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A NON-PARTISAN MAGAZINE OF FREE DISCUSSION. IT AIMS TO INTERPRET THE NEW AMERICA THAT IS ATTAINING CONSCIOUSNESS IN THIS DECADE. THE FORUM GIVES BOTH SIDES. WHATEVER IS ATTACKED BY CONTRIBUTORS THIS MONTH MAY BE PRAISED IN LATER ISSUES

HAS AVIATION A FUTURE?
A DEBATE·

I — THE LIMITS OF COMMERCIAL AVIATION

CAPTAIN ALFRED CHARLES DEWAR, R.N., O.B.E.

WHEN one speaks of a future for commercial aviation, one means a future not merely of daring enterprise and heavily subsidized routes, but a future in terms of definite commercial success on a large scale. Every new instrument of man's invention attracts around it a ring of ardent enthusiasts who paint its future in roseate hues. But sooner or later they find that it is encompassed about with definite and inevitable limitations, inherent in its own nature, which cannot be overcome. It reaches a certain point of development which it can only surpass at the cost of vastly disproportionate labor and expense.

It has been so with the locomotive and steamship, and it will be so with aircraft. Limitations may be imposed as surely by considerations of economic expediency as by the more rigid restrictions of natural laws. Thus it is certain that it would be entirely feasible to build cargo steamers with a speed of twenty knots; but it is equally certain that cargo steamers with a speed of twenty knots are not built. The reason is simple. They would not pay. And so the cargo steamer of the world plugs across the

ocean at ten to twelve knots — much the same speed that it was making twenty years ago.

Nowhere do these limitations apply more forcibly than to aircraft. A plane has to contend directly against gravity. Before it can carry anything, it has first to lift itself, and then lift its load. This is a staggering handicap. Approximately four-fifths of the horsepower of a big plane is absorbed merely in maintaining the craft and its load in the air. Air transport can never contend seriously with transport by land and water, where the actual weight is carried by the earth and sea and the engine has merely to push or pull its load along.

At sea if a greater weight is to be carried, a bigger ship is built and a more powerful engine is put into it. The sea will carry anything you build. However heavy the locomotive, the earth will carry it. But in the air one is confronted with a definite relation between horsepower and load. A quarter of a century of experiment has taught the designer that one horsepower will support and propel a maximum weight of about twenty-five pounds. This total weight includes the plane, the engine, the fuel, the passengers — everything. In big planes and little planes, in all sorts and sizes of planes, the power load governs everything.

As a matter of fact, twenty-five pounds to the horsepower is the absolute and dangerous limit. Colonel Lindbergh's famous plane weighed 23.6 pounds to the horsepower; Chamberlin's 24.5; Byrd's 22.5. All were perilously near the danger limit of power loading; all had great difficulty in taking off. When Captain René Fonck started in September, 1926, his margin was too small. The plane took off, but it was overloaded and in a few seconds crashed to the earth in flames.

In the ordinary commercial plane the total weight carried must not exceed twenty pounds to the horsepower. The six-hundred-horsepower Farman-Goliath has a total lift of 11,020 pounds, which means a power load of eighteen pounds. If you want one to carry twice the weight, you must double its horsepower and its size. This ratio between horsepower and weight applies to every plane whether it is a Super-Farman-Goliath with a span of 114 feet or Colonel Lindbergh's famous little machine.

And there is a further limit which bars the path to bigger planes. There is a limit of structural stress. The designer will tell you that beyond a total weight of eighteen thousand pounds, a larger proportion of weight has to be put into the structure

leaving a smaller proportion for engines and useful load (fuel and oil).

It comes finally to this, that a passenger plane developing 1,155 horsepower is capable of a comparatively short voyage of say two hundred miles with fourteen passengers and seven hundred pounds of freight, or approximately three pounds of paying load to the horsepower.

Now how does this compare with a train or steamer? A locomotive engine of one thousand horsepower will pull a total load of some three hundred tons and a paying load of fifty tons, or something like one thousand pounds to the horsepower. A cargo steamer of two thousand five hundred horsepower will move 10,500 tons of cargo, or some four tons to the horsepower.

In one word, power load is an insuperable bar to air transport on a big scale. Apart from all questions of convenience and comfort — in which land and water transport must always be infinitely superior — no form of transport which is forced to measure its weights in skimpy figures of pounds and fractional ounces can ever be more than an emergency or supplementary means of locomotion. It may and will, of course, be argued that paying load per horsepower is not a wholly sound basis of comparison, for a train must have a permanent way, and a motor vehicle requires a road. But the final test of economic efficiency is ability to pay one's way.

Air transport has never paid its way, and there is no prospect that it will. It is maintained by subsidies. Thus the present rate of subsidy of Imperial Airways in Great Britain is three shillings and ninepence — or about ninety cents — a mile, which is nearly $408 for each trip from Croydon to Paris and back.

The same conditions prevail everywhere. In Germany seventy per cent of the cost of actual air transport is derived from subsidy and taxation. In the United States two-thirds of the cost of the Air Mail Service is met from government funds. The expenditure may be justified in terms of utility, and the advantages of a speedy mail service may be worth the expense involved. But the same argument cannot apply to the ordinary run of traffic; and the fact remains that even in the transport of mails, the air cannot compete economically with the rail or road.

