

which have so far led to accidents, we find that they are rendered harmless. There are exceptions, but they would be of such infrequent occurrence that the safety of regular civil flying would reach, if not exceed, the railway standard.

Mr. Chairman, Gentlemen,

I offer my sincere apology for having raised many points with which everyone present is familiar. My excuse is, that they could not be avoided if the subjects were to be treated rationally. I am, further, in the unfortunate position of having expressed emphatic views on matters which are still the subject of acute controversy in the aeronautical world.

My object, frankly, has been to stimulate those who are responsible for the progress of aviation either to refute my arguments or to employ and act on them.

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## DISCUSSION.

CAPTAIN SAYERS :—Mr. Bramson is to be congratulated on a most valuable and interesting lecture. As, however, he is anxious for criticism I shall criticise first and agree with him afterwards.

Mr. Bramson states that we can assume "reasonable limits" within which the times of arrival and departure of commercial aircraft may be allowed to vary. That raises a big question. What are reasonable limits? If you are seven minutes late by railway that sounds very little, but on a 14 minutes' trip it is 50 per cent. If you got 50 per cent. delay on the run from London to Glasgow that would be very serious. I think it is reasonable to say that you must only criticise an air line for irregularity in comparison with the alternative services. If you choose a district where there are railways already, then you have to run a service whose regularity is greater than that of the competing railways. A man who wants to save three hours between, say, London and Paris, wishes to start either as late as possible to reach his destination by a certain time, or else to start at once and arrive as quickly as possible. It is no use telling him that an aeroplane saves time travelling if it does not travel at the time that suits him. You must, therefore, run a more frequent service than your competitor if you wish the increased speed of air transit to be fully effective.

A high average of regularity means a complicated system of organisation. The railways have built up their regularity and safety organisation slowly, and it now represents a very small cost per passenger mile. The air service has very much less traffic, and has to put in an expensive organisation to get the same degree of safety. Obviously, it cannot afford it. They must, therefore, do what the railways have done—start where they have no competitors.

If you analyse the costs of the air services you will find that over 50 per cent. of the cost goes in overhead charges, which are largely due to the attempt to secure safety and regularity. If money could be allocated to having more reliable aeroplanes, with less expense in organisation, the service could be run much more cheaply. If you use three-engined machines and do not have forced landings, you could scrap half your aerodromes and fly with a very much smaller ground staff organisation, and that would compensate for the extra cost in running of three-engined machines.

Mr. Bramson refers to Mr. North's remarks, that the probability of a forced landing with a three-engined machine is two thousand times smaller than in the case of the twin engine. Those statements are very sweeping, and are bound up in the assumption that the aeroplane can fly on two-thirds of its power. If it can fly on half of its power the two-engined machine would be as satisfactory as the three-engined one. If the aeroplane has  $1/N$  of its power available for service, then a machine with  $N$  or some multiple of  $N$  is much safer than a machine with any other number of engines. The more engines you have, the more engine failures you will have. You have to ensure that one engine failure will not remove the whole of your reserve power. It would be quite possible to make a safe two-engined machine.

Re landing scheme, I think the lecturer has to some extent done the Air Ministry an injustice in his criticism of their fog landing scheme. That scheme as a whole is quite good.

It is intended to secure that the pilot sees the aerodrome surface in time to land. In Mr. Bramson's arrangement I think there is too much ground co-operation at the last moment.

Re telling the pilot his actual height, there are quite a number of excellent landing barometers in existence, graduated from 2,000 feet to ground level. All the pilot need be told from the ground is the actual reading of the barometer on the aerodrome. He then sets zero height to this reading on an auxiliary scale, and his landing barometer gives height above the aerodrome.

Re the involuntary stall, this is of great importance, as it is the cause of many accidents, and a scheme for landing on the aerodrome would reduce them very considerably.

It does seem to me that this paper has a very great value in telling us what we ought to be legislating for in ten years' time, and not what we ought to be aiming at at the present moment. Any effort to develop express air lines at the present moment is going to be very difficult in view of financial conditions, and is only possible with State assistance, which means

really that we are paying for Air Ministry experiments of an expensive nature. The alternative method for developing Civil Aviation is to find work suitable for the aeroplane in its present state. There is plenty of such work to be found.

CAPTAIN LAMPLUGH :—There are one or two points I should like to raise.

Mr. Bramson says that no air service has yet paid, but the S.C.A.D. and A. Line, operating in Columbia, according to the balance sheet, paid 10 per cent. in the years 1921, 1922 and 1923. I believe it was the first commercial air service to pay its way entirely without subsidy.

I quite agree with all Mr. Bramson has said with regard to multi-engined aircraft, but I think they only take us half way to the economical use of commercial aircraft. I think we have to get a little beyond existing power units, to get efficiency.

I have recently been going into the question of the use of the Diesel engine, which is being taken up in this country. The Germans think that fuel bills would be reduced by 25 per cent., and the fire insurance on aircraft and cargo could be reduced, and also (which is most important) the potential passengers' fear of fire would be entirely eradicated. These items are of the greatest importance.

