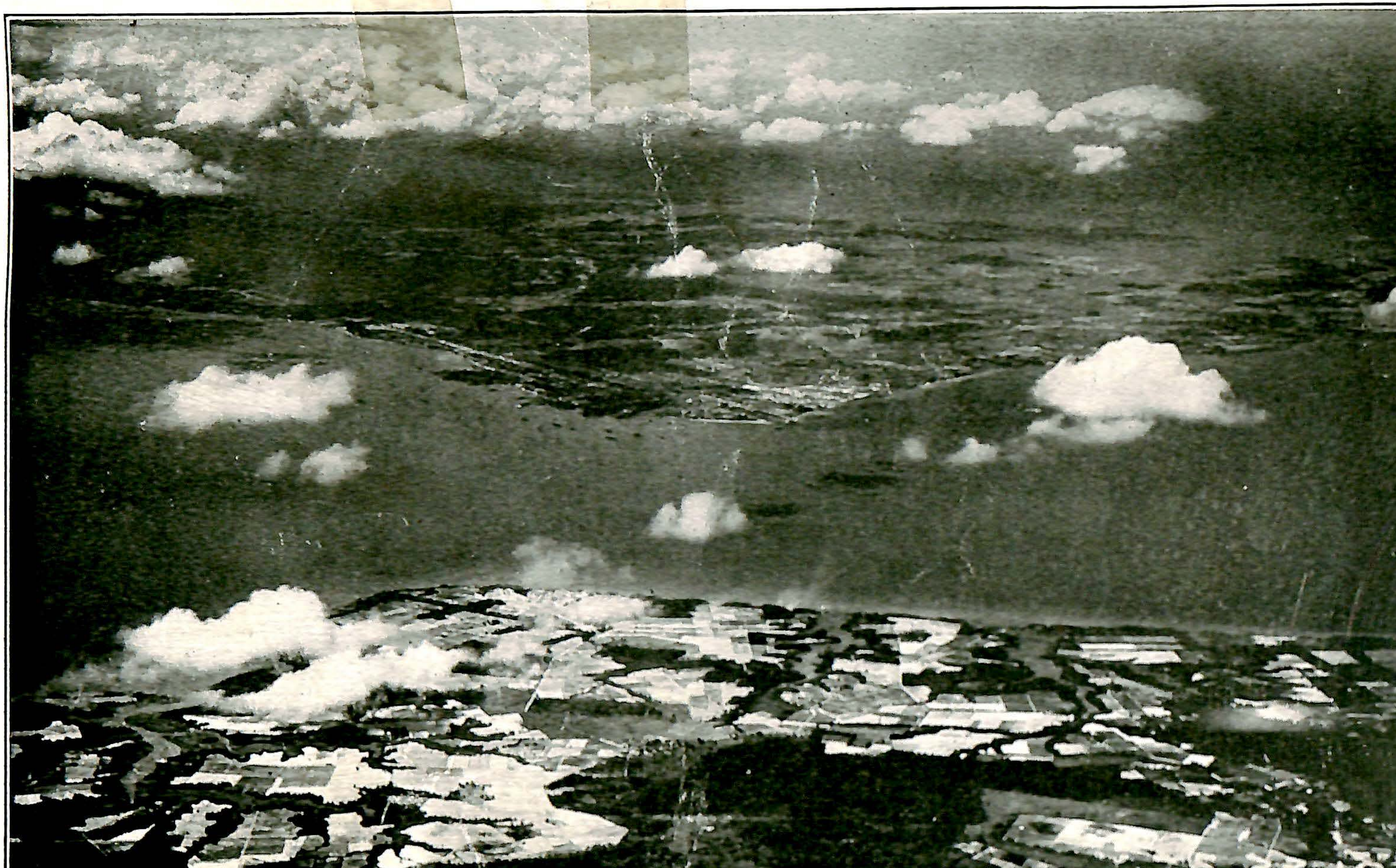
AIRCRAFT YEAR BOOK

ISSUED BY

MANUFACTURERS AIRCRAFT ASSOCIATION, INC.

1920



Dominion — Over Earth, Ocean, Air

Training Dept.
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PUBLISHED BY
DOUBLEDAY, PAGE AND COMPANY
FOR THE
MANUFACTURERS AIRCRAFT ASSOCIATION, INC.
501 FIFTH AVENUE, NEW YORK CITY

DEDICATION

For I dipt into the future, far as human eye could see,
Saw the Vision of the world, and all the wonder that
would be;
Saw the heavens fill with commerce: argosies of magic
sails,
Pilots of the purple twilight, dropping down with costly
bales . . .

— TENNYSON "Locksley Hall"

This volume is dedicated to the memory of the aviators who have fallen in war and peace, and out of whose endeavors there is developing a new art giving man dominion over Earth, Ocean, Air

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INTRODUCTION

The Manufacturers Aircraft Association presents the Aircraft Year Book for 1920, the second of the series.

