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AIR FREIGHT FOR DEFENSE

By WILLIAM M. SHEEHAN*

Many years ago in the capital of old Nippon, crowds gathered to watch the Emperor pass by. Word had gone forth that the Son of Heaven was to wear a new and wondrous cloak, of silk finer than a spider's web, so delicate that it could only be appreciated by persons of superior perception and taste. Many were the exclamations as the proud ruler moved along, gracefully hunching his collar or kicking aside a rebellious fold. Each, fearing his own stupidity, was loath to admit that he could not enjoy the rare spectacle. Until at length one small voice cried out, "But he has nothing on at all." Then others, soon all, agreed that in truth the Emperor's vaunted garment existed only in imagination.

There is a parallel today. Among our people, anxious lest some hostile air force rain upon their homes and industries the same death and destruction that has made a shambles of Old World cities, has grown a hope and belief that the present expansion program will provide us with the strongest, most complete air power ever known. Comforted that tens of thousands of bombers, fighters and other combat planes are on the way, we envision an air arm that will cast over not only the United States but the entire Western Hemisphere a cloak of impenetrable aerial protection.

Yet the cold and obvious fact is that the air force we are planning threatens bitter disillusionment—for want of one unspectacular but essential type of aircraft, the sky truck. As though we provided a mechanized army with tanks and armored cars but no trucks, or a navy with battleships and destroyers but no supply vessels, we are

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trying to create a balanced air arm without the thousands of troop and cargo transports that modern warfare makes absolutely imperative. Our eagerly awaited cloak of security is nothing but pieces of a fine garment without stitches to hold them together.

Years ago, Admiral Mahan, one of our great naval authorities, said,

"The student will observe that changes in tactics have not only taken place after changes in weapons, which necessarily is the case, but that the interval between such changes has been unduly long. This doubtless arises from the fact that an improvement of weapons is due to the energy of one or two men, while changes in tactics have to overcome the inertia of a conservative class * * * it is a great evil. It can be remedied only by a candid recognition of each change."

Now there can be no doubt that our leaders have "recognized" the airplane as a new and important kind of weapon. Powerful combat units, discussion in responsible circles of a 125,000 plane air force, indicate that. Even as early as 1931, progressive elements in the U. S. Army, realizing that the moving of troops and equipment by air might be much more effective than hit-and-run bombing, experimented in flying a whole battery of field artillery from one end of the Panama Canal to the other. But the fact that since then so little has been accomplished in military air transportation, and in all published programs for expansion such relatively small emphasis has been placed upon the airplane as a carrier, justifies the conviction that our leadership has yet to recognize the *full* potentialities of air power. Admiral Mahan was right. The interval between discovery of the transport plane as a weapon and its use for tactics, logistics and other military purposes is much too long.

It must be admitted that Germany has suffered less from "conservative inertia" in this respect than have we. For by 1935 she had not only experimented in the flying of troops and equipment but had commenced the large-scale production of a standardized sky truck, the Junkers Ju 52.

So it was that during the battle of Norway the Nazis were well supplied with transport aircraft. Shuttling back and forth like busy ants these Ju 52's, augmented by 40-place Junkers Ju 90's and Focke Wulf Condors, dropped men and material at numerous strategic points. Grey-clad soldiers with rifles, machine guns, light field guns, mine throwers and collapsible motorcycles, were flown over, and beyond the powerful British fleet. Perhaps sea power was not

defeated by air power in that campaign, but it was most effectively circumvented.

More significant was Nazi use of sky trucks in smashing Belgium and Holland. Here appeared both parachute and air landing troops and for the first time, according to R. C. Candee, Chief of the Intelligence Division, Office of the Chief of the Air Corps, was accomplished that which the consensus of military opinion had previously agreed impossible, namely, the capture and holding of ground by an air force.

In the Balkans, high-lift, rough-landing sky trucks were employed with success. In Africa, General Wavell's hard-won gains were lost to mechanized forces refueled in part from aerial tankers. Troops ferried by air are a feature of the present Libyan battle. The strongly defended island of Crete succumbed not to land artillery or naval invaders, but to air borne troops complete with small tanks, maintained by airplanes and gliders.

