

POST WAR AIRCRAFT MANUFACTURING IN SOUTHERN CALIFORNIA

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Aviation manufacturing in Southern California has matured more rapidly than most people outside the industry realize. This is not surprising when we consider the necessity for restrictions on production information which might give aid and comfort to our enemies. However, now certain facts can be told which most decidedly do not aid and comfort them—in fact they should give him plenty to worry about. This is not intended to sound boastful. We have had enough of that, but let the figures speak for themselves.

You probably have read that in our own backyard we have equaled aircraft production rates in all of Germany and doubled Japan's output. These ratios will be doubled again in 1943. By weight, the proper way to measure aircraft production, well over 50% of all aircraft delivered to our armed services are coming from companies with headquarters here.

To give you some idea how this industry has grown, remember that the industry around Los Angeles in 1939 consisted of four major companies employing about 16,000 workmen. At that time Detroit had about 191,000 automotive workers, the movies employed 30,000 people, furniture manufacturing about 20,000.

By the end of 1942 the number of men and women employed by aircraft plants, parts suppliers and subcontractors in our country greatly exceeded those building automobiles in Detroit. In fact, they made up a huge family entirely capable of supporting an entire city the size of Cleveland, itself the sixth largest city in the United States.

In dollar value of aircraft manufactured here, our companies produced in 1942 a value equivalent to almost two-thirds the total automobile passenger car volume for the United States and Canada during that industry's best year. This year we will exceed in dollar value automobiles and trucks. This is most significant when we consider that the aircraft industry must work to much closer tolerances than in building automobiles. A modern airplane more closely resembles in precision the operations of a huge watch.

When we consider what has happened to the aircraft industry here in four short years, we can be sure that nothing in the industrial history of the world has paralleled the rapid growth in manufactured output of airplanes, not only here, but elsewhere in the United States.

To concern ourselves with the airplanes themselves, Southern California companies are producing two of the standard fighters or pursuits in production for Army, Navy and British; both standard four-engined bombers; three out of six dive bombers; two out of three patrol bombers; the only attack bomber; three out of five medium bombers; six out of eleven cargo transports and seven out of twenty-six trainers, liaison and gliders. From this information you can clearly see that

the majority of the large and hard hitting combat airplanes are made here.

Now that we have the picture of war production, what may we expect in the post-war era? So much has been written on this subject that your author hesitates to enter the arena with the numerous prophets and oracles who already dominate the stage. The only thing which gives me courage is the rather muddled thinking which many of these prophets seem to be reveling in, and the fact that most of our better qualified observers are so busy turning out planes and operating airlines for the Army that they have not taken time out from these more important duties to give us some real insight into what we may expect.

Raymond Moley, one of our more reliable columnists and writers, expressed some interesting views regarding post-war aviation in the March 8 issue of the Newsweek magazine. In his discussion he stated that, after a recent trip to Los Angeles where he had occasion to talk with aircraft executives, he felt that the viewpoints of these men were very similar concerning the possibilities of future commercial developments of their product. He made special reference to the opinion of one executive that the helicopter was not only adaptable to private use, but also for passenger and freight transportation for relatively short distances. The drawbacks in such equipment are recognized, but it is believed that they are overbalanced by the safety factor.

Mr. Moley reports that these men realize the important results which will come from the development of larger bombers and transports toward further development of long distance passenger and freight transportation. They are, however, giving some thought to the possible adverse situation which may be created by the conversion of war planes to civilian purposes. Mr. Moley reports that it is the general feeling that the war is removing certain obstacles which heretofore restrained invention and experimentation. The present developments would appear, therefore, to be contributing to the design and development of improved equipment which would be highly beneficial to commercial air transportation after the war. Mr. Moley also pointed out the importance of our developments in the utilization of wood and plastics, as well as light metals. He is a strong supporter of the belief that metal will probably play the most important part in future developments.

The author is in complete agreement with Mr. Moley's comments. In connection with that opinion, we may expect that the helicopter will in time give the automobile the only real competition it may expect from the airplane, as far as providing a private means of transportation. Capable of vertical ascent and descent, hovering over one spot, coming to a complete stop