Mr. Bramson says that we must look for our revenue to an increase of cargoes carried. I do not think that is altogether possible. Aircraft can only carry certain specific cargoes; they cannot compete with rail and boat in bulk cargoes. In such cases as last week, where over three quarters of a million in bullion have been sent from this country to Amsterdam, aircraft are of use, but I do not think there would be many such instances. Their cargo work, therefore, is very much limited.

Mr. Bramson referred to a series of accidents, four of which I think he said were caused by error of judgment. I should like to say that in one of the cases mentioned I happened to be on the spot, that is, the accident at Ostend to the DH. 34 in May last, and I am sure it was not the pilot's fault in that case. Again, coming to the accident at Croydon last August; the pilot in that case deliberately crashed with the object of saving his passengers. That again is recorded as an error of judgment; I think this is altogether wrong.

I agree with Captain Sayers regarding railway regularity. I happened to show Mr. Bramson's paper to-day to a friend who uses the Southern Railway, and is late every morning with the greatest regularity.

In conclusion, I should like to congratulate Mr. Bramson on having given us an exceedingly able paper.

MAJOR C. C. TURNER :—I agree so heartily with nearly everything Mr. Bramson has said that my remarks will be brief.

With reference to Captain Sayers's remarks, I take exception to his statement that the railways have attained their success by operating on routes where there is no competition. I think the contrary is the case. The first railways ran near to the old coach roads, and in my opinion the immediate future of the air lines lies in a similar policy. They should not only go where there is no competition, but where it is greatest, and where, therefore,

there is the assurance of traffic and freights.

I thought that the lecturer's suggestions for means by which regularity can be obtained pointed the way to a more frequent Paris air service than by boat and train. I can visualise an aeroplane service every hour each way, and you would thereby increase your revenue, and commercial aviation would tend to become a more paying proposition than it is at present.

I am very pessimistic about the success of Mr. Bramson's landing scheme unless the Government are likely to take it up. Two years ago Mr. Courtney put forward a suggestion to the Air Ministry that they should give a trial to a scheme like Mr. Bramson's. He was not considering a Leader cable, but his system had certain substitutes, and was at least worthy of being put to the test. It postulated a landing speed of 35 m.p.h., and with that and what he proposed a pilot could land anywhere. Nothing was done, however, and even now the Air Ministry is still only talking about a possible operation with the means at hand.

Mr. Bramson referred to the number of accidents caused by pilots leaving the aerodrome and then attempting to turn. This is always fatal. I understand you cannot prevent a pilot attempting to turn, and in spite of injunctions given him he will always try to turn back if his engine fails. Unless the anti-stall gear will give him very timely warning, or prevent him attempting this manoeuvre, it seems to me that even that gear might not avert this class of accident. I believe, however, the anti-stall gear does give timely warning, and I only mention this in order that Mr. Bramson may refer to it in his reply.

MR. HOWARD FLANDERS :—Some years ago the Tubes were unable to obtain a paying number of passengers, and investigation of the service offered showed that they were running long trains at infrequent intervals. A change was made to frequent services of short trains, which resulted in a greatly increased number of passengers with a consequent improvement in revenue. We have a somewhat similar condition obtaining in aviation—large aircraft at infrequent intervals, and considerable delays between the terminal aerodrome and the city.

If this could be changed to a half-hourly service with small aircraft, and rapid transport from the aerodrome to meet trains at Waddon, there would undoubtedly be a considerable increase in the number of passengers, because they would feel that they could get to Paris (or elsewhere) at any time with not more than half an hour's delay.

Concerning the difficulties of landing at night in fogs, etc., I would draw members' attention to the Loth leader cable system as set forth in a paper read by Mr. Loth in December, 1923, which is reproduced in Minutes of Proceedings No. 9. This system not only gives the pilot the direction of flight, but also indicates his altitude above the ground, and whether the ground is rising or falling in height above sea level. It has always seemed to me that this system, if fully carried out, would render flying at night as reliable as the railway, and there is never any need for the pilot to fly low in foggy weather; he can fly above the clouds with full knowledge of his

exact position relative to the leader cable, and indications of emergency landing grounds can easily be given by a change in the beat note. From tests made it appears possible for a pilot to make a flight and land without relying on sight in any way.

As regards the reliability of aircraft, I am of opinion that the heat engine will never give 100 per cent. reliability. Schemes have been put forward for a wireless transmission of power by which, if it was universally applied over the whole of the earth's surface, there would be no losses (due to the formation of stationary waves); therefore, as the frequency would probably be high, the motors would not require a large amount of copper or iron in their windings, which would tend to a considerable reduction in weight over the electric motors at present available. This, of course, cannot be regarded as anything capable of immediate application, because its use is impossible unless universally adopted to prevent loss. Under these circumstances, of course, the temporary breakdown of one or two power stations would not greatly affect the user.

It is worth noting that *Quantas*, in 1924, maintained 100 per cent. reliability with their air service. Of course, the climatic conditions in *Australia* was a factor in attaining this reliability.