Finally in the gigantic Russian campaign, although no longer progressing favorably for the Nazis, sky trucks have been a vital auxiliary, without which the German push might have collapsed long ago. For it is not like Napoleon's disastrous invasion, the Nazis are moving behind a 2200 mile front. The difficulties of moving troops and supplies over such an area are stupendous, especially when it has been the avowed policy of the retreating armies to leave nothing but scorched earth behind—no railroad tracks, bridges, roads, tunnels—every square foot of ground subject to hidden mines. That lines of communication have been kept open and a relentless pressure maintained for so long in hostile territory is attributable in part to the fleet of not hundreds but *thousands* of busily shuttling Junkers.¹

One views these conquests with wonder. How could Nazi Germany, a short time ago completely bankrupt, opposed by the finest army, the most powerful navy and resources of almost the entire world, come to dominate in the space of two years sixteen countries of Europe? Ruthless terrorism, clever Machiavellianism, fifth columning, treachery, deceit—all these, to be sure. But more fundamental has been the power of its armies. Not old-fashioned military might such as that in which France excelled, but a power

1. According to official German statistics, during the period June 22, 1941, to October 31, 1941, on the Eastern front alone, Luftwaffe transports moved up 42,000 tons of supplies, making 80,000 trips, flying a total distance of 12,500,000 miles. For purposes of comparison, all the cargo, freight or express, military or commercial, flown during the entire past year in the United States amounted to about a fifth of the quantity indicated above.

that Admiral Mahan would say resulted from overcoming "the inertia of a conservative class." The ability not only to find new weapons, different types of tanks, guns, combat planes, submarines, etc., but to apply them in changes of tactics. Not the least among these has been use of the sky truck to speed up operations to an unprecedented tempo. Nazi strategists have grasped the real significance of air power. By putting whole regiments on wings, they have embarked upon what may prove to be the most revolutionary change in military thought that man has ever known. War has moved into the third dimension.²

The building of armed forces is a matter which civilians usually leave to others. Yet, in the absence of indications that our leaders appreciate the necessity of building large sky truck auxiliaries, constructive suggestions from those engaged in civil aspects of sky trucking are a responsibility. In this spirit, it is proposed to consider, first, what sky trucking facilities the United States has on hand or, so far as is known, on order; next, how sky truck auxiliaries would enhance our military strength; and finally, how such auxiliaries might be obtained.

I.

The only aircraft that have had any appreciable experience moving heavy freight in this country are the sky trucks of the Army Air Corps, for the most part 12 ton, twin-engined Douglasses. Last year the Army's transports, fifty or sixty in number, moved more than 4,000 tons of aircraft engines, propellers and other cargo, operating scheduled runs between four major depots at Middletown, Pennsylvania, Fairfield, Ohio, San Antonio, Texas, and Sacramento, California. The Air Corps' newly formed Air Service Command now claims over three hundred transports for passengers and cargo. Good as far as it goes, but hardly worthy of a first class air power.

Contrast this handful of freighters with the Nazi horde, which by Allied estimates is anywhere from 5,000 to 10,000—probably closer to the latter figure.

For want of the necessary types and quantities of airplanes, no more than four battalions in the U. S. Army are receiving training in parachute tactics. Only recently was the first battalion of 550 men created to study and practice maneuvers involving air

2. "Air power today has decided the fate of nations. Germany with her powerful air armada has vanquished one people after another. On the ground, large armies had been mobilized to resist her, but each time it was that additional power in the air that decided the fate of each individual nation." Henry L. Stimson.

landings. And if one searches published breakdowns of United States warplane orders for future comfort, he will discover only about five hundred additional aircraft destined to supplement our military air transport services during the next few years.

Whereas the carefully planned German air force counts more than *sixteen* percent of its first line fighting strength in the form of troop and cargo bearing sky trucks, Uncle Sam, who maintains garrisons scattered over a third of the earth's surface, had up to a few months ago less than *four* percent of total aircraft strength in this form.

But how might increased emphasis on the production and use of sky trucks contribute to American defense?

II.

The first answer is by direct military utilization of such equipment, both for regular supply auxiliaries and for tactical maneuvers.

Since the dawn of time logistics, or the movement of troops and supplies, has been one of the most fundamental of military problems. "The art of war consists of always having more forces than the opponent . . . at the point where one attacks," said Napoleon—a thought more succinctly phrased by the General Staff School in its *Principles of Strategy*, "Be stronger at the decisive point." Decisive points shift frequently and suddenly. Therefore the need of the fastest possible transport facilities is obvious. A fleet of 1,000 sky trucks divided among army, navy and air corps, although far short of German figures, would go a long way toward speeding up our military supply services.