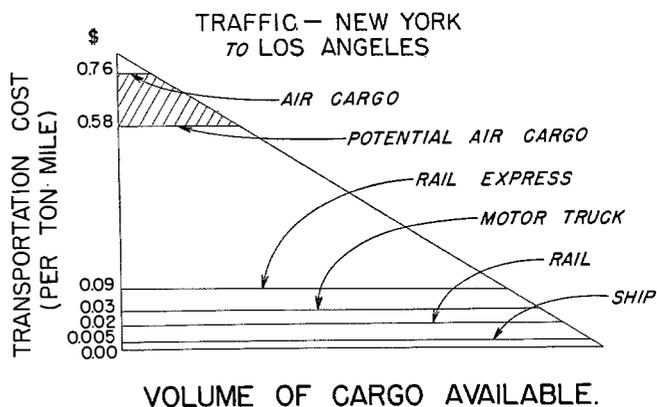
from speeds of 50 miles per hour or greater in less space than that required by the average car, movement from side or back—this development of Sikorsky's which has been accelerated by the war, may be the answer to the man who seeks safe, short range transportation and economical transportation at speeds up to 100 miles per hour. If the motor fails, this machine merely floats or parachutes to the ground. No landing field, with time lost and expensive maintenance, would be involved. While such a machine may not be made available from mass production plants for five years, certainly Army experiments publicized to date would indicate that it is on the way. This development will probably not be a factor in long haul commercial air transportation, but it could change the commuting and vacationing habits of large segments of our population.

The higher speed, conventional airplane, as we have known it in the past, will, in the opinion of the author, remain in the category of the yacht. Sportsmen, ex-military pilots and the well-to-do may buy a large number of airplanes in the category of our primary, basic, and advance trainer class, but here the market should rapidly reach the saturation point, with no basic economic reason to support it, and many manufacturers scrambling for the comparatively few number of prospective buyers. With the laws of gravity still at work, accidents will continue to be frequent, as it takes a considerable amount of skill and judgment to fly an airplane, which requires high forward speed to produce sufficient lift. Navigational aids to help overcome hazards in bad flying weather are constantly being developed, but these are likely to be expensive. Congestion around airports will force a ban on their use of commercial terminals by the private pilot and force him out to more remote and less accessible locations. Strict traffic control near all large cities, to safeguard commercial, as well as private flying, will be just as necessary as the present highway patrolman and stop signs. The essential difference, except for the helicopter, between the motor car and the airplane is that low speed is the friend of the automobile and the enemy of the airplane. As long as a wing is used for lift, and the economic advantage of air travel lies in speed, the human element remains dominant, as far as accidents are concerned.

The military market for our airplanes will undoubtedly remain, particularly for those favored few who have new models in production, or are well advanced in their experimental stage when the war is over. Most Americans agree that we will still require a sizeable air force to police the world. The average military plane is obsolete in from three to five years—hence a potential market for those manufacturers with the best designers and greater military experience. However, the most wishful thinkers cannot grant that this field will consume more than a fraction of the present capacity. The business will probably go back to a few companies, of which Southern California should have a higher proportion than any other single section of the country. Big mid-western assembly plants and many automotive operations probably will be discontinued, or converted to other types of manufacture.

We now come to a consideration of the cargo and commercial transport field—one which is receiving much public attention. To properly understand the potentialities in this field, it

is necessary to understand the nature of the cargo or transport airplane itself, and its limitations. Today our ocean shipping lanes are seriously menaced by enemy submarines. Sources of fuel are in the hands of our enemies, particularly in the far Pacific, making necessary the shipment of high octane aviation gasoline over great distances by tanker. In a survey made by the Standard Oil Company of New Jersey, it was found that most cargo planes now in transoceanic service require more tankers to keep them in operation than they replace in freight ships. In spite of this inability to carry a payload, plus sufficient fuel to make return trips, saving in time and war demands for extreme flexibility make their use highly necessary. In peace time the problem of fuel supply becomes less complicated, but, nevertheless, the economic considerations, temporarily makes less transportation.



Let us visualize a triangle with the transportation cost per ton mile plotted vertically and the volume of potential traffic plotted horizontally. It is clear that the volume of goods available at the highest ton mile rate (air transportation) is an infinitesimal fraction of the volume available at the lowest ton mile rate (ocean shipping). For example, between New York and Los Angeles it now costs 96c per pound to transport steel by air, about 3c per pound by rail freight and, if the service were available, about 1½c by ship through the Panama Canal. This is true in spite of the fact that the respective distances are somewhere in the neighborhood of 2500 miles by air; 3000 miles by rail, and 6000 miles by ship. Obviously, except in cases of extreme emergency, steel would never come to Los Angeles by air. On the other hand, where speed is essential, and when rate differentials are slight, due to the higher costs in transporting by railroad or ship, that is, in the passenger mail, light weight cargo and perishable goods field, potential traffic is great. However, the tonnage or volume of this type of traffic is small when we compare it with bulk shipments.

