft, Suffolk). Very carefully trace the letters, go over on the rear

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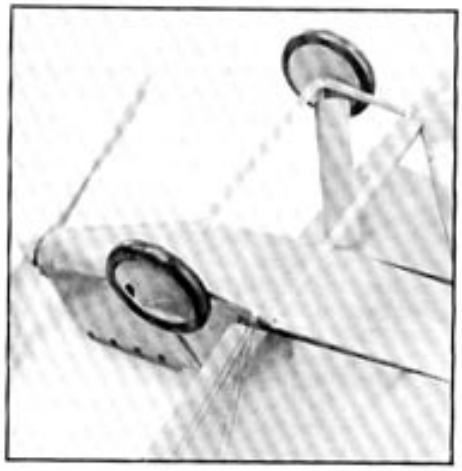
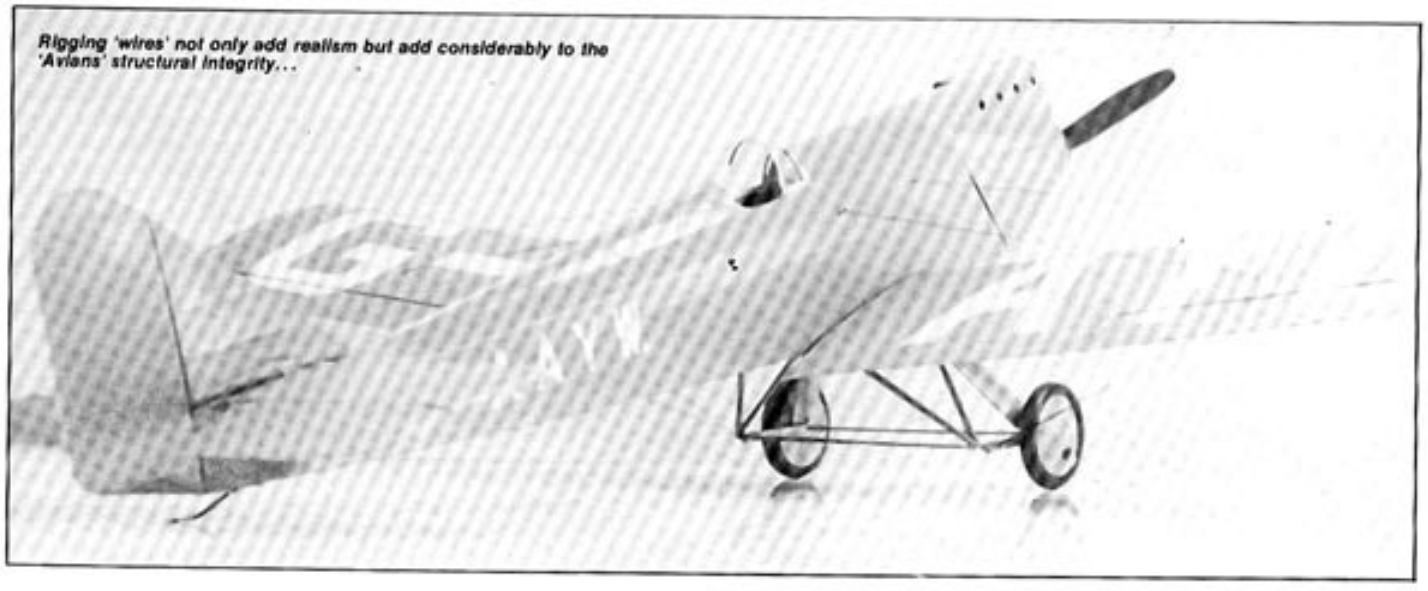


Rigging 'wires' not only add realism but add considerably to the 'Avians' structural integrity...



Avro Avian Monoplane

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face of the tracing paper and transfer to the white surface of the decal. This way, you only need to lightly cut the shapes - if you trace onto the back of the carrier sheet you will have to cut right through, of course. Use a clean rubber (eraser to our American readers!) to remove the pencil and then apply the decals to the model.

Wet the area with a little water to which a spot of washing-up liquid has been added. This makes it easy to move the letter around, in fact it can be used to soften a 'set' decal if you subsequently decide it is in the wrong place. Position the letters against a feint line drawn on the model with a soft pencil and space with a strip of paper marked off from the plan.

Unfortunately, *Trimfilm* is too narrow for the wing registration. You could make each letter in two parts, but *Hannants* also supply sheets of clear decal, you will need two to allow for mistakes! Give this just sufficient coats of the spray white primer to cover and treat as for the *Trimfilm*, although the effect is not quite as good, since it is thicker. There are also two tiny red, gold and blue emblems and a weight table, neither of which I have done as yet, but these will be made from the clear decal.

Finally, solder twists of fuse wire to retain the wheels, then apply the cones made from paper, previously doped and coloured.

Assembly and trimming

Control surfaces are attached to the wings and tail, glued with little pieces of 1/64in balsa between, in order to give a gap. I found that if the rigging loops were made fairly tight, they kept the wings in place on their dowels. With the motor installed, I was disappointed to find I needed several grams of lead in the nose to achieve a reasonable balance point...the model clattered onto the scales at 64g - well over my target weight!

I did my initial trimming outdoors and had little trouble in achieving a stable right-circling flight pattern, with ample duration and scale speed...in spite of the weight. In fact this would make a very nice outdoor model for calm evenings, but it was intended for indoors so I took it along to a local meeting to see how it performed within four walls...

The hall was quite long but very narrow compared to, say, the Walsall site for the Indoor Nationals and I found myself very glad that it was not a one-piece model! With some extra right rudder I was able to get it to turn tightly without any problems but there was so little margin for error that most flights gradually wandered towards a wall - those that were not terminated early, finished in very satisfactory landings.

Once again, the scale speed seemed about right even with the model carrying so much weight - it was just the sound of the bang when it hit the wall that worried me!

I would say that getting almost any indoor model to fly safely is fairly straightforward; the time-consuming part is getting the right combination of motor thickness and length. The aim is for the model to have sufficient power to take off and cruise at reasonable height, but also land with turns remaining. This latter point seems quite important, as it eliminates problems of transition and the need for a freewheeling propeller, not to mention the noseblock falling out!

I would suggest beginning with four strands of ⅛in flat rubber, and take it from there. Increasing motor length will give more duration but less power for take-off and height gain, while shortening the motor, or increasing strand number and/or width will have the reverse effect, possibly leading to turns running out in the air. You may find it useful to make a jig on which to test the motors with a propeller attached, rather than keep putting them in and out of the model.

In conclusion, I think this has proved to be a very suitable first indoor scale model, and it should be a simple matter to produce a lighter version by following the retrospective suggestions. Why not have a go at the Indoor Nats.?

Avro Avian weights:

	Uncovered	Covered and painted
Fuselage	8.0g	16.1g (+ panels)
Wings	7.0g	14.3g
Tail	1.5g	3.7g
Undercarriage	7.0g	7.3g
Prop/noseblock	5.2g	5.2g
	28.7g	46.6g
+ motor, details and ballast	Total	64.0g