Now that we are at war there is danger of attack along either coast. Our best equipment, including the all too few mobile anti-aircraft guns, is placed along the Atlantic seaboard. Suddenly aircraft carriers appear off the Pacific shores and send squadron after squadron of bombers to destroy airports, power dams, communication facilities, as well as the forty or fifty percent of aircraft production which lies conveniently bunched there. It might be necessary to move a large amount of troops, guns and supplies across the country with the greatest possible speed. How would the Army accomplish this? Judging by maneuvers up to the present time, by trucks and trains. For although the Air Corps has experimented in moving heavy pieces and troops with side arms, there has never been a truly large scale movement of men with heavy military

equipment in our planes. As a matter of fact, as indicated previously, the Air Corps has never had enough sky trucks to undertake such maneuvers. The citizens of Los Angeles would have to wait three days and two nights for the fastest express trains to reach them from the other coast.

In tying together the far-flung ramparts of our defense area the need of great numbers of sky trucks is particularly apparent. For the advantage of air transportation stands out sharply when contrasted with ten or twelve knot surface vessels. It is regrettable that today our vital outposts in Alaska, Hawaii, the Philippines, Iceland, Greenland, Trinidad, the West Indies, and Dutch Guiana, have no sky truck connection worthy of the name with main bases, but must await slow, plodding marine vehicles for virtually all their needs.

In a letter to Admiral Land several years ago, President Roosevelt wrote, "You and I know, from our work during the war, the disabilities of a navy which lacks an adequate merchant fleet. With all its enormous potential combat power, such a navy is tied to its land bases." Is it not obvious that an air force without aircraft supply vehicles is equally under disabilities? We are spending billions to enlarge our naval auxiliary. Is not creation of aerial auxiliaries just as important?

Strangely enough, the nation which heretofore has shown itself most progressive in development of transportation facilities, that can lay claim to more than a quarter of the world's scheduled airways, one-third the railways, one-half the paved highways, has made no appreciable effort to harness as its servant, even for its military forces, the fastest cargo medium of the day. But, aware that levees, bridges, canal locks, tunnels, road junctions and long, gleaming rail lines are the first objectives of high flying bombers in modern warfare, more and more citizens are beginning to inquire why provision is not being made for vehicles which use the indestructible pathways of the air, the landing fields of which can be any ball park, meadow or level stretch of road, the transport functions of which are not likely to be impaired by civilian congestion in time of trouble.

Even more promising than in naval and military supply systems is the use of sky trucks for maneuvers of attack.

In this connection, the relation of speed to the effectiveness of attack, as propounded by Colonel James L. Walsh to the Army Industrial College, is of interest. Making an obvious analogy to the

fundamental laws of motion set forth by Isaac Newton, Colonel Walsh said:

"In war, the kinetic energy of attack increases directly with the weight but increases as the square of velocity. Velocity, in turn, increases directly with distance covered in a given time, but inversely with time required to traverse a given distance. Hence, if weight is doubled, striking energy is doubled. But if time is halved, striking energy is quadrupled, and if time is cut down to one third, striking energy is increased ninefold—which perhaps explains the startling effectiveness of today's war."

According to Colonel Walsh's theory, other factors such as fire-power and armor protection remaining the same, the military effectiveness of an army has a cubic relation to its speed of movement. If, as is roughly the case, aircraft transport and combat units are capable of moving ten times faster than surface vehicles, the effectiveness of an army transported in airplanes should then be of the order of ten cubed, or 1000 times, greater than a similar truck- or ship-borne force. To be sure, practical difficulties might prevent the full benefit theoretically possible from being immediately attained. Yet even the partial workability of this stupendous concept is sufficient to justify great reliance upon air transportation in tactical maneuvers of offense.

Because of the importance of speed,³ some experts now advocate that Uncle Sam lead in taking the final step of evolving air power. They urge that enough of the sky truck type of airplane be constructed as soon as possible to serve as the basis of what, for want of a better term, might be called "airmadas"—fleets of scouts, bombers, fighters, and transports for carrying whole divisions or armies, parachute troops, infantrymen, artillerymen, engineers and all their equipment. Intended primarily to collaborate with land and sea forces, these air units would, however, be capable of independent action in taking and holding territory of strategic importance.

