factor of safety in the materials of construction. If it is unsafe to anticipate an exaggerated efficiency, it would be equally unsafe to ruthlessly sacrifice the factor of safety in order to reduce the weight of the machine to a value in keeping with a very small ϵ and the desired flight speed. It is clear that the manufacturer of aeroplanes must move warily, and X, x and ϵ will have served their purpose if they give him some little glimmer of light in the dark.

And now it is necessary to give, quite briefly, the details of the calculations on which the charts are based :—

1 h.p. = 375 mile-pounds per hour.

∴ $375 \times \epsilon$ = maximum power available per h.p.

Weight × gradient-angle = resistance to flight.

[The difference between the gliding-speed and maximum flight speed introduces an error in the assumption that the gliding angle = equivalent gradient of horizontal flight; but the fact remains that the gliding angle is the best comparative figure of resistance at present available for several different types of machines, and as such is naturally a guiding factor in design. In any case, it is *essential* to design for some *gradient* angle, and it is for the manufacturer to make the choice in the light of the best evidence available. From the Military Trials, it is apparent that 1 in 6 is a reasonable figure, and the charts have therefore been based on this value.]

Thus :—

(Weight of machine in flight (lbs.) ÷ available power (h.p.) from engine selected) = load per h.p. (lbs.),

and, Resistance to flight per h.p. = (load per h.p. ÷ 6).

So, Maximum flight speed m.p.h. = $6(375\epsilon)$ ÷ (load per h.p.).

The next step is to find the appropriate loading for the wings, which is where the constants X and x come in so handily to simplify the calculation.

It will be remembered that—

X = (load per h.p.) × (loading per sq. ft.), and $x = X \div 2$.

Loading per sq. ft. = (max. flight speed) ÷ ½(load per h.p.).

∴ Wing area per h.p. = (load per h.p.). (Loading per sq. ft.).

The three calculations are graphically illustrated in the charts by the three curves.

There is also a subsidiary calculation that can be made from the chart, which gives the appropriate effective angle for the wings in each case.

Thus (referring to "Principles of Flight," p. 73, formula 10) :—

Loading per sq. ft. = $(V^2 \tan \beta) \div 200$.

∴ $\tan \beta = 200$ (loading per sq. ft.) $\div V^2$.

From which simple formulæ have been derived the values of the limiting effective wing angles attached to each diagram. For the meaning of "effective angle" in this connection, however, readers must refer to the book above mentioned, as the subject is too extensive to be a digression in the present place.

These wing angles are interesting as they indicate the relative amount by which the wings of a machine can be altered in angle in order to fly more slowly for the same amount of power consumed. That is to say, the degree to which increasing the wing angle alone will reduce the present known value of a machine's efficiency.

Again, each wing angle has its appropriate coefficient of flight (gliding angle) which for these charts ranges from more than 1 in 9 to less than 1 in 5. Thus, a good gliding angle implies a fine wing, which in turn implies a low loading or a high speed.

It must clearly be borne in mind that the charts give *limiting* values; they establish a relationship that must not be exceeded, but, of course, they leave it open for a designer to keep as far below their standard as he can. It depends, as I said in the first instance, altogether on the point of view from which the design originates. If the object is to build a typical 80 per cent. efficiency monoplane, then the full values permissible according to the 80 per cent. chart may be taken. But, if the origin of design is to obtain a greater range of speed by the use of larger wings and a lower loading, on a machine that in structural design belongs to the 80 per cent. class, it does not mean to say that the modified dimensions will limit the maximum actual flight speed to the new value of x.

Thus, let us take the Farman as a case in point. This machine has a value of $\epsilon = 46$ per cent., but from its structural design there is nothing to indicate why it should not reasonably anticipate an efficiency in the order of 65 per cent., which is readily attainable by most biplanes. Its very large area is the only disproportionate factor in the situation, the loading being less than 3 lbs. per sq. ft.

Turning to the 45 per cent. chart it will be observed that the wings lift this loading at just under 40 m.p.h. (the gliding speed was 39 m.p.h. and the gliding angle 1 in 6·8), and turning to the 65 per cent. chart it will be observed that the load per h.p., which is just under 27, can be propelled at 55 m.p.h. for 65 per cent. efficiency and a resistance of 1 in 6. The actual maximum flight speed of the machine was, as it happened, 55·2, but the demonstrated efficiency was only 58. I do not pretend that these charts afford ready-made solutions to problems of this character, because a number of factors have to be considered that cannot thus simply be taken into account. They may, however, pave the way to something more useful in the future, and if they help firmly to establish in the minds of students a fundamental line of thought of the simplest possible mechanical order, the labour spent upon them will not altogether have been in vain, and the process of "thinking aloud" in FLIGHT from week to week during the height of the interest in the Military Trials, not wholly without some justification.

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The Royal Aero Club of the United Kingdom

OFFICIAL NOTICES TO MEMBERS

Royal Flying Corps Fatalities.

The news of the sad accidents at Graveley and Oxford was received at the Club with great sorrow, and the Chairman, Sir Charles Rose, immediately forwarded messages of sympathy to the relatives of Capt. P. Hamilton, Lieut. A. Wyness-Stuart, Lieut. E. Hotchkiss and Lieut. Claude A. Bettington. The following message has been received from Major F. H. Sykes, Commandant of the Military Wing of the Royal Flying Corps :—

"All ranks thank Chairman and members Royal Aero Club very sincerely for kind message of sympathy."

Officials of the Club visited the scene of both accidents, and a careful examination of the wreckage was made. Reports will be submitted by them to the Accidents Investigation Committee, a meeting of which has been specially called for Tuesday next.

Dublin to Belfast Race.

The race from Dublin to Belfast was started at Leopardstown on Saturday last, but, owing to the unsuitable weather, the competitors were unable to reach Belfast. Astley and Valentine both managed to get as far as Newry, a distance of about 60 miles, when the weather conditions prevented them from continuing the race. The Committee of the Irish Aero Club decided to divide the first prize of £300 between Mr. H. J. D. Astley and Mr. James Valentine. Lieut. Porte was awarded the "Shell" prize of £50, Mr. Desmond Arthur a special prize of £25. A further sum of £40 was given to each competitor towards his expenses. Excellent arrangements were made by the Irish Aero Club, of which Mr. John Dunville is the chairman.

British Empire Michelin Competitions.

Intending Competitors are again reminded of the following prizes :—

British Empire Michelin Cup No. 1... ... £500 Prize.
British Empire Michelin Cup No. 2... ... £600 Prize.

The Competition for No. 1 Prize closes on October 31st, 1912, and No. 2 on October 15th, 1912.

The rules can be obtained on application to the Secretary.

Gift of Pictures.

Dr. W. J. S. Lockyer has presented the Club with two framed photographs of the Eastchurch Flying Ground, taken from a height of about 1,000 ft. from Mr. F. K. McClean's tractor biplane.

Mr. Esdaile has presented the Club with an original copy of a poster representing and describing (in Kanarese) the first aerial flight in Bangalore, Southern India.

166, Piccadilly. HAROLD E. PERRIN, Secretary.