The partisans of aviation reply airily that the plane is only in its infancy. But is it? Every machine must at some time reach its zenith of development. The steam engine took nearly a century

to reach maturity. But time runs faster now: ten years of the present century can easily outstrip fifty of the last. Aircraft have seen over twenty years of forced and precocious development, and are probably well within sight of their zenith.

Whatever may be their line of development, the fact remains irrefutable that in any question of transport in bulk, the plane is hopelessly outclassed. The freight of an ordinary train carrying a load of one hundred tons would require at least twenty or thirty large planes, while the dead-weight cargo of a moderate-sized tramp steamer carrying five thousand tons would require hundreds of planes and involve a long series of transshipments.

But in using large planes in large numbers there are limits of common-sense convenience. The large plane is an intolerably bulky and inconvenient vehicle to load and unload, and considering the small load it can carry, it may safely be said that there would be an actual loss, rather than a saving of time, in the transport of any considerable volume of freight by air.

Again, though speed is the ace of air transport, it is not the ace of trumps. What is required in world transport is regularity. The prime essential of traffic on a large scale is the maintenance of a regular schedule. Speed may be very important on some occasions, but it is not a primary consideration. It would be quite possible to build cargo steamers to go fifteen knots instead of ten; but it is not economical.

It is precisely in this requisite of regularity that aircraft are notoriously deficient. They are slaves of weather and cannot run to a strict schedule on voyages of any length. They are governed by the wind. Here one meets with the dominant consideration governing navigation in the air. Aircraft do not struggle against the wind. The wind is merely a moving current of air and they are carried bodily along in it, just as a ship is carried by the tide. The wind envelops them and they are carried with it, just as a small model airplane flown in a liner's saloon is carried along with the ship.

If the wind starts blowing at forty miles an hour across its track, a plane will be carried bodily to one side at forty miles an hour, and its pilot will know nothing of it unless he can measure the drift by observation of a ship or of land or by wireless directional signals, though the latter are often rendered uncertain by atmospherics and are not reliable when a plane is moving at high speed. The fact that aircraft move in a medium which is itself

moving in unknown and variable directions, at changing speeds which may approximate one-half of the plane's own, is a severe handicap to long-distance oceanic flights. For these reasons aircraft cannot fulfill the first demand of transport — regularity.

Comfort, too, and safety are important requirements which aircraft do not meet, for no one can say that a vessel is really safe which is only so when moving and becomes unsafe if, through some minor mishap, the engine breaks down.

It is not contended, of course, that there is no place for air transport. There is a place, and, in certain exceptional circumstances, possibly a considerable place — but never a great place. Across stretches of difficult and undeveloped country, where the rail and road do not run, on short routes for carrying goods of little weight and bulk, when speed is of primary importance, when a business man wants to expedite an important interview, when a film must be rushed to Chicago or New York, then the airplane will be used. But the bulk of traffic will always go by land and sea, because earth and water can sustain great weight and air cannot.

All these considerations apply with tenfold force to airships. They are even more at the mercy of weather than planes. Their inferior speed exposes them for a longer time to the drift of the wind and their mammoth bulk renders them incredibly fragile. The disaster to the "Shenandoah" (September 3, 1925), which was manned by the best airmen in the States and started with the latest weather information, is a terrible example of their vulnerability in this respect.

Their paying load is simply laughable. The airship, R-100, being built for the Airship Guarantee Company in Great Britain, with a capacity of five-million cubic feet, will have a paying load at the most of twelve tons, which means that a vessel costing probably three hundred and fifty thousand pounds will carry — dangerously, clumsily, and unpunctually — the load of a single railway car.

A single charge of hydrogen gas for this monster may cost from two thousand five hundred pounds to seven thousand five hundred pounds. Actually, hydrogen gas is far too dangerous and helium (with seven per cent less lift) must be used, and helium can be obtained only from natural gas at a cost of about eleven pounds — or fifty-five dollars per thousand cubic feet. Here one is faced with the obstacle of a world supply of helium too limited

to permit its use on a large scale. Airships are, in fact, obsolete. Like the monsters of prehistoric times, they are too ponderous and clumsy to survive. A few specimens may still linger on before they disappear, but they can never compete with carriage by rail and road and sea.

What then is the sum of the whole matter? There is no large and growing future for commercial aviation, because the future will never be much more than the present. There is a place for short-range traffic in planes to carry mails and those few passengers whom necessity impels to save time at the expense of comfort. But their number is not great. Recent sensational achievements in aviation have blinded its exponents to the inevitable obstacles. The feats of heroism and endurance performed in long oceanic flights are merely a token of the stern limitations which beset them. "Thou hast placed bounds upon them which they shall not pass."

The devotees of new instruments can never see anything else. The princes of the power of the air wax sarcastic over what they call "the Noah's Ark school" of transport. But the Ark could carry a considerable freight and bore it in safety. Noah used flight merely as an auxiliary to sea transport, and that is all it is good for.

II — FACING AVIATION'S CRITICS

COMMANDER RICHARD E. BYRD, U.S.N.

WHEN a boxer rushes in with swinging arms, he may rain blows upon his opponent, but he leaves his midriff open to some heavy wallops from the enemy. Aviation is like such a boxer in that it is plunging gaily ahead just now with little attention to the body blows many competent critics are aiming at its midriff.

I think there are two reasons for this. First, we Americans are so enthusiastic when once we get started that occasionally our emotion runs away with our common sense. We are in a seventh heaven of self-esteem over this thrilling matter of human flight