In keeping with the wise principle of retaining military strength within the United States as long as possible and sending it out to points remote from our cities and industries only when it is clear from which direction we were in greatest danger, there ought to be at least four airmadas, one in each corner of the country. That in

3. "The tempo of battle, as many have observed recently, has speeded up tremendously, but the ultimate in our time will be reached not by the Panzer Divisions, not by the mechanized brigades, but by parachute troops and air infantry." Major General H. H. Arnold and Colonel I. C. Baker in *Winged Warfare*, Harper, N. Y., 1941.

the Northwest would be poised to hop to Alaska, that in the Southwest to Hawaii, the Southeast one to South America, the Northeast to Iceland. For these purposes, a range of approximately 1,500 miles should suffice.⁴

Having decided upon a range, we are in a position to see what loads can be transported. In the following table are shown the weight-hauling characteristics of two long range aircraft produced for the United States air arms. The first, the Boeing B17E, is a recent version of the Army's familiar "Flying Fortress." The other, the Consolidated PBY2-2, a late edition of a distinguished series of navy patrol bombers. The Boeing is a four-engined landplane of about 22 tons when loaded, the Consolidated a four-engined seaplane of about 30 tons. Either could, with minor structural changes such as enlarged doors, seats and bomb racks removed, "beefed-up" floors, etc., be converted into extremely useful sky trucks.

MILITARY LOADS OF POTENTIAL SKY TRUCKS

Range	Boeing B17E (Landplane)	Consolidated PBY2-2 (Seaplane)
1500 mi.....	16,120 lbs.	24,160 lbs.
3500 mi.....	10,000 lbs.	14,920 lbs.

It may be that other makes of aircraft would show equally good or better figures. The Douglas B19, for example, gigantic 82 ton landplane recently completed for the U. S. Army, is able to haul a greater load of fuel than a railroad tank car. Probably more useful as freight car than bomber, several thousand of this type could ferry staggering quantities of men and material to remote points in a short time. But the B19 giant is an experimental proposition. It would be years before we could count upon a fleet of them. In the interest of immediate practicability, tried models such as the two selected above would seem preferable.

Supposing the airmada is built around a streamlined division of ten to twelve thousand men, complete with much if not all the equipment now carried in major maneuvers, how many airplanes would be needed for each?

Lt. Colonel Wm. C. Lee, in the *Infantry Journal*, said the number is astonishingly large, yet "not so great that American

4. Such a range would enable the Northwest air force to reach its objective in a single hop—while the Southwest airmada would have a longer single hop to Hawaii—and the Northeast and Southeast forces would have two hops to Iceland and the bulge of Brazil, respectively. It is significant that long range of operations has been emphasized as one of the first needs of our developing air power by many distinguished military authorities, including Major General H. H. Arnold, Deputy Chief of Staff of the Army for Air.

industry should be unable to produce them." According to the writer's calculations, approximately 3,500 sky trucks of the types mentioned above, plus of course, combat airplanes for protection, would be necessary.⁵

Half of the sky trucks would be landplanes, half seaplanes, in order both to spread risks and reduce congestion at landing fields. Many of them would be adapted for specialized uses such as ambulance planes, repair shops, camp kitchens, fuel tenders. Vital equipment would be carried in duplicate to care for washouts. All planes would be equipped for quick loading, rough landing and would carry the maximum loads compatible with reasonable safety. Upon reaching destinations, some would be immediately re-converted to original functions of bombers and long range patrol ships. The balance would wing back to the nearest supply base to ferry in additional supplies.

Scouts, pursuits, interceptors, observation planes, dive bombers and other types of combat planes that the particular situation might require would be there. Dispatched in staggered groups—again to avoid congestions at intermediate or objective landing fields—the entire formation would proceed somewhat like a naval fleet. In front, swift scouts, in constant radio communication with other units, then twin-engined destroyer-like fighters grouped about hard-hitting bombers, and finally the heavily loaded transports convoyed by more destroyer-type aircraft. Just as a naval fleet may proceed at the speed most suitable for its submarines and oil tenders, so the armada could move at the speed most suitable for its sky trucks—a relatively slow tempo which would enable greater loads to be carried and, incidentally, permit the convoying planes to escape the necessity of refueling while in flight.

One can imagine circumstances that might cause such an armada to be called into action. Major General J. J. Fulano, in command of the Southeast Airmada Division, with headquarters at Tampa, Florida, has received orders to proceed at once to eastern Brazil, where a group of Fascist army officers has assumed control of the government. Having directed an orderly to fetch the heavy, loose-leaf book known as "Plan C," General Fulano studies the key pages.

5. It is assumed that the armada division would require sufficient aircraft to carry approximately 20,000 tons of material and 1000 tons of extra fuel. Referring to the capacities at 3000 miles (enabling a 1500 mile hop and return) shown in the above table for the Boeing and Consolidated airplanes, a need of 150 of each for personnel, 80 of each for fuel, 1600 of each to carry material, or a total of 3660 (roughly 3500) sky trucks in all is indicated.