Looking again at our triangle you will see that, as ton mile costs of air transportation are reduced, potential volume goes up, not in direct proportion, but at a much more rapid rate. Therefore, a cut in rates for air transportation by one-fourth might expand volume of traffic, not by one-fourth but, let us say by ten times. Therefore, let us examine the possibilities of effecting such a reduction in air transportation costs. To do so we must understand the fundamental limitations of the airplane.

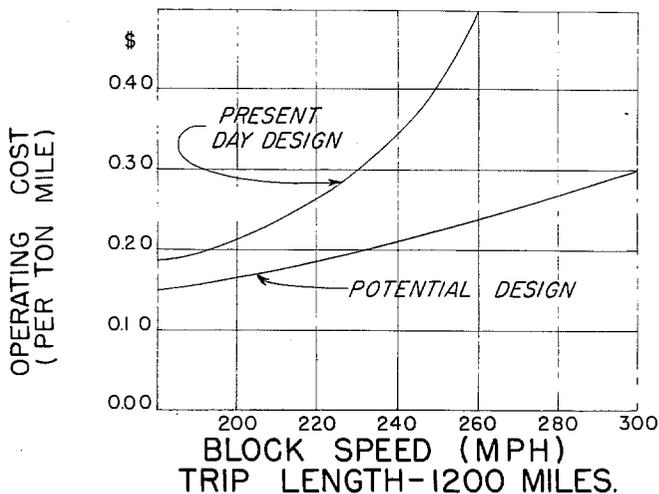
The best study which I have seen on the economic aspects of transport airplane performance was reported in Volume 7, No. 6, April 1940 edition of the Journal of Aeronautical Sciences. The article, written by W. C. Mentzer and Hal E. Novise, engineers with United Airlines, makes use of numerous mathematical formulas and many charts, from which certain conclusions are drawn. All data has been taken from actual operating experience and theoretical calculations are based on improvements in airplane design which may be available to the airlines when the war is over.

The study makes it possible to arrive at the following conclusions:

1. Commercial operators can afford to pay almost any price within reason for new equipment which reduces ton mile operating costs—particularly for use on the long-haul routes. This answers the question; how are the manufacturers going to compete with the hundreds of cargo and transport airplanes now in service with Army and Navy and likely to be made available to commercial operators after the war? Continued improvement in design will make it impossible for present day equipment acquired at no cost to the airlines to compete commercially with new equipment available after the war at a substantial acquisition cost.

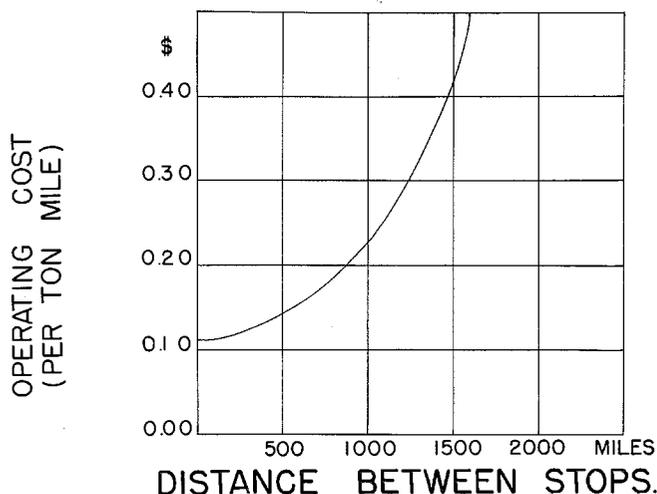
2. Costs per ton mile increase greatly in lengthening distance between stops. Because increased gasoline weight for longer trips reduces the pay load which can be transported, it is easy to see how ton mile costs would rise. Carrying this to an extreme, it is easy to see that a trip length equal to the maximum range of the airplane would preclude the carrying of any payload—its entire lifting capacity would be used in transporting crew and its own fuel. A cargo plane just capable of flying the Atlantic, with adequate reserve fuel, would be unsatisfactory for commercial use on this run. Improvements in design now known to be possible pay increasingly bigger dividends as the non-stop trip is lengthened.

3. Costs per ton mile increase greatly as the speed of a given airplane is increased beyond its most economical cruising speed, or as the time schedule is cut for any given equipment. This



difference in operating cost due to increased speed is less in an airplane of clean design at 200 miles per hour on a trip 1200 miles in length may be 15c per ton mile. If the speed is increased to 240 miles per hour the cost increases to 21c, or an increase of 6c, or 40%. If a more obsolete airplane is operated with larger power plant at the same two speeds on the same trip the cost per ton mile increases from 18c to 36c or by 100%.

