DISCUSSION.

CHAIRMAN (MR. MOLESWORTH): We are grateful to Mr. Manning for a most interesting paper, and I hope the discussion will be fruitful.

CAPT. SAYERS: Mr. Manning's paper has raised many points of interest, but it will not be necessary to touch on more than one or two.

Re controls, Mr. Manning says that a rudder of ample size should be arranged for. That is true, but it is a curious fact that under certain conditions it does not matter what size the rudder is; it still goes on doing nothing. There have been one or two cases where the provision of a very small amount of dihedral of the wings produced more effect than any change in rudders did. So far as the "Pixie" is concerned there is room for very much investigation in this matter.

I am inclined to think that one of the most important factors in this connection is one which has never been revealed by any model tests so far, for the reason that acceleration effects cannot be reproduced in the wind tunnel.

The first effect of putting on rudder is to produce an acceleration. If the rudder is high relative to the C.G. there is an angular acceleration around the C.G. causing an initial bank in the wrong direction for the intended turn. This initial bank—if the machine is lacking in lateral stability—produces a further rolling movement in the wrong direction and ailerons may not be able to overcome this rolling movement, or without producing an inverse yawing movement equal to that due to the rudder. Under these conditions the rudder is useless. Given an adequate dihedral the sideslip due to the yaw caused by the rudder produces a rolling movement in the right direction, and the smallest rudder will produce the desired effect.

Mr. Manning mentions the irregularity of torque caused by a small number of cylinders. I cannot see any reason why we should expect a regularity of torque to produce any effect. Irregularity is a time matter. In a small engine running at high speeds you can use a small number of cylinders and obtain the same real regularity as in a slow speed engine with more cylinders.

I much approve Mr. Manning's suggestion as to adopting the simplest alternative in doubtful cases. I should say, adopt the simplest unless you are quite certain that the other has an outstanding advantage.

Re machines of 10,000 lbs., if by using improved aerodynamic efficiency you can get the weight per h.p. up to 40 lbs., then you can afford to put up structure weight a great deal. The difficulty is not quite so serious as it looks when you regard it from the point of view of structure weight percentages, because it does not so much matter what percentage of useful load you can carry as how much useful load you can carry per h.p.

Re light aircraft for Canada and the difficulty that the landing grounds

there are water, and that in the seaplane the hump speed is, generally speaking, a deciding factor in the minimum h.p., that is true for all normal types of seaplane, but the hump speed is in some ways analagous to the stalling speed of an aeroplane. The usual type of seaplane float is not a good hydroplane, and its hump speed and hump h.p. could be reduced by putting up its planing area. I think that any attempt to make a light seaplane will have to be tackled on the lines of using hydrovanes of good form such as were tested in 1911 by an Italian designer, which have been used for emergency sea landing since. There are some small difficulties, but they can be overcome.

COLONEL OGILVIE: I did not come here to-night to talk, but to listen. I should, however, like to thank Mr. Manning for his paper, which strikes me as being an admirable one, and to draw the attention of the members of the Institution to the position that Mr. Manning holds in this low-powered flight question. He was the first person to take a practical interest and to find out the possibilities of what could be done in using the smallest-powered engine which could fly suitably with a pilot.

This question of low-powered flying is one which is really very new. Although, as Mr. Manning says, aeroplanes used to fly with very much smaller power in the early days, there was no interest taken in it from an economical point of view. The endeavour was to get an aeroplane to fly at all which would avoid the pilot having a smash. That was the primary consideration, and we used what engines we could get, not because we were interested in the economy of the thing, but because there was nothing else to be done. Before the war the interest was in improving performance for military purposes; no other development was thought of. It is only within the last year or two that this question of economy in flying has taken so prominent a position in the minds of aeronautical engineers, chiefly in the hope that we shall be able to reduce the cost of flying for commercial purposes. Without this reduction, although there are transport services in operation, there can be no real progress in aerial transport.

Another aspect of this low-powered flying was borne out in recent experiments being conducted in France. I daresay some of you may have noticed this in the papers. There is a French constructor who has a project in hand for a large commercial machine, and in order to save the cost of experimenting with the big machine after he has it built (which may run into many thousands), he is taking the step of building a small machine for pilot only, and I believe that that experiment, which may cost him perhaps £1,000, will bring a very good return in saving the cost of experimenting with a big machine.

Regarding aspect ratio, I want to ask Mr. Manning what would be the loss of efficiency if wings on the same basis as were used in the "Wren" were reduced to an aspect ratio of about 6 to 1, because it is almost impossible to imagine that in a really large aeroplane that aspect ratio of the "Wren" would be possible.

Re propeller, I have always taken great interest in this question of gearing, and there is no doubt after the trials which have been made that propellers running up to 3,000 or 3,500 are quite practical propositions, but for such small engines there is really very little reason to suppose that they could not run to 8 or 9 or 10 thousand. Engines of quite large diameters have run up to 7,000 in recent automobile racing. So tiny an engine as would be fitted in a small machine should be able to run up to 10,000. As far as we know at present we shall not be able to get a good propeller at such revolutions. For 30 or 35 m.p.h. forward speed a 10,000 propeller would hardly be practicable, and it seems to me that we shall have to have a gear incorporated with the engine as part of it, and not attached to it as was done at Lympne. This was a great source of anxiety on these trials, but I do not think that would be the case if they were properly designed in the engine.