"Military Intelligence reports enemy activity obscured by unusual secrecy at Dakar. Coastal command reports no naval action in vicinity of Trinidad. Revolutionists incapable of strong resistance save, possibly, at Rio de Janeiro."

"That means we had better let Rio go until the hump is under control," concludes the general.

Orders are given. Radios crackle. Hustle and bustle fill dozens of airports from Key West to New Orleans, from Charlottesville, North Carolina, to Pine Bluff, Arkansas.

Wing commanders give orders to group commanders, relayed on by them to squadron leaders, from there to thousands of eager pilots, navigators, radio operators, mechanics, infantrymen, artillerymen, engineers.

Without delay, two parachute battalions in transports accompanied by scouts, fighters and several refueling planes are zooming to their destination at 300 miles per hour. "Take principal harbors and beach points—occupy airports, strategic rivers and lakes—seize control of rail lines and highways from Maranhao to Salvador," is their mission. Intended only to overcome weak resistance or demoralize internal communications where there might be strong resistance, these parachuting pioneers carry mostly light equipment—side arms, wire cutters, dynamite, light machine guns, 60 mm. mortars, folding bicycles.

On their tails come detachments of engineers, specialists in preparing airports, either by expanding existing fields or making new ones in strategic spots previously selected. They are equipped with shovels, dynamite, tractors, scrapers, bull-dozers, giant searchlights, artificial landing strips. With them come several units of anti-aircraft troops with their highly mobile 37 mm. anti-aircraft guns.

Finally, traveling half as fast, come the main forces. Both at the halfway stop at Trinidad and at various destination airports, double landing strips laid into the prevailing wind permit a steady trickle of incoming planes on one side, of outgoing planes on the other. Equipment of air infantry and artillerymen, besides personal luggage, food, tents, rifles, includes most of the items standard for the surface army today. The 134 lb. 81 mm. mortar, the 37 mm. anti-tank gun that shoots 7500 yards, pierces 1½ inch armor like butter and weighs 850 lbs. The 1,470 lb. 75 mm. howitzer, and the

new 105 mm. howitzer that will soon replace the old 75's as standard light artillery piece. Motorcycles equipped with .45 caliber sub-machine guns—tiny, 2,200 lb. "jeep" liaison cars which can scoot with four men over rough country at high speed—1½ ton utility trucks, 5 ton scout cars. Even our 9½ ton heavy armored cars, 13½ ton light tanks and the huge 15 ton 155 mm. gun, whose 95 lb. shell can be hurled more than 14 miles for the longest range of any field artillery weapon in our army, should be capable of transport in sky trucks such as the Douglas B19—if not in the Consolidated seaplane described above.

With advance detachments in possession of all key points within twelve hours and the more slowly flying main forces commencing to arrive twenty-four hours after the original order to proceed, General Fulano may enjoy a feeling of achievement. Speeding directly over ocean, mountain, jungle, his men will have commenced effective occupation of a strategic region 3,000 miles away within the space of a single day, an accomplishment which would have taken a surface expedition weeks or more.

But the General's duties are by no means near an end. His sky trucks must hourly ferry up more supplies and equipment. Bombs and bomb racks, so that sky trucks remaining with the advance forces may be converted into bombers—machine guns and extra fuel tanks so that others may be converted into long range patrol boats. Spare parts and replacement engines. The large field guns may soon have a daily appetite of something like 44 tons of shells, the small field pieces 179 tons, the howitzers 256 tons, the rifles 209 tons of bullets. His men will need each day about 135 tons of food supplies, a part of which may be obtainable from the occupied country. Combat and scout planes and surface vehicles may use several thousand tons of fuel a day. To meet such demands, the General's sky trucks have a maximum daily ferrying capacity of 22,875 tons, granted supplies have been previously located at the advance base at Trinidad—of 11,437 tons if operating back to the main base in the United States. In either case it should be ample quantity, even allowing for crackups and other mishaps.

Although responsibility for upkeep of aircraft may devolve on allied divisions and facilities at Trinidad may be available for major repairs, General Fulano will rely on his ten or twelve thousand supra-marines, men of exceptional ability and training, for first aid to disabled planes. As time allows, however, more and more service detachments will be ferried up to advance stations, grad-

ually freeing the air infantry and artillerymen for their primary function of fighting.

The foregoing, of course, is not intended to constitute a prophetic picture of the hop-skip-and-jump warfare of the future. No one can clearly foresee that. But it does purport to convey an idea, based upon the performance and capabilities of current types of aircraft, of what could be done to put an army on wings.