4. The cost per ton mile decreases as the operator is able to improve the utilization of his equipment, or in other words, improve his load factor. This point is so obvious that it should require no further explanation.



5. For a trip of 900 miles in length a modernized airplane costing two and one-half times as much as an obsolete one will reduce relative ton mile costs at cruising speeds of 240 miles per hour and up by a much greater proportion than the same airplane operating at lower speeds. That is, assuming of course that bigger power plants were installed in the more obsolete airplane to make the higher speed possible. From this we can draw the logical conclusion that as the time schedules for all trips are cut down it becomes increasingly difficult to compete with the present day equipment. With any equipment, at speeds above the 200 miles per hour rate, it would seem that ton mile costs for transportation would advance, but the advance in cost as speeds increase will be less than with present day transport airplanes.

Thus, we see the importance of continued improvements in design by our companies—in fact, it is so necessary in the cargo and transport field that those companies without the best engineering brains may find it impossible to compete. The volume of this business should be great, but still nothing like our present manufacturing capacity.

To summarize the author's views, it would appear that the helicopter may ultimately be the most common privately owned aircraft. This may come within the first five years following the war. It may have a profound effect upon many of our living habits. Private airplanes of conventional design will be sold in lesser volume—to the sportsman and the wealthy—those who can pay for speed.

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most of the needed materials. A considerable number of persons also produced similar masks for their own private use. On breathing in through the scam mask the outside air passes through the films of liquid lamellae which are suspended between the threads of the various layers of cloth. A difference in pressure of only a few inches of water column is necessary to make the air pass. This transfusion of gases through thin liquid films, as well as the various physical and chemical processes which accompany it, present some rather interesting scientific and technical problems which justify a more detailed study.

The problem also was studied of making large buildings gas tight by filtering the air at the intakes and by creating a positive pressue of about one half of an inch water head in the interior of the buildings. With all of the windows closed the doors could then be used freely for entrance and exit without danger of poison gas entering. An air intake of this kind was installed for the control center of the City of Pasadena. The air intakes must be located as high as possible. The most suitable building to be rendered gas tight on the campus is the biology building, but no practical action has as yet been taken. The protection of factory buildings and the machinery which they contain presents some of the most interesting problems of gas defense, and it is to be hoped that adequate studies in this direction are being made. Even if we never should be forced to make practical use of the results of such studies, they might be of value to our friends overseas who are more likely to be exposed to enemy gas attacks.

In conclusion we wish to express our gratitude to the great number of persons who have cooperated in our efforts. Lack of space makes it impossible to mention them individually. I wish, however, to express my most sincere thanks to Mr. Charles Arthur, Director of the Health Department of Pasadena, who most clearly recognized his responsibility in working for the protection of the civil population; without his untiring assistance and support our efforts would have been futile. The effective cooperation of the senior gas officer, Mr. Ted V. Ackerman, as well as that of many of my colleagues at the Institute likewise is highly appreciated.

Military airplanes will probably continue to occupy a prominent place in our industry, especially among those who have the most flexible design and manufacturing facilities. World and national political factors will largely govern here.

Commercial cargo and passenger transportation will provide a large demand, especially for the bigger airplanes, but this field will be dominated by those companies with the highest degree of engineering skill. Airline operators will greatly expand their potential volume of traffic, especially as design changes permit further declines in operating costs. However, in the field of bulk cargo there will be plenty of business for the railroads and our ships—at least as far as we can see ahead. New merchandising methods may develop, as air transportation makes it possible to reduce the need for carrying large inventories of the higher cost goods. But cost of transportation will still be a governing factor, even though the small town merchant may have the goods of the world within a few hours reach. The general level of prosperity in this country, following the war, will be the big question mark. Also our world-wide tariff policy. The means of trading with all the peoples of the earth and easy access to them will certainly be at our disposal through the use of the airplane. Will our political leaders see the light?

However, let me emphasize the fact that none of this can come true for us if we lose the war. That is why post-war planning seems to me to be decidedly secondary at this time. Our engineers are developing many things for war which can be used in peace. Let's not take our minds from the big task at hand today. The development of the airplane is *evolutionary* rather than *revolutionary*. If we make the world a safe place to live in—post-war aviation will follow as a matter of course and on an unprecedented scale. The war has accelerated its development—let's not throw away these benefits by dissipating our energies in fighting with our Allies for future air commerce now while our enemies strive to drive us from the skies.

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