DURING the past 5 years much experimental work has been carried out, in certain circles, on the subject of Lightweight Model Aircraft. As the interest in this particular branch of our hobby seems to have grown considerably of late, it was thought that it was high time an article was written on the subject.

Due to space limitations, it has been decided to limit this particular article to Lightweight Sailplanes and to discuss the other half of the branch, namely Lightweight rubber powered models, at some later date. It is also hoped later to discuss the power model question. Much has been written on the latter, and many plans have appeared in journals in this country. Nevertheless, statistics show that Great Britain is still very far behind the American and the Continentals—one might even say 10 years. However, more about that later, we're digressing from the point.

Back in 1942 experiments were carried out with extremely light sailplanes, incorporating single surfaced planes and no weight box! The wing was merely set far enough back for the nose of the model to obtain correct balance. The models were found to be unsuccessful—towline launching was almost an impossibility—and were blown about, in even a slight breeze, like so much chaff!

Heavier models were therefore constructed and at once proved more successful. Long fuselages—giving long moment arms—of small cross sectional area were found to be a definite advantage. Stability was greatly improved, as well as performance. Parasol mainplanes, giving a more undisturbed airflow over the wing section were another improvement. Naturally problems arose, one of the greatest being rigidity. No one will disagree when it is stated that nothing can upset the stability of the model more than flexibility of the lifting surfaces and rudder surfaces. The use of long and small cross-sectional area fuselages brings about flexibility and double cross-grained tissue covering was introduced as a remedy. Damp weather slackened the tissue, however, and we were back where we started from. At length much internal cross bracing was used and this brought the required result. Even uncovered fuselages were remarkably rigid, and the trouble was entirely eliminated when the covering was applied. Right is a sketch to give the general idea.

The next problem that arose was the debatable question over tail surfaces. Should the tail-plane be lifting, non-lifting or inverted lift? Should it be placed high or low upon its fin? Should more than one fin be incorporated? In order to decide these points we must ask ourselves to what purpose are we designing and building the model? We are aiming to produce a consistent and high performance sailplane. Now if we place the tailplane high or low upon its fin, rigidity once more becomes the problem, also stability.

It was found that no definite advantage was obtained by placing the tail high or low, added to the fact that it was more difficult to do so. Consequently to save ourselves much bother, we placed the tail on the fuselage.

Many people are loath to use non-lifting tail surfaces, in the belief that they are losing valuable lift. Lifting tailplanes were always found to be a source of trouble, especially when a full section was employed. Marvelous results were obtained in dead calm weather but dive-in after the model turned down wind, in a stiff breeze, caused too many broken models and too many lost contests! Non-lifting or very shallow lifting sections were found to be far more reliable, and so in these days of tissue and good balsa shortage, high lifting tailplanes were left severely alone.

For the sake of simplicity, the old idea of using one fin was used. Use of two fins did not seem advantageous and once again difficulties in obtaining the necessary rigidity were encountered. The stability is perhaps better when two fins are used and so a compromise was introduced—namely the use of tip dihedral and polyhedral on the tailplane.

Various wing sections were used in an effort to discover the most suitable. The question we must ask ourselves here is do we wish speed too, or not? If we do wish for speed and not thermals then surely we'd build a heavy model. The lightweight sailplane is of little use for slope soaring as Mr. Temple will readily agree. We desire the model to fly slowly, and so benefit any thermal it may encounter. Undercambered wing sections produce slow flight and much experimenting was carried out with various types.

It was found that the deeper the undercamber the slower was the forward motion, but extremes brought about bad stability. Bad stability was also encountered using deeply undercambered and thick sections, as shown in the accompanying diagram (2).

In the section Marquardt S—2 was found exactly what was desired. Slow flight was obtained, high lift and good stability. Many other sections where suitably modified, also give excellent results and a few details will be given here regarding these. Because of shallowness in all these sections, spars which would cause weakness were eliminated and a thick leading and trailing edge employed. To cut down on weight soft stock is recommended. Due to the large section, strength is ample.

Covering of deeply cambered surfaces presents no difficulties, if one cements the tissue to all its ribs on the
undersurface and to the point of deepest camber first, cementing to leading and trailing edges finally. In order to achieve an accurate wing section, without using spars, it is desirable to use many more ribs than usual and so prevent the tissue sagging and giving a "scalloped" effect to the finished wing.

Constant chord wings were favoured for simplicity, as were slabsided fuselages, the improved results from streamlined models scarcely warranting the extra work entailed in their construction.

A sailplane should turn in quite small circles, if it is to take advantage of any available lift from thermals, and here difficulty arises in tow-launching. Offset tow hooks, however, cured the fault of turning on the line, the hooks being bound to the side of the fuselage to which the model would normally turn, i.e. if the model turns to the right, the tow hook should be on the right-hand side of the fuselage, so that the turn is counteracted whilst on the line.

Tow hooks were set well back, the rear one being right under the C.G. The rate of climb is thus terrific when the model is on the line and considerable strain is imposed upon the mainplane. Thus it was found that a running launch was favoured in place of winching. Under most conditions, it was found necessary after the model was launched to run towards the model in order to relieve the strain on the wings by the high rate of climb.

Finally, it was thought that one or two practical limits on construction would be welcome.

(a) If plenty of cement is used on all joints, the model will never rely upon its covering to hold it together.

(b) The best way to re-cover a model is to submerge it in a bathful of water around 60-70 degrees F. The tissue floats off and the model can be re-covered in entirely different colours with no trace of the former covering.

(c) Multi-coloured models keep in sight longer.

(d) Dethermalisers prove very useful in contests and are simple to construct. All that is necessary is a piece of tissue about 8 ins. diam. (for a 30 in. span model) with a 3/4 in. dia. hole in its centre. Four or 6 cotton strands are cemented at equal distances around the circumference and tied together about 6 ins. below the chute. A single piece of cotton is used to attach the ends of the strands to the very end of the fuselage, its length depending upon the length of the latter. The chute is folded and held to the fuselage by a piece of cotton (the shrouds should be taut.) On one corner of the fuselage a piece of mica is cemented, the cotton holding the chute to the fuselage side passing over this. Fuse is made by soaking string in a solution of potassium nitrate and allowing it to dry. Rate of combustion per inch is determined.

Before a competition flight, one estimates on the conditions of the day (wind, visibility, etc.) the maximum duration a model could do before passing from sight and the appropriate amount of fuse is cut; e.g. if fuse burns at rate of 1 inch min. and max. duration possible under weather conditions is 5 mins., 10 ins. of fuse should be used. This is placed under the cotton holding the chute to the fuselage and over the mica, so that 5 ins. of the fuse hangs either side of the cotton. Both ends of the fuse are set alight. By using this method, if one end of the fuse expires, there is still the other! On reaching the mica the fuse burns through, the cotton releases the chute, which opens behind the model and brings the latter safely to terra firma. N.B.—Mica should be used in preference to other substances, as it does not absorb heat from the smouldering fuse and put it out before the cotton is burnt through.

The accompanying sketch shows the general arrangement.

The added weight is negligible and by its use a contest may be won and an otherwise lost model safely retrieved. As an example I might quote Mr. Waring’s model in the 1946 Gamage Cup.

The sailplane design given overleaf incorporates most of the desired features mentioned above and has proved itself to be a reliable and consistent high duration performer. Full size plans are available, price 3/-, from our Leicester Offices.