Nor is there any desire to gloss over obstacles which must be overcome before independent airmadas of occupation may be relied upon as instruments of military tactics. Some of the problems seem almost insuperable. Adapting large aircraft for landing on rough terrain or for containing heavy, concentrated loads. Training airport layout engineers and selecting highly skilled mechanical infantrymen and artillerymen. Procuring sufficient pilots. "Airlining" equipment and ordnance to minimum weight and bulk. "Fitting" pieces that can not be broken down into smaller sections. And, above all, organizing the entire operation so that when the time comes, it may be conducted with the smoothness and swiftness that success demands.

But no matter how great these problems, we should be able to count upon the ingenuity of American military authorities to work them out. For the core of the idea is sound—airplanes *can* carry large military loads in addition to the fuel necessary for their return to bases of origin—a large number of the appropriate types can carry to and maintain at remote destinations entire divisions or armies. The difference between what has been proposed herein and what has been done already by the Luftwaffe is one of degree only. However the difficult details may ultimately be worked out, the outlines are apparent.

A matter for reflection is that what we could do, others could, too—perhaps first. It is not a preposterous suspicion that Germany, with its megalomaniac-led war machine which has already had tremendously valuable experience in the use of parachute and air landing troops in various situations abroad, might attempt sudden penetration of this hemisphere by airmadas, wholly or in part.

Years before this war began, Nazi pilots were flying great four-engined commercial airliners, the same type that made the 3900 mile non-stop flights between Berlin and New York, regularly from western Africa to Brazil. Even though chief Nazi require-

ments in the war have been for short-range aircraft, long-range equipment has not been neglected. The economical oil-burning Diesel aircraft engine (which we so unwisely overlook) has been perfected to the point where for long distances it compares favorably with our highly developed, fuel-hungry gasoline engines. Powered with four of the Diesels, Germany's 22 ton Dornier Do26 flying boat, now in use as part of the counter-blockade, can fly 5,593 miles on less than four tons of fuel. The more conventionally powered (gasoline) Föcke Wulf Kurier could in less than eight hours transfer thirty or forty men, or four tons of supplies, from Dakar to Brazil. It is reported to have an all-out cruising range of 10,000 miles.

"The only thing that can defeat air power is an air force that can go up and stop it," said Billy Mitchell. Surely the thing most likely to discourage ambitious, air-minded aggressor nations from developing long-range airmadas capable of flying over our Atlantic fleet and funneling into some inaccessible and possibly hospitable territory far from our own bases, is the existence of just that sort of air force in the United States.

III.

Another important use of a sky truck auxiliary would be of indirect military value, i.e., in speeding up rearmament production.

A fleet of three or four hundred transports similar to those now employed by the Air Corps, to haul only heavy, bulky materials, parts, tools, supplies and products of our vital war industries, would hasten the day when we can feel prepared for any contingency. Utilizing essentially the same routes and stops as existing airlines—probably operated as a new and separate transport activity by them—this cargo service would connect practically every important industrial center by air. Rearmament transportation would be on a six to ten fold faster basis. The industrial areas of either coast, three thousand miles apart, would be merely a day's flight from each other.

Not only the magnitude of our rearmament program, but the evident determination of the Government to spread the work about in order that every available industrial plant contribute to the nation's effort, places a tremendous emphasis upon swift commodity transportation. Parts for bomb-sights, rangefinders, new and secret apparatus, have always been produced in isolated shops, then assembled elsewhere under strict surveillance. Now, production

of such large objects as ships and tanks are subject to this transport-burdening "sub-contracting." In the vital aircraft manufacturing industry itself, where more than fifty-five percent of requirements for fabrication are shipped, on the average, over 1,500 miles for assembly, there is a great and growing need of a freight service swifter than that of trucks and trains.

Beyond our borders there may soon be an even greater need for a sky truck auxiliary. Certain raw materials, tin, rubber, antimony, vanadium, manganese, essential to American industry, are imported in part or in whole from abroad. Many of these now come from the Orient, a source which even the most confirmed optimist will admit might suddenly be cut off. Despite stock piles, in some cases all too inadequate, we are likely to have urgent need for such materials produced outside the country if war troubles grow.

Fortunately we may fill most of our wants in countries to the south. Tin from Bolivia, antimony from Mexico, vanadium from Peru, cinchona from Colombia, rubber and manganese from Brazil. We may also supplement our own supplies of copper and nitrates from Chile, of wool, tungsten and hides from Argentina, of bauxite from the Guianas.

