# PRACTICAL FLYING

**Paper read by Mr. M. L. Bramson, A.C.G.I., (Member) before the Institution, in the Lecture Room of the Junior Institution of Engineers. 39, Victoria Street, Westminster, S.W.1, on 10th November 1925, Mr. H. B. Molesworth in the Chair.**

Mr. Chairman, Gentlemen,

The title of this paper had to be chosen before the paper was written, and is in consequence a bit of a misnomer. It is proposed to deal chiefly with those aspects of flying which are *not yet* practical, with the object—and this should be the object of all proceedings of an institution such as ours—of provoking thought, discussion and invention.

The function of aeronautical engineers is to place in the hands of pilots and aircraft operators, such a combination of aeroplanes, machinery and organisation as will make safe, regular and economical flying possible.

A study of present day aviation reveals very important shortcomings in these respects, and it is interesting, and necessary, to examine these shortcomings and to determine to what extent they may be due to insufficient co-ordination of existing knowledge, and to what extent new invention or discovery may be required to achieve our purpose.

Let us define the terms safety, regularity and economy, and also their inter-dependence, if any. Now it is clear, that before we can define safe flying, we must make up our minds what degree of regularity is necessary, because a flying concern operating on fine days only naturally attains a greater degree of safety than one which endeavours to operate on every day throughout the year. Let us, therefore, define regularity first.

https://doi.org/10.1017/S2976690700000978 Published online by Cambridge University Press

Regularity is often stated as the ratio of flights completed to flights scheduled. This needs a little amplification, because it is not only the *flights* which are scheduled, but also the times of departure and arrival.

Without going into this very deeply, we can assume reasonable limits within which those times may be allowed to vary.

If now we take the British railway services as our pattern, and it is a pattern of a very high standard (we need not bring the average down by including the Southern), we may reasonably say that we shall be satisfied when any desired air line can be run with the same regularity.

The regularity achieved by Imperials Airways during 1924, was about 78 per cent. The United States postal service achieved in the same year a regularity of 94.5 per cent. We know, of course, that the railway regularity is, to all intents and purposes, 100 per cent. We, therefore, have quite a long way to go.

If we examine the reasons why scheduled flights have been either cancelled or interrupted, we find that *defect in aircraft* and *weather* are the main causes.

If we further examine what types of weather have caused cancellation or interruption of flights, we find that they are in no case such as would actually prevent an aeroplane from cleaving the atmosphere. They are in most cases accounted for by the fact that at present the safety of flying is absolutely dependent upon visual connection between the ground and the pilot when landing. Other cases are due to the fact that machines are still being flown which must land if engine failure occurs, and to such machines a low ceiling will frequently mean such a low degree of safety, that operating companies or pilots consider flight inadvisable. Here again we have clearly shown the dependence of regularity upon safety. Now let us consider economy. It is a well-known and regrettable fact that no country has so far succeeded in operating a paying air line. The large number of civilian air lines which are nevertheless being operated regularly in Europe and America, all have to be subsidised by the State. The only aircraft operating concerns which have managed to pay their way without Government subsidies are precisely those to whom regularity is not essential, and who can therefore achieve the necessary degree of safety by choosing thir own weather conditions. The joy-riding concerns, the aerial survey companies, and last but not least, the Savage Sky-writing Company are representative examples.

Now it is clearly realised by everybody that "Civil aviation," as Mr. Churchill has said, "must fly by itself," and to attain that purpose, an immense amount of thought and skill has been applied by designers and engineers throughout the world, but to my mind—and I offer my views with due deference to those of others—the problem has been tackled too narrowly. The attitude has been *"economy is wanted, therefore we must economise, and the only obvious way to economise is to reduce cost."* Hence low cost per passenger mile has been the universal bogey of aircraft designers and operators. But surely this is a narrow view. Why not concentrate instead on an increase in revenue, which is another way of

https://doi.org/10.1017/S2976690700000978 Published online by Cambridge University Press

saying, why not eliminate the existing reasons why the demand for flying is so limited? If those reasons were eliminated, the advantages of flying over other forms of transport, the superior speed and comfort which is possible, would at last be realised and exploited by the public, and the increased demand would then make it possible to charge economic fares, even though the operating cost per passenger mile were to remain what it is at present, or even if it were to be increased.

I am convinced that if flying were made safe it would automatically become economical. If you agree with me, then you must also agree that in aviation, safety first is something more than a humanitarian slogan—it must be treated as a fundamental principle, upon which economy, regularity, and in fact, all progress is dependent. It also follows that whenever there is conflict between considerations of safety and of passenger mile economy, it is economical, in the true sense of the word, to let the considerations of safety prevail.