In compiling this volume, the Association has enjoyed the cordial cooperation of the Army, Navy, and the Post Office air service. Appreciation is due especially to Lieut. Col. H. M. Hickam, Chief of the Information Group of the Army Air Service, Major Ernest L. Jones, also of the Information Group; to Lieut. Commander R. E. Byrd, and Lieut. L. B. Averill, of Naval Aviation; and to Otto Praeger, Second Assistant Postmaster General.

The Manufacturers Aircraft Association believes that the American public realizes the fact that we, the pioneers in aviation, must, and will lead the world. Prior to our entrance into the war, the art was neglected; the few months of the conflict were taken up with an industrial effort, without parallel in the history of the United States, and unequaled, we believe, in the results visible when the Armistice was signed, November 11th, 1918. On that date began a new period for aeronautics, and this volume records what has been accomplished to the close of 1919.

Manufacturers Aircraft Association Inc.

New York, January 1st, 1920.

Take the Wings of the Morning and Fly to the Uttermost Parts of the Sea.

CHAPTER I

AIRCRAFT IN COMMERCE

SINCE the signing of the Armistice, November 11th, 1918, when the science of aeronautics was released from war, and permitted to demonstrate its possibilities in peace, the earth has been two-thirds flown around.

The Atlantic Ocean has been safely crossed four times, twice in heavier-than-air machines, and twice in lighter-than-air craft, and to America — the discoverer of the airplane — has gone the matchless honor of first achieving this feat.

Many thousands of persons — men, women and children — have been carried as passengers, for there is hardly a country one can think of, not even excepting China and the new Arabian kingdom of Hedjas, in which civil aerial transport has not been attempted to some degree.

As certain years, such as those which produced the first practical proof of some new progress by man, have passed into history as the opening of a new era, so the year 1919 will be recorded as the beginning of the Flying Age.

What was prophecy a year ago is fulfilled to-day.

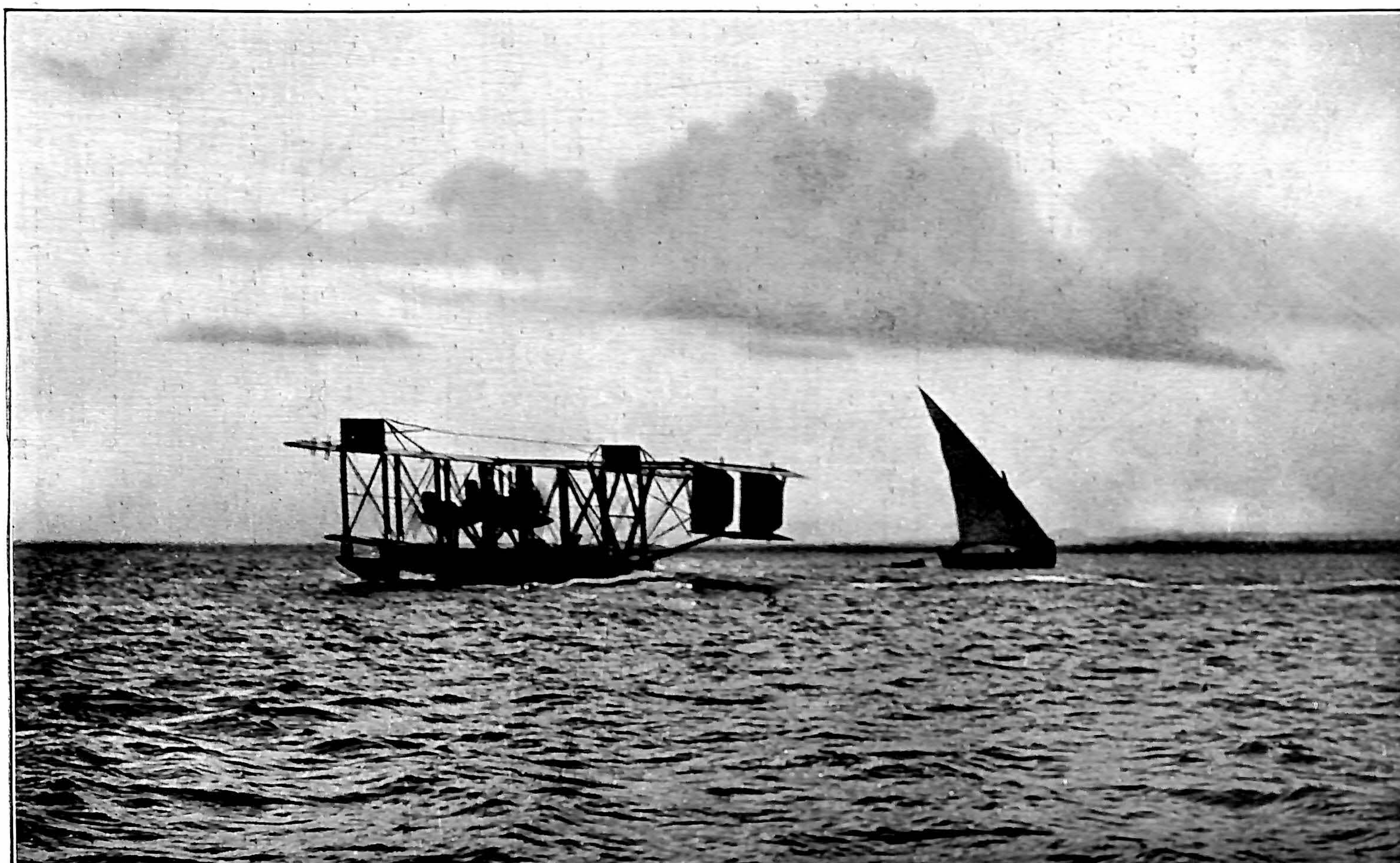
"The Afternoon Mail" is a daily occurrence. The routes from Washington to New York and New York to Chicago are in regular operation, and ships are under construction to carry letters and parcel post to Omaha and San Francisco.