But how will we transport these materials up to the United States? By surface vessels, to be sure. Yet no one knows, if or when the worst came to pass, how many merchant ships we might have, or whether marine commerce with South America would be free from hostile naval action. Even if we had enough vessels and adequate convoy protection, a fleet of six or seven hundred cargo planes, which by flying directly to inland mines and plantations would be free of the notoriously inadequate transport facilities of mountain, jungle and desert covered South America, might well be a precious asset in days to come.

There remains to be considered what we have in this country of a non-military character that might be used for industrial sky-trucking.

We have, of course, an efficient but expensive AIR EXPRESS service, operated jointly by the airlines and railroads, whereby shipments are carried in small compartments in the same planes with passengers and mail. This operation is neither by experience nor size of accommodations suited for large scale heavy freight activity.

It is a grave error to assume, as do some students of the transportation problem, that in event of a crisis the 350 aircraft of domestic airlines and 150 airplanes of the country's foreign airlines could readily be converted to use either for industrial transportation or some more direct military purpose. They would be wholly deficient not only from the point of view of numbers, but also in types and, most important, in organizational experience.

If the need suddenly arises to move important supplies or a large force in the quickest way possible, we can not simply commandeer all transport planes as the French pressed into service all the taxicabs of Paris during World War I. Modern warfare is highly dependent upon careful long range planning, and the problems inherent in air transportation are vastly greater than those of surface transportation. The interior of our conscript planes would have to be revamped—floors reinforced—hatches put in. Airports would have to be prepared, supplies cached. Without previous extensive practice, the use of these few hundred airliners might prove quite disastrous.

Moreover, it is doubtful whether the airliners should be relieved of their vital function of speeding army officers, government officials, businessmen, technicians, mail and urgently needed small parts across our broad country. Defense efforts would be seriously impaired. The British, pressed as they are for anything that will fly, have found it expedient to maintain ninety-five percent of their pre-war commercial air schedules. The Germans have even added to theirs, using new equipment for the purpose.

Military or commercial, our sky trucking assets are practically nil. Incredible as it may seem, we do not appear to have even the will to correct this situation. But can it be corrected? Can this hole in our defense armor be plugged in time?

A careful, reasoned answer is in the affirmative—*if*, and only if, we act immediately and our action is decisive and energetic.

IV.

The need of at least 16,000 sky trucks has already been mentioned, 1,000 for the regular supply auxiliary of the army, navy and air force, 14,000 for the four airmada divisions, 650 for airlines operating to remote sections of the Western Hemisphere, and 350 for industrial rearmament transportation within the United States. They should be divided among three existing types of

aircraft, short-haul and long-haul landplanes and long-haul sea-planes, and should be available well before the earliest possible date of any hemispheric invasion attempt.

It might be wise to plan the building of 16,000 sky trucks per year, until a total of sixty or seventy thousand has been secured, when a 16,000 annual replacement would serve to maintain the nation's sky truck auxiliaries in proper, modern condition. After the first critically needed 16,000 had been allocated for the purposes indicated above, subsequent production could augment them, and, to an even greater extent, replace slower surface facilities as they become worn or destroyed. If, as at the moment seems likely, a battle of transportation is to continue for many years whether there be war or peace, and if the freight portion of total airline activity is ultimately to reach the dominating proportion of seventy-five or eighty percent as in every other form of transportation, an objective of sixty or seventy thousand sky trucks is by no means disproportionate for a nation which has a peace-time need of 5,000,000 surface trucks, 11,500,000 tons of cargo vessels and 1,750,000 freight cars.

16,000 planes per year would require a productive rate of about 45 per day, a more conservative figure than the 1,000 airplanes daily desired by Mr. Ford or the 500 suggested by C. I. O.'s Walther Reuter, even allowing that the sky trucks are larger planes. Incidentally, if, as appears preferable, sky truck production is added to the military plane production already planned, in such a way as not to interfere with it, the President's 50,000 military planes per year objective should be reached in 1942 or 1943, instead of 1944, the date heretofore set for its accomplishment.

How much of a burden upon the nation's productive capacity would be involved in adding 16,000 transports per year to the aircraft already planned? According to calculations of T. P. Wright, one of the country's outstanding authorities in these matters, we should produce approximately 28,000 trainers, bombers, pursuits, etc., in 1942, 39,000 in 1943, 49,000 in 1944.

There are two features about the sky truck program, as distinguished from other types of military aircraft construction, that make possible rapid increase of production: 1) concentration on a few types, and 2) no design changes.