In conclusion I would thank Mr. Manning very much for his paper.

MR. S. H. EVANS: I would endorse Mr. Manning's point re the rising scale of equipment weight on modern fighting machines: camera-gear, guns, etc., appear much too high with resulting poor all-round performance compared to the war period with smaller engines. Thus I know of one small machine where the camera-gear weighs about 150 lbs., and I think the Vickers gun wants scrapping, or at any rate re-designing from an aeronautical standpoint.

Apropos the lecturer's remarks on stalling, or rather lack of a decided stall on these small machines, I fancy that a tapered monoplane wing with 9.25 aspect ratio may perhaps have something to do with this, apart from the low wing loading. It is a well-known characteristic of such aerofoils that the lift curve is very flat at the critical angle and there is not much of a peak at all to it, possibly through reduction of end loss over the tip sections, the thinning of which may be equivalent to a further virtual increase of aspect ratio. The reverse usually holds for a thick wing of uniform section without taper, the "stall" in the lift curve being extremely sharp, for we may imagine the air at the extreme tip section to fall over a cliff when passing from wing to "no wing" over an infinitesimal distance. This is perhaps rather a crude and simple analogy to what actually does happen in the vortex theory. In larger machines, the Fokker "F 3" is a well-known example of this reputed "soft stall" and I should imagine the Dornier "Falcon" to be just the reverse and in fact poor altogether on lateral control due to its thick uniform wing with square tips. Incidentally I do not think we shall be able to realise such a large aspect ratio as the "Wren" on larger machines; at least for an economical structure.

I am also interested in Mr. Manning's remarks about rudder design, and I understand Capt. Sayers to suggest some connection with an acceleration theory. May I suggest another possible and simple explanation since the paper quotes the small rudder of the Parnall "Pixie," which gave rise to some little scepticism at the time. In the usual type of rudder there is prob-

ably a fair amount of interference and blanketing from the fuselage and tail plane, whereas the " Pixie " rudder surface is almost completely clear and above the fuselage altogether, which may help control considerably: again, the " Pixie " has a triangulated tail plane which should be very stiff and free from vibration over the tip. This question of rudder position and interference struck me particularly on the Itford gliders.

I note Mr. Manning is in favour of the small twin-cylinder engine and here perhaps the 4-bladed propeller would be very suitable for extra fly-wheel effect, though, of course, slightly less efficient aerodynamically.

As to the light seaplane, I think the small Dornier Flying Boat is a good lead in this direction, though it is not quite a light-plane in the present-day sense. This type of machine with the wide root step should amply fulfil Capt. Sayers' point re water loadings, as the planing surface can be of fairly large area.

I should like to thank Mr. Manning for giving us some of his unique and valuable experience this evening; and also the Institution for allowing me to join in the discussion.

MR. POULSEN: Mr. Manning pointed out the advantage of a low landing speed on a high L/D. It seems to me, however, that while you are flying into the aerodrome your high L/D is a disadvantage, as the machine seems to fly for a mile before it comes down. If you could spoil your gliding angle at the last moment it would be a good thing.

MR. MANNING'S REPLY TO THE DISCUSSION.

Capt. Sayers, I entirely agree with him regarding dihedral and the rudder, but you cannot help anybody by applying one force to any particular place; you must have two. He described the reverse ruling for a machine with a high rudder. What probably happens is that both forces are being applied on the same side, and the machine is side-slipping. The effect of dihedral is to produce a force in the opposite direction of the rudder and some distance away from it.

Regarding irregularity of torque, I agree generally, but there is a difference between the six-cylinder engine and the two-cylinder torque curve.

Concerning his remarks re water surfaces for floats, I am not so sure that the hydroplane arrangement would be good for a river in Canada. In a river full of weeds this would not give confidence.

Regarding Colonel Ogilvie's remarks, I am glad he referred to the French constructor's experiments, because they are very interesting, and the idea of making models for testing is one that might be followed up.

Re aspect ratio 9.25 to 1 and 1 to 6, it is difficult to answer from memory.

I think the difference is something like 17 to 24; at any rate, it is quite considerable.

I agree with Colonel Ogilvie's remarks that it would be very much better to incorporate gears with the engines, but at the same time the weight objection remains.

Replying to Lieut. Olechnovitch, it is difficult to answer his question re the propeller, but it was an ordinary one of mahogany; there was nothing particular about it in any way.

Replying to Mr. Evans, I agree that the excessive weight of the equipment for military machines is very great. With regard to guns, the question of the weight of these is very complicated. It is just possible that if the gun was made light it would be difficult to get the recoil mechanism to work.

With regard to four-bladed propellers, these might be tried, but I do not think they have any great virtue. I do not see why the fly-wheel effect should be more than with two.

Re the " Pixie " rudder, strictly speaking, this was bigger than shown in the photographs.

Replying to Mr. Poulsen, I agree with the disadvantage of a high L/D in landing, and it is possible that a different type of wing drag will have to be designed for these machines, but this is not so easy as it looks, and entails the possibility of accidents.

A hearty vote of thanks to Mr. Manning, proposed by Colonel Ogilvie and seconded by Capt. Sayers, brought the meeting to a close.

https://doi.org/10.1017/S2976690700000826 Published online by Cambridge University Press