STABILITY OF THE CLARKE GLIDER.

BY T. W. K. CLARKE.

IN FLIGHT of December 4th, a correspondent, "P. K.," raised the question of the longitudinal stability of a machine having a small plane in front and a large one behind. In answering, you referred to my models, quoting Lanchester to the effect that the reason of this stability was a problem of some obscurity. In a paper read before the Aeronautical Society last year, I referred to this point, and gave an explanation of the action, which is somewhat akin to that of the dihedral angle in connection with transverse stability. Possibly it may be of interest to recapitulate the argument :—

Denote by A (Fig. 1) the area of the large back surface, and by α its inclination to the line of flight.

FIG. 1.

Denote by B (Fig. 1) the area of the small front surface, and by β its inclination to the line of flight.

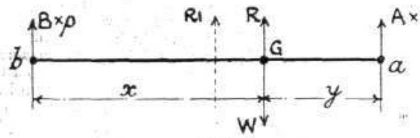

FIG. 2.

a and b are the centres of pressure of the two surfaces during flight.

Denote by Y the inclination of the front surface to the back surface. (In my models this is generally about $2\frac{1}{2}°$.)

For simplicity imagine the two surfaces to be flat.

We see that we have $\beta = \alpha + Y$.

Now since α and β are small (6° or 7° at most) we know that the intensities of the air pressures (*i.e.*, lbs. per sq. ft.) on A and B are roughly proportional to their inclinations α and β, and therefore the total pressures on the surfaces are proportional to $A \times \alpha$ and $B \times \beta$, and may be supposed to act upwards at a and b, as shown in Fig. 2.

The resultant of these two pressures will be a force R acting upwards and dividing ab into two sections, x and y, proportional to $A \times \alpha$ and $B \times \beta$.

$$i.e., \frac{y}{x} = \frac{B.\beta}{A.\alpha} = \frac{B(\alpha + Y)}{A.\alpha} = \frac{B}{A}\left(1 + \frac{Y}{\alpha}\right)$$

For steady flight this force must just balance the weight, W (Fig. 2), and therefore must act upwards through the centre of gravity.

Now suppose that, for some cause or other, the inclination of the machine to the direction of flight, *i.e.*, α (and also β) is reduced. Then $\frac{\gamma}{a}$ is increased, for γ is a constant of the machine. Also $\frac{y}{x}$ is increased, *i.e.*, y is increased and x decreased. The resultant of the pressure then moves forward to R^1 ahead of G, and we see that we get a righting couple that tends to increase α again. Thus if α was increased by accident the machine would tend to tilt so as to bring α back to its original value. Hence we see that such a disposition of surfaces tends to keep a machine at a constant inclination to the direction of motion.

If such a machine, while being propelled by a screw capable of keeping it flying in a horizontal line, should at any time begin to turn downwards (keeping, of course, the same inclination to the direction of motion—in this case a curve), its velocity forward will begin to increase owing to the help given by gravity, and it will, therefore, get an excess of pressure, and begin to rise again until its velocity becomes normal again, *i.e.*, the machine will be stable (longitudinally) in the ordinary sense. But this recovery motion may be overdone and an oscillation set up, which may either die out or increase. The former is perfect stability, the latter culminates in capsizing of the machine. As to which will happen depends on the actual values of the areas, moment of inertia, &c. The calculation is exactly similar to that initiated by Mr. Lanchester, except that his calculation is a particular case (viz., when $\alpha = \theta$). I do not propose to inflict it upon your readers (nor have I got it or the formula by me now). The deductions as to I (moment of inertia) and l (in this case the distance ab), &c., are, of course, also similar.

Mr. Lanchester, in his book, refers to the large back surface of my machine as "a species of pertrophied tail." I think I should be just as logical to refer to the small tail surfaces of his beautiful models, as also to those of others having tails, as "atrophied sustaining surfaces." On the Blériot and Antoinette machines it is interesting to note that the essential difference is that in the former the back surface is a sustainer, while in the latter it is a pure tail, *i.e.*, directive only.

The advantage of having the small surface in front is that interference, due to the rear surface being in or near the wake of the front surface, is reduced. My models have in this respect taught me a great deal, and so far as models are concerned the arrangement of the leading plane gives a handier position for the centre of gravity.

May I be allowed to mention that in my 1907 patent I claim a machine "having two sustaining surfaces set transversely across the framing, in which the front one is considerably smaller than the back." This, I believe, is good, and I mention it as I believe there are some people making such machines (for sale) who may not be aware of my claim.

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"WILD-CAT" SCHEMES AND "PREMIUM" HUNTERS.

THE following warning has been issued by the Aeronautical Society which should be noted against the time any flagrant cases of promotion see the light of publicity. We have several times given our views upon this same subject :—

The Council of the Aeronautical Society of Great Britain, in view of the many companies now being formed or about to be formed for the purposes of exploiting various types of flying machines, or for dealing generally in aeronautical appliances, consider it their duty to warn the public against investing in any such concerns without previously making thorough inquiries. They also warn the public against paying premiums, &c., for instruction in aeronautics without satisfactory evidence that the instructor is fully qualified to impart the same.

These warnings are issued in the interests of the aeronautical science and industry as well as of the general public, for it will be evident that any cases of fraud in the early stages of a new industry would seriously militate against its development and prosperity.

EDWARD P. FROST,
President Aeronautical Society of Great Britain.