It must, therefore, be a matter of supreme importance to our profession to collect and analyse all accident and irregularity statistics, so that efforts to increase the safety of flying, instead of being vague and casual, may become properly focused upon those features which are most in need of improvement.

I have here before me the Air Ministry Annual Report on the progress of Civil Aviation, covering the period from the 1st April, 1924, to 31st March, 1925. It contains a number of statistical tables, the most interesting of which, from our point of view, are tables D, E and F. Table D deals with what is called the efficiency of British subsidised air services, table E deals with causes of involuntary landings, and table F with civil aviation accidents. The information contained in table D concerning efficiency is based on flights commenced, and on this basis the percentage flights completed uninterrupted is 94 per cent. This is apparently very good, but these figures obviously give no information as to the number of scheduled flights cancelled. There are indications that the number may be very high, because the number of flights commenced in July, 1924, was 778, whereas the number of flights commenced, for instance, in January, was only 153. It may be argued that the services are reduced during the winter, but that is beside the point. Railway services are only reduced in the measure that the demand is reduced. The air services are mainly curtailed because, with existing equipment and organisation, they have to be, but apart from this, a more accurate index to commercial regularity would have been obtained if these tables and percentages had been compiled on a basis of flights scheduled.

This is the American practice. I have endeavoured to correct the figures of table D, so as to obtain the percentage of flights completed uninterrupted. On a flight's scheduled basis, the figure obtained is 78 per cent. The difference—16 per cent.—represents (roughly) flights cancelled.

I have no means of ascertaining the causes, but we may be reasonably certain that they have been mainly weather, apart perhaps, from a shortage of machines and engine failures discovered on the ground. The true com-

https://doi.org/10.1017/S2976690700000978 Published online by Cambridge University Press

mercial regularity figures are, therefore, seen to be not nearly so rosy as they appear on the surface, and they do, in fact, represent an important reason for the unpopularity of aerial travel among business men.

Table E gives the percentage of involuntary landings as 7 per cent. Out of the total number of involuntary landings, which was 286, 50 per cent. were due to weather, 34 per cent. to engine and installation failure, 16 per cent to other reasons.

Remembering that every involuntary landing represents potentially an accident, a total of 286 such landings in a year or over 5 per week is rather alarming.

Table F appears to deal only with accidents involving death or injury to passengers, of which there was only one, i.e., the Christmas Eve accident in which a pilot and 7 passengers were killed.

There is another table. The total number of accidents during the period was 12, and their causes are classified broadly in this table. Of these accidents, 4 occurred on established air routes, 1 in the hire services, 6 in the short passenger flights, and 1 during a constructor's trial. The causes of these accidents are classified under the following headings:— Error of judgment on the part of pilot (caused 4), defect in aircraft structure or controls (caused 2), defect in engine or installation (caused 2), weather conditions (caused 1), other causes (caused 3).

It we examine these accidents in detail, we find that a number of them, though not primarily caused by error of judgment, and therefore not classified under that heading, were in fact accompanied by stalling near the ground. This, for instance, applies to the Christmas Eve accident, which, although classified under the heading "Other causes," was in fact rendered fatal by a stall.

The detailed particulars of all these accidents are so interesting, and have such an important bearing on our subject, that I make no apology for reading them to you in full.

*(The Lecturer then reads extracts from page 25 of Report.)*

Bearing all these specific accidents in mind, I make bold to make one or two generalisations on the subject. My contention is that they are no less true because they are sweeping.

Since aviation began, and until this very day, the technique of flying has been completely dominated by the risk inherent in "hanging" on an engine. It has also been dominated, but to a lesser extent, by the necessity of seeing an aerodrome in order to land on it.

Imagine for a moment you are piloting a passenger aeroplane through changing weather conditions; clouds are getting low and you are faced with the alternative of flying above them or below them. If you fly below them you can find your way, but if engine failure occurs, you have to land within an area which is proportional to the square of your height. If the country is at all unfavourable, the same minimum height will, as a rule, be far in excess of the altitude of the low clouds. Therefore, if you do decide to fly below them, you know definitely that engine failure will, in all probability, involve a crash.

https://doi.org/10.1017/S2976690700000978 Published online by Cambridge University Press

Now that, gentlemen, is not practical flying. If, on the other hand, you decide to fly above the clouds, you can find your way by dead reckoning or other navigational methods. Should, however, engine failure occur, the extra safety which might have been expected from greater altitude will prove to be illusory, because no choice of landing ground can be made until the ground can be seen; that is, not until you are below the clouds, and therefore, you are in exactly the same predicament as before, with the very grave further possibility that the clouds may, at the particular point where you are coming out of them, reach the ground.

