A WARNING TO PILOTS.

By HARRIS BOOTH, A.M.Inst.C.E. A.F.Ae.S.

THOUGH it is now pretty generally admitted that the use of a speed indicator is a good safeguard—almost an absolute safeguard—against accidents due to stalling a machine, it is curiously noticeable that those pilots whose experience has been limited to the pitot tube type are of the reverse opinion.

Until quite recently I, rather foolishly, supposed that this was mainly due to prejudice on the part of pilots trained in the old school to rely on the feel of the machine, though I thought it might be partly due to the fact that this type usually depends on a liquid gauge, which is obviously rather liable to get out of order.

The other day, however, I discovered the true reason for the discredit from which this type suffers: it is that the liquid gauge part of the apparatus is *gravity controlled*; that is to say, the liquid column is urged up by the pitot pressure and held back by its weight, so that it moves just so much as to keep the balance between these two opposing forces. This arrangement seems, at first sight, to be so simple that it cannot very well go wrong, but, as a matter of fact, it can and does go wrong, and that just when it is most needed.

As I have said, in this kind of instrument everything depends on two things, namely, the action of the pitot tube and the weight of the liquid. Now, as a matter of fact, the pitot tube is infallible: it sends a pressure down the pipe which is proportional to the square of the relative speed under all possible conditions in actual flying practice, but the *weight* of the liquid in the gauge-glass actually *varies* whenever the machine meets with any conditions that cause it to rise or fall.

The reason for this is that if, for instance, the machine meets a head gust, the relative velocity of the air being temporarily increased, the machine has too much lift on it, and therefore rises with a slight acceleration. The effect of this on the pilot is well known; it forces him harder into his seat, *i.e.*, his weight is, practically speaking, increased for the time being. What applies to the pilot, applies equally to the liquid in the gauge; its weight is increased, and it is thus prevented from moving to the position which properly corresponds to the higher velocity, and, indeed, the liquid actually stays still in the glass, as will be evident from a numerical case.

First of all, suppose as an extreme case (though one not likely to occur in practice) that the machine meets a head gust of its own velocity; this doubles the relative wind speed, so that the lift is four times the normal. This, of course, causes the machine to move upwards with an acceleration equal to three times the acceleration of gravity, all bodies in the machine consequently appearing to be four times as heavy as usual (as we learn from elementary dynamics), so that the liquid in the gauge-glass, in particular, has its weight* temporarily increased to four times the normal. Turning now to the pitot tube, as the relative wind speed is doubled, the pitot pressure is multiplied by four. Thus both the forces on the liquid are multiplied by four; the liquid is, therefore, still in balance and does not have to move in the glass to get a new position of equilibrium.

That is to say, a head gust of velocity equal to the machine's normal flying speed has *no effect* on an instrument of this type.

We will take one more case, and this time one which commonly occurs in flying. Suppose that the machine is struck by a following gust of 10 per cent. of the normal flying speed. The relative speed is reduced by 10 per cent., the lift is reduced by 20 per cent., the weight of the liquid is reduced by 20 per cent., and the pressure in the pitot tube is likewise reduced by 20 per cent. Result, again *no movement* of the gauge at all.

Other cases can be easily worked out in a similar way, and it will always be found that although the instrument gives the real speed when flying steadily, *as soon as anything happens*, the instrument gives *quite the wrong reading*.

The above does not pretend to be a full scientific exposition of the cause of failure of these instruments, and indeed the full proof is rather cumbersome, and would probably only carry conviction to the minority. I, therefore, give a couple of easy (and safe) practical tests by which any pilot who has the gravity type of instrument on his machine can satisfy himself of its uselessness, and I strongly recommend all pilots who have these speed-indicators to make these trials, since an ounce of test is worth a pound of theoretical argument.

First Test.—Take the machine up on a fairly calm day, and then move the elevator control backwards and forwards (say, once in a second or two). You will then notice that the speed-indicator moves considerably when this is done. But if you have a speed-indicator worked by springs or their equivalent, you will see that it does not budge for such rapid control movements.

Now ask yourself whether your machine really changed its velocity on the instant with the movement of the control (as the gravity instrument asks you to believe), or whether it had not time to get going at a new speed before the reversal of the control checked it again (as the spring instrument says).

Second Test.—Take the machine out in as gusty a wind as you care to fly in, and take notice of the readings of the gravity indicator at rest, while running on the ground, and when aloft. You will see that the gusts are registered all right while the machine is resting on the ground or running supported by the ground, but once it is air-borne, the gust readings cease and, in fact, the gauge remains at rest excepting when it is disturbed by your elevator movements. Now, if you have a spring-controlled type of instrument, you will see that it gives you the gusts in the air just as much as on the ground.

These tests should convince you that there is something wrong with the gravity-controlled type, and that you ought not to rely on this kind of instrument.

In conclusion, I have only to express my willingness to explain as far as I am able any doubtful points which may crop up on this subject.

* Its *mass*, however, is, of course, still the same.

Lord Kitchener Tries an Aeroplane.

ON the 29th ult., Lord Kitchener enjoyed a flight with Olivier on an 80 h.p. Farman biplane, and on his return to *terra firma* said he thought it was "a splendid game." During a 15-minute trip, starting from the Heliopolis flying ground, the machine was piloted over the outskirts of Cairo.

Olivier Flies Round the Pyramids.

SOME time ago the Boghos Nubar prize of £400 was offered for the first aviator who should fly from Heliopolis round the Ghizeh and Zakkareh Pyramids and back to Heliopolis. This flight was carried out by Olivier on his Farman biplane the other day, and it is announced that he has been awarded the prize.