MR. C. G. COLEBROOK :—Mr. Bramson has made one outstanding point, that it is essential to increase the revenue which commercial aircraft can earn, and that the safety in flying will play a vital part in securing that desirable end.

Captain Sayers advanced an interesting point of view in saying that we should endeavour to make commercial aircraft pay by going where there is less or no competition. When, however, you operate away from your home base your overhead charges are going to be high. *Imperial Airways* will find that problem in the *Egypt to India* route.

It would be a confession of failure if we relaxed any of the efforts we are making to maintain commercial aviation between *Great Britain* and the *Continent*; we are bound to keep on until we make that route profitable. I entirely agree with Mr. Bramson that if we can make machines safe and overcome the weather, then we can increase traffic and so reduce overhead charges.

As to the sound locator, that has been tried by others, and I remember Major Tucker some time ago showing that there are great deflections of sound under different weather conditions. If the *Air Ministry* system of electrical communication by automatic devices proves thoroughly practical, the problem of landing in fog will have been solved.

I should like to ask Mr. Bramson whether he thinks there is any advantage commercially in the use of smaller aircraft, as it is argued that the proposition of paying load to total load and of revenue to expenses is considerably less than with the use of larger machines.

MR. OSWALD :—Mr. Bramson has dealt with " *Practical Flying* " from the points of view of *Safety*, *Regularity* and *Economy*, especially as affected by atmospheric conditions. He has also briefly drawn attention to the effect of engine failure on the three desirable qualities, rightly emphasising the

use of three-engined machines. But even in three-engined machines it is imperative to remove the causes of engine failures. One of the chief causes of the latter up to the present has been trouble with the water cooling installation. The remedy is the employment of the now thoroughly tested out air cooled engines. They create a little more head resistance, but for civil flying the effect is negligible.

Ease and rapidity of power plant installation and inspection has a vital bearing on Safety, Regularity and Economy. Sir Sefton Brancker has recently put forward the suggestion that the power plant installation should be in one unit, which could be quickly wheeled up and attached to the machine or vice versa. This would lead to the optimum use of the machine, and thoroughness of inspection. This may seem an unattainable ideal to aircraft engineers at present, still, it is worth striving after.

The present cost of running a commercial aeroplane is 5s. per ton mile. This cost is divided as follows:—Fuel and oil, 11d.; maintenance and overhaul of engines, 1s. 2d.; maintenance and overhaul of machine, 7d.; overhead charges, insurance and depreciation, 2s.; miscellaneous, 4d.

Present knowledge shows that these figures can be reduced; for fuel by the use of heavy oil engines, such as those developed by Beardmores; for maintenance and overhaul of machines by the use of metal aircraft. The latter plus the use of three-engined machines will bring down depreciation and insurance charges.

Finally, in commercial flying we have to consider the convenience of the passengers. At present, between London and Paris an hour is required at either place to get the passengers to or from the aerodromes. Why don't we run a flying boat service between the Thames and the Seine and thus save two hours? Surely to-day the flying boat should no longer be the Cinderella of aircraft, but from a commercial point of view should be judged on its merits.

#### MR. BRAMSON'S REPLY TO THE DISCUSSION.

Captain Sayers's method of evaluating regularity as the percentage time delay on a basis of the normal time of the journey would lead to very curious results in the case of short journeys.

His main point, namely, that work should be found suitable for aeroplanes in their present state is no doubt the logical attitude of anyone wanting to establish a dividend-paying operating company. But competition is good for trade, and it is only, I think, by endeavouring to construct aeroplanes and develop ground organisations capable of competing with existing means of transport, that real progress will ultimately be made.

Replying to Captain Lamplugh, the introduction of the Diesel engine opens up a field of possible economies the importance of which cannot be exaggerated. The reduction of insurance premiums, for instance—a subject on which Captain Lamplugh is an authority—would have effects far beyond the direct savings involved. It does not require much imagination to realise that a free life insurance policy issued with each air line ticket would have a tremendous effect upon the passenger load factor, and therefore reduce the percentage overhead charges.

In referring to increased cargoes, I meant increased demand for space, so that higher prices could be charged.

In reply to Major Turner, I am obliged to him for giving me an opportunity to explain certain points in relation to the Savage-Bramson Anti-Stall Gear, to which he referred. The Anti-Stall gear makes it impossible for a stall to occur without the pilot having received timely warning of it. It will, therefore, in all cases, prevent the type of crash—practically always fatal—which consists of a sudden nose dive or spin into the ground. But naturally, accidents which are caused by engine failures not accompanied or followed by a stall cannot be prevented by an anti-stall gear. This device will, however, turn a potentially fatal accident into a non-fatal one.

In reply to Mr. Howard-Flanders, a high frequency air service is an ideal to be pursued, but I must repeat that questions of frequency, comfort, economy and regularity must always be secondary to those of safety.

In reply to Mr. Colebrook, the relative commercial merits of large and small aircraft is a somewhat large question, which is very much affected by the range required. For long ranges large aircraft are essential; for short distances the economical size would be largely determined by the amount of traffic obtainable.

A very hearty vote of thanks to Mr. Bramson for his valuable and interesting paper brought the meeting to a close.

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