The Problem of Cross-Atlantic Flying*

By L. Blinn Desbleds

ONE of the first, if not the first commercial application of long-range aircraft, will be the carrying of mails and of light articles, whenever speed is a matter of consequence. This by itself would not, however, be of such moment as to cause great losses or uneasiness to the shipping industry; but mails contain, among other things, business letters, soliciting orders, catalogs, plans and drawings of machinery which may be required for the development of new countries, letters of credit and legal documents which are necessary for the carrying out of new undertakings; in short, it may be said that modern commerce could not exist without correspondence. In fact, I do not think one would be far wrong in taking it as an axiom that the commerce of the country can be measured by the bulk of its correspondence. And, from this axiom, it would follow that whatever factor influences the correspondence of an industrial must, of necessity, influence its commerce.

Some may, perhaps, at first be inclined to conclude that, granted that aircraft will, in the future, take the place of mail boats, there would only be a gradual transference of the mail service from steamers to aircraft, and that the bulk of foreign correspondence and its consequent influence upon the commerce and shipping of this country would be unaffected by such a transference. Such a conclusion would be erroneous for two reasons.

In the first place, the speed of aircraft is much greater than that of surface vessels. The considerable difference in the speed of aircraft and of watercraft would bring about a greatly increased exchange of correspondence between distant countries than is now possible, and this accelerated rate of exchange of correspondence would in time react upon the commerce between such countries, and, consequently, upon their shipping.

In the light of such reasoning it is at once apparent, therefore, that the commerce and shipping of a country must profit considerably by the advent of aircraft. To this conclusion a proviso must, however, be added. It is that British commerce and shipping would profit by the advent of mail-carrying aircraft only if the mail-carrying business of the air is in British hands. If, after the war, the monopoly of aerial correspondence is left to the Germans, then it would naturally follow that the advantages derived from such correspondence would go to their commerce and shipping.

I have used the word "monopoly" advisedly, for at the present moment the Germans alone possess aircraft that could be employed for the commercial purposes to which allusion has been made; and it is betraying no secret to say that this country does not yet possess any aircraft having anything approaching the commercial capabilities of the German Zeppelins.

Unless a most serious and concentrated effort is made to wipe out our present disadvantage in the matter of long-range aircraft, we shall, when peace is concluded, find ourselves extremely handicapped in carrying out the commercial war which, it is agreed in every quarter, will immediately follow the conclusion of peace.

I hope that, in these few words, I have made clear the importance of aircraft to the future of British shipping; and I would venture to suggest to the members of this Institution that they should consider the subject, not from the theoretical or academic, but from the absolutely practical point of view, and that they should immediately consider the best steps to be taken to grapple with a very serious position.

In proceeding I shall endeavor to show, with all the clearness at my command, why in the present state of development of aeronautical science the aeroplane cannot, for some time to come, be considered as a competitor of the airship for long distance flights, such as the crossing of the Atlantic, and to indicate definitely the lines along which aeroplanes must be developed so that they may have an increased radius of action.

It seems to me that with reference to navigation the majority of British airmen are, as regards the best utilization of their machines, groping in the dark for the lack of exact scientific knowledge concerning their aeroplanes. In the course of this paper you will, I think, appreciate the full force of this remark, and you will then, no doubt, agree that the Royal Flying Corps and the Royal Naval Air Service would be still further improved if their members had, besides their bravery, coolness, and adaptability, a truly scientific knowledge of their machines and of the laws relating to their employment for maximum results. As it has recently been announced that a professor of meteorology has been attached to the Royal Flying Corps, it is to be hoped that this important and most useful appointment will be quickly followed by the just as important, and just as useful, appointment of one or more professors of practical aerial navigation to our air services.

*Abridged from a paper presented before the Institution of Engineers and Shipbuilders in Scotland.

It has been said, and with truth, that in the case of aeroplanes, the development of a particular quality is always attended by the development of a defect. In designing aeroplanes for particular purposes, as well as in their employment, a continuous compromise has to be made between a number of conflicting coefficients. In fact, the degree of adaptability of an aeroplane for a given function always depends upon the degree of success in compromising the different conflicting factors influencing the problem. Thus it is, for example, that, in designing a long-range aeroplane, there is a conflict between the useful weight and the deadweight. If the deadweight is sacrificed to the useful weight, then the range of the aeroplane is increased from the fact that it can take on board more motor fuel, thus enabling the engines to work for a longer time. When designing an aeroplane for maximum range of flight one is, therefore, very much tempted to cut down, to the extreme limit, the deadweight of the machine; but the reduction in the deadweight of an aeroplane of given type cannot go beyond a certain limit, and must be in accordance with rules relating to the strength of the materials employed in its construction. Also, from the very fact that a long-range aeroplane is subjected to more continuous strains than a short-range one, and that, besides, in a long journey, the machine may have to contend with stronger or more frequent gusts than in one of short duration, the long-range aeroplane must, as regards strength, possess a factor of safety at least as great and, if possible, greater than one destined for short-range flights. Thus it is found that in carrying out the compromise between the deadweight and the useful weight of an aeroplane of a given type the designer, for consideration of strength, is prevented by strict laws from cutting down the deadweight beyond a certain limit which, in the present system of aircraft construction, is very quickly reached. Indeed, it can be proved that in the present state of development of aerodynamical science, and with the present methods of construction, an aeroplane which is made to lift a useful weight greater than one ton, in useful load and fuel, does not possess as regards strength a sufficient factor of safety.

The conflict between the two factors, useful weight and deadweight which is settled, as already seen, by strict engineering laws relating to strength of materials is only one example of how a compromise is reached between a number of factors affecting aeroplane design and utilization.