It is this deadly risk which no civil aviation pilot in his senses is willing to take, and which renders proper aerial navigation practically non-existent.

The remedy is to construct aeroplanes which do not have to land when one engine failure occurs.

All aeroplanes must, for acceleration and climbing purposes, be provided with an excess of power over that which is required for normal cruising. Existing aeroplanes frequently require less than two-thirds of their total horse-power to maintain cruising speed. Sub-divide the power plant into three equal units and you have an aeroplane which need not land when one engine failure occurs.

Mr. J. D. North has established the probability formulæ covering this case, as well as that of the single and twin engine machine, and the numerical application of these formulæ to concrete examples has been recently made in "Flight." It was there shown that, all other factors being equal, the probability of a forced landing with a twin engine machine is twice as great as with a single engine machine, and that the probability of a forced landing with a three engine machine is 2,000 times smaller than in the case of the twin engine. This represents, to all intents and purposes, immunity from forced landing due to engine failure. It may be argued that everybody is fully aware of the advantages of three-engined machines, and that this is proved by the number of these which are on order. My reply is that single engine machines are also on order and in service, and that the subject is being dealt with, not as it ought to be, in conformity with the fundamental principle, but rather by way of timid experiments. This is all the more astounding when it is considered that these facts have been known and available for years. I cannot resist the temptation to give you another railway analogy: Assume that the failure of a locomotive engine, and the consequent stoppage of the train meant a potential disaster; is it conceivable that in such a case trains would be run for years with only single locomotives? Now let us go back to the clouds. Assume again that we are flying in changing weather, but that in this case we have three engines, and that it will, therefore, not be necessary to land if one of them fails. It will then be the natural thing to navigate above the clouds, provided we know that our terminal aerodrome is free from fog. Here we come to the second consideration which at present hampers regularity and interferes with safety, and which still would do so if machines were proof against forced landings. The problem of guiding an aeroplane into a fog-bound aerodrome has been under consideration officially, I believe, for a long time.

https://doi.org/10.1017/S2976690700000978 Published online by Cambridge University Press

The Air Ministry report, to which reference has been made already, contains the following remarks :—

(*Extract here from page 17 of Report.*)

It is to be doubted whether any scheme involving a reliance upon lights on the ground being visible to the pilot, will ever be able to deal with the worst fogs experienced in this country, seeing that, in many cases, the altitude at which machines would have to follow the leader cable, would be considerable if local obstacles are to be cleared.

The following method of organising fog landings at regular aerodromes has occurred to me, and I shall be glad to have it thoroughly scrutinised and criticised; no doubt it will be during the discussion.

The following requirements are called for in order to put the scheme into effect :—

(1) Two-way wireless telephone communication between the machine and the aerodrome.

(2) A good altimeter provided with a special fixed scale of datum points to which the zero of the altitude scale can be set.

(3) A direction-finding accoustical listening post, also in two-way communication with the pilot.

(4) A straight Loth leader cable of a few miles, with its corresponding electrical equipment on board the machine.

(5) Direction-finding wireless equipment on the ground enabling the machine to be guided to within 5 or 10 miles of the Aerodrome.

(*Here follows description of scheme and blackboard drawing.*)

Assume now that we have a service equipped with machines which are proof against forced landings, due to engine failure, and which can be guided into and land on a fog-bound aerodrome. This very fact will automatically eliminate forced landings due to weather, for the only types of weather which at present cause forced landings are bad visibility or very low clouds, and those cases we have dealt with.

We still have not dealt with the class of accident which is both frequent and serious, and which is very often associated with anxious efforts to bring off a forced landing, namely, the involuntary stall.

There is no doubt that the tendency to stall involuntarily will occur less frequently when forced landings have been eliminated, but the fact remains that stalling near the ground is nearly always fatal, and that no machine should be flown which can stall without the pilot having been given an infallible warning in time to prevent it.

This problem has been solved. The system by which this result has been achieved has been fully described in the technical press, and I need not, therefore, go into it in detail, beyond saying that, whether safety or economy be the first consideration, no aeroplane should fly without that apparatus.

Suppose now, that we have in fact eliminated forced landings due to engine failure and weather; that we have rendered it possible to find and to land on fog-bound aerodromes, and that all machines are so equipped that involuntary stalling is impossible. Then, if ye analyse the circumstances

https://doi.org/10.1017/S2976690700000978 Published online by Cambridge University Press

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.

---

## 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 us 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.

https://doi.org/10.1017/S2976690700000978 Published online by Cambridge University Press