1) Our presently planned production calls for forty or fifty different types of military aircraft. It is generally conceded that

despite the great advantages of standardization the complexities of modern aerial warfare prevent the use of any smaller number of models. Thus, on the average, we are producing something like five or six hundred planes of each type per year, and at peak production in 1944 will average barely more than 1000 planes of each type. The sky truck program would call for at most only three makes of aircraft, each, incidentally, devoid of the instruments, accessories, gadgets, trappings and highly specialized armament that characterize combat planes. Production would average 5000 planes of each type. As a result, sky truck construction would have a much better chance of achieving "mass production" than any other type of airplane fabrication.

2) Manufacturers of combat planes, like the dog after the mechanical rabbit, are continually striving for unattainable perfection. Each time a new idea promises better performance, production is stopped, blueprints revised, tooling changed, new jigs built. Like the woman who was afraid to stop adding to her house lest the spirits punish her, engineers seem to be forever withholding a final O K and large scale production is always "just around the corner." Nor is this fussiness avoidable in combat plane production. An air force would be foolish to risk its precious pilots in equipment even slightly inferior to that of the enemy.

But there would be none of this delay in building sky trucks. The three chosen types of aircraft would be copied as they were, with the readjustment of providing larger doors, stronger floors and loading facilities which do not exist today. As with the Nazis' Junkers Ju 52's, the objective would be quantity rather than quality.

To effect such a program legislative and executive action would of course be necessary. A chief of production appointed by the President and empowered to commandeer all necessary non-military production capacity. Drop hammers, turret lathes, drill presses, hydro presses, grinders, shapers, milling and boring machines as well as labor, materials and factory space would be appropriated "for the duration" from the automobile or any other industry as might be necessary. Blueprints, jigs and dies would be scattered throughout private industry in order that scores of them might be copied, installed and used as quickly as possible.

The Government has provided for creation of new manufacturing capacity to build annually 10,000 long range bombers of the Flying Fortress and Consolidated Flying Boat types. A difference

between this and the program proposed herein is that, plane for plane, sky truck production would be considerably easier of attainment. Moreover, while the bombers in themselves are a drain on our supply of materials, the sky trucks would to a great extent help replenish them.

As a corollary of sky truck expansion, we would have to make great efforts in other directions, too. To get the most out of our supra-expeditionary force, we would need more and better airports within the United States—all the air bases that can be procured beyond our borders. We should have to train tens of thousands of mechanics, navigators, radiographers, meteorologists. Pilots, too, would be a problem, although sky trucking would enable good use of our "overage" men and provide a training field for inexperienced military fliers. With sky truck designs frozen for a year or so, time would be given for very desirable research along the lines of specially designed freightplanes⁶ for use in subsequent standardizations. Gliders, too, merit intensive research. For sooner than we think they may be to air cargo what boxcars are to railroads, trailers to highway trucking.

To many the advent of peace seems so remote that to mention plans for the post-war world is a waste of time. Yet peace is sure to come, and, like the holocaust itself, may happen sooner than expected. At any rate, so great an expenditure⁷ as this sky truck program would necessitate ought not be made without consideration of its relation to cessation of hostilities. Pursuits and bombers, like destroyers and battleships, will be so much junk at war's end. Vehicles designed for fighting are bound to be inefficient and uneconomical for other purposes, such as commercial transportation, particularly air freight transportation. But the sky truck would be useful, come war or peace. Of the fifty or sixty billions which at this writing have been spent or committed to defense purposes, little will be as usefully invested as would be the funds for these sky trucks.

The sky truck program here presented is essentially an emergency one. We should, of course, prefer it to grow slowly and

6. "It is not unlikely that a new cargo type, the heavy freight carrier, will shortly appear in the military arms of the leading nations. There is some evidence of it abroad and there is a general demand among the tactical units and in the supply agencies for such a type in this country. * * * The designs submitted to date point to a fairly slow plane with great weight-lifting ability and particularly designed for the rapid loading and unloading of freight. * * * The trend toward the general use of air infantry necessitates a troop transport of large capacity." Major General H. H. Arnold, *op. cit.*, p. 18.

7. Cost of the 16,000 planes per year should approximate three billion dollars.

surely—even as the French and British intended that and other phases of aviation to grow in their countries. But if we have to defend this hemisphere, we shall probably not be given all the time we should like by our enemies. Transportation may well be the key problem, a large fleet of sky trucks a precious aid. Along with all the other rearmament demands those sky trucks would entail a burden on the energies and pocketbooks of the American people. But the rewards would be great—a modernly geared army and navy supply system, a rearmament industry that functioned with utmost speed and efficiency, the world's fastest, most deadly striking units. And these, with the program of combat plane construction upon which we have already embarked, would provide us with the cloak of protection that we are all so anxious to see.