Experience in the employment of aeroplanes has now shown that a speed of 90 kilometers per hour (55.9 miles per hour) is a minimum below which safety in flight, especially a long-range one, is rather precarious.

The efficiency of a propelling plant suited to the aeroplane on which it is mounted, lies between 75 and 80 per cent. An efficiency of 78 per cent is a normal figure.

Maximum-range flight depends upon two circumstances:

- (a) The designing and construction of a machine in which the different range-influencing coefficients are thoroughly studied.
- (b) The flying of such a machine in a thoroughly scientific manner.

An aeroplane, as at present conceived and constructed, cannot rise if the useful weight is greater than 1,000 kg. (about one ton).

The following figures, however, relate to one of the now numerous projects for flying the Atlantic:

4 motors of 100 h.p. each	1680 kg.
Fuel, lubricating oil, provisions, etc.	4200 kg.
Crew of 10 men	700 kg.
Weight of bare aeroplane	2420 kg.
	9000 kg.

The useful weight being 4,900 kg.

This weight of 4,900 kg. is about five times the useful weight which any aeroplane, with the present aerodynamical efficiency, and with existing methods of construction, could lift with safety as regards strength.

How is it, then, that this project of Atlantic flying has been considered capable of realization? It is simply because the machine which has been proposed to realize it would have a factor of safety much below the one which has been recognized as absolutely necessary for flying in weather at all gusty. In fact, the amount of useful weight lifted is found to vary inversely as the cube of the factor of safety. In other words, if the factor of safety of an aeroplane is halved, the useful weight could be eight times as great. An aeroplane with a factor of safety lower than the present one would not, however, present the degree of reliability or safety which aircraft employed for commercial purposes must necessarily possess.

The aeroplanes which are now used for military purposes have a factor of safety of 6, and, taking into account the risks, as regards induced stresses to which a long-range aeroplane would be submitted, this factor of

safety can, by no means, be considered a high one. In short, it may be concluded that the project of a cross-Atlantic flight by aeroplane could now be realized only as a sporting feat by a pilot who would be prepared to take enormous risks. With existing types of machines it is only possible by a reduction of the factor of safety. So long as the range of an aeroplane is obtained to the detriment of safety, the machine cannot be considered as a commercial means of locomotion for that range.

In conclusion, I may say that in this paper I have been able to consider only a small aspect of the problem of cross-Atlantic flying, which, for complete solution, demands not only a study of the aerodynamics and strength of aeroplanes, but also a large number of questions relating to the internal-combustion engine, meteorology, choice of routes, navigation, the provision for special instruments, and numberless other items of importance.

Electric Conductors

ELECTRIC cables are used for a great many purposes, such as the transmission of electric power, the conduction of telephonic and telegraphic currents, etc. In some cases a cable carries a great many separate currents, and in some cases only a single current. The use of a cable in the transmission of a single current is in general restricted to the cases where the current is large. This requires a large conductor, which for practical reasons is stranded. It may be either a single group of solid wires, or it may have a more complex structure. A seven-strand cable may be a single conductor made up of seven solid wires, or a single conductor made up of seven groups of wires, or a combination of seven conductors insulated from one another. In the latter case, each of the seven strands may be either solid or itself stranded. When one of the strands of a conductor is composed of more than one wire, each element of the strand is also called a strand. Stranded conductors are very commonly formed of concentric strands, which consist of a central core surrounded by one or more layers of helically laid wires. If used as a completed cable, such a conductor is called a concentric-lay cable. Such a group may be combined with others in the same way in which the wires are combined in the group, thus forming a concentric strand composed of elements each of which is a concentric strand. If a concentric strand so formed is used as a completed cable, it is known as a rope-lay cable.

In the long-distance transmission of power, overhead bare cables of copper or aluminum are extensively used. For underground conduit transmission, cables are heavily insulated and protected by a covering of lead. The insulation may be rubber, varnished cambric, paper, or special compounds. Single-conductor cables of this kind are frequently used for direct current mains. For single-phase alternating service duplex cables are in considerable use. Flat twin cables are most convenient and cheapest where the cable is not unusually large. For alternating currents, two-conductor and three-conductor concentric cables are in great favor. Cables that are to be buried in the earth or used under water have a jute and asphalt covering over the lead, and over that an armor of steel wires or band steel.

Telephone and telegraph cables consist of many wires, each separately insulated with paper, fiber, or rubber, the whole having a light insulating wrapping and a lead sheath. The size of the wires used is more or less standardized, so the size of the cable is roughly indicated when the number of wires is stated, as e.g., when one speaks of a 200-conductor cable. In a telephone cable the wires are twisted together in pairs.

There are, of course, many special kinds of electric cables, for which trade names have been adopted according to their construction or uses. This holds true also of smaller electric conductors, to which the term "cable" does not apply. The smaller conductors are usually either single wires, stranded wires, or cords. There is a great range of flexibility and of kind of insulation in the various divisions, such as magnet wire, heater cord, lamp cord, etc. The twisted pair is used with many portable electric devices.—Circular 37, U. S. Bureau of Standards.

Removal of Rust from Iron Plates

A FINELY CRUSHED mixture of 2 parts of sodium bisulfate and 1 of common salt is wetted until cohesive, applied to the iron plate, and left on till the plate is clean. The action is much more rapid if the plate is scraped every 2 to 3 hours and scrubbed with a wire brush and water, and the treatment repeated. When clean the plate is well washed, finally with an alkaline solution, and dried quickly.—*Note in Jour. Soc. Chem. Ind.* on an article by F. W. WATSON in *J. Chem. Met., and Min. Soc., S. Africa*.