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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

TECHNICAL MEMORANDUM. 166

LESSONS OF THE GLIDER MEETS.

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LESSONS OF THE GLIDER MEETS.*

By Edward P. Warner.

Three glider meets have now been held in Europe during 1922. From the Combegrasse in Auvergne, from the Wasserkuppe in Hesse, and from the Itford Hill on the South Downs the motorless flying machines have been launched forth. All previous records have been beaten many time over, and the information obtained in the several countries should now be gathered together with a view to deducing the general rules on which successful gliding rests.

If aeronautical engineers had been questioned as to those rules a year ago they would have declared with substantial unanimity that the primary essentials were light wing loading and high efficiency, or low resistance. The high efficiency insured the ability to glide on a path only slightly inclined below the horizontal, while the light unit loading connoted a low speed along the path. Obviously a low rate of vertical descent, the fundamental desideratum in a glider, can be obtained only by traveling as slowly as possible along a path inclined as little as possible.

So we should have reasoned last spring, but the event has shown the reasoning not wholly correct, or at least incomplete. The machines which hold the world's records today are not by any means those which conform most closely to the specifications just laid down.

In the first place light loading has proved unimportant, except that a lightly loaded glider can perform satisfactorily in somewhat lighter winds than would be possible for the more heavily loaded

* Taken from the Christian Science Monitor, November 13, 1922.

types. In some cases it even seems harmful. Neither the Hanover glider, on which Hentzen flew for three hours and ten minutes, nor the Peyret monoplane on which Maneyrol later beat the German's time by 12 minutes was very light; the wing loading being about $2\frac{1}{2}$ pounds a square foot of wing surface in each case. This is the same loading that was used in the early Wright biplanes that were employed for exhibition work in 1910 and 1911. Many of the French gliders were loaded only $1\frac{1}{2}$ pounds a square foot or less, and Fokker's biplane actually went below a pound, but the French performancesat the Combegrasse were disappointing and it was interesting to notice that Fokker made his best showing and his longest flights when carrying a passenger as ballast. Another illustration of the possibilities of high loading was given by the record of Squadron Leader Grey at the English meet. He made a glide lasting more than an hour on a machine assembled from parts of old airplanes at a total cost of less than $5.00, although the weight of the structural parts was appropriate to a pursuit airplane required to mount a 200-horsepower engine and execute acrobatic maneuvers rather than to the very gentle stresses falling on a glider.

The reason for the merits of heavy loading is not wholly clear, but it is involved largely in control. A heavy machine can soar, or glide in ascending currents, if the wind is strong enough and if the pilot is able to find the ascending current and stay in it. To do that requires that he should always have control enabling him to turn quickly and to combat without loss of time any disturbances arising from atmospheric irregularities. It is easiest to obtain

satisfactory control at moderately high speed, especially in strong winds. The term high speed in this connection is of course purely relative, since even the heaviest and fastest glider would hardly exceed 40 miles an hour, 25 to 35 being the normal rate of travel for most of the successful machines.

Although the controls of the record-breakers were, as just noted, in all cases distinguished by power and certainty and quickness of response these results were ordinarily accomplished without radical innovation in design. The one exception was the Peyret machine, present holder of the world's duration record, which has two wings of equal size in tandem arrangement, the trailing edges of both wings being fitted with flaps. The glider could be rolled by pulling the flaps down on one side and up on the other, while the longitudinal inclination could be altered by pulling both flaps down on the forward wing and up on the rear, or vice versa. This differential adjustment was obtained through a system of gearing rather more complex than the standard control, but splendid results were obtained. No doubt next year will see numerous further experiments along the same lines, as it is easier, cheaper, and safer to try such innovations on gliders than on engine-driven airplanes.

As for efficiency it is found that the best results are in general obtained with monoplanes, only the Fokker among the biplanes having made a good record. The most successful designs have wings of large aspect ratio, or long in span from tip to tip and of small length parallel to the direction of flight, and it is known that that, like the monoplane arrangement, is a feature favorable to

aerodynamic efficiency. In one instance very excellent flights of considerable duration were made with a machine built with great crudeness and seemingly without regard to what would ordinarily be regarded as the first rules of aerodynamics in design, but with an abnormally high aspect ratio, the wing being about 50 feet by 3. Some very good gliders did not even have high aspect ratio. The Peyret, the present record holder, uses a wing arrangement of very low efficiency in conjunction with a body of such high resistance that many observers doubted its ability to get off the ground. The record flight was made in a 40-mile wind. It can be said of efficiency, as of light loading, that it can be dispensed with if conditions are sufficiently favorable, and that the one thing without which it is impossible to achieve success is adequate control.

In summary, the experiences of the summer showed that it is possible to soar for hours over a favorable terrain with a glider embodying no radical departures from standard airplane practice, and that the difficulty of constructing good gliders has in general been overrated. It is a matter of good design and good piloting rather than of featherweight construction.

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