Small sporting machines would be needed, it was said — and we have them now, land and water types, to meet the increasing demand.

Comfortable aerial liners would be evolved, we hoped, and by last summer we built them and flew them, five and eight and twelve passenger airplanes and sea planes.

The "freighter" would be next, it was predicted, and freighters, as this book goes to press, are taking the air — huge ships that carry from fifteen hundred to six thousand pounds, in addition to equipment, fuel and crew.

Airplanes, keeping swift vigil over our forests, were visualized, and in 1919 they were actually the means of saving millions of dollars worth of property and doubtless many lives, from destruction,



The Old and the New. The N.C.-4 in Portuguese Waters.—Courtesy Naval Aviation Photography by reporting timber fires before the flames got beyond control.

The long coast line of the United States, with its menace to shipping, could well be protected by aircraft, was the declaration, and late in 1919 the first airplane left Hazelhurst Field, Mineola, Long Island, for the first patrol down the Atlantic shore.

The miner in remote regions, the oil operator plagued by bandits, the rancher perplexed by the failure of motor or horse transport,—these, we said a year ago, would have legitimate uses for aircraft. To-day, planes are carrying oil field payrolls, enabling executives to cover tremendous distances daily, and capitalists have called airplane manufacturers to their assistance in taking machinery to a rich but hitherto inaccessible gold mine, then removing the ore to tidewater.

Most stimulating of all were the forecasts — visions, some said — of a trans-Atlantic flight. "My first impression," said Lieut. Commander A. C. Read, of the N.C.-4, "on reaching Lisbon, was that the Atlantic Ocean had shrunk tremendously in size."

And so indeed it had, as had also the world — and man's conception of them. Kipling, many years ago, in his classic "The Night Mail," described the flight between suns from England to Canada, and shortly after Read flew the Atlantic, Capt. John Alcock took off from Newfoundland at dusk and early the next morning came down in Ireland.

Fiction had become fact.

Since then, flight has followed upon flight in the United States, a pleasure "hop" at the village airdrome, a "taxi" to Atlantic City or Catalina, races to Canada and across the continent, a jaunt around the rim of the United States, a business cruise to Cuba, and now, as the year closes, a flight from England to Australia.

Thus, in twelve months time, we have seen an art, born but a short time before the World War and confined within military limits during the progress of the conflict, struggle for acceptance as a new factor in commerce.

The year, in so far as the United States was concerned, has been unique. Whereas, on the signing of the Armistice, the other great powers, Great Britain, France, Italy and Japan, recognized the importance of aircraft, not only in commerce direct, but as an indispensable element in national defense, and appropriated hundreds of millions of dollars for the encouragement of the art, our Government halted for months between two opinions, with the result that

of the Capitol, Washington, D. C. (Courtesy U. S. Air Service.)

the industry was hard pressed, and the improvement of types was gravely delayed.

That we are demonstrating the practicability of aerial transport, is due to the courage and the patience, the vision and the persistence of the men who designed and built and flew the craft which have startled and inspired America.

PRESENT AND PROBABLE USES OF AIRCRAFT

To enable the reader to visualize the impressive scope of aerial transport, there is offered the following tabulation of present and probable uses of aircraft:

- Passenger and Freight Service
  - "Hops" at fairs, expositions, and carnivals.
  - Commuting, intercity travel.
  - Overtaking steamers and trains.
  - Aerial ferries.
  - Competition with rail and water transportation lines, increasing as time, value and facilities govern and as aircraft develop in providing economical and regular service.
  - Establishing new means of communication with regions hitherto inaccessible or neglected by rail and steam lines.
- Pleasure and Sport
  - Pleasure
    - Touring: In private ships: in chartered liners.
  - Sport
    - Flying to golf, baseball, football, polo, etc.
    - Establishment of new records.
    - Aerial combat for points.
    - Exhibition flying.
    - Racing.
    - Amateur photography.
    - Flying to hunting and fishing grounds.
    - Hunting and fishing in aircraft.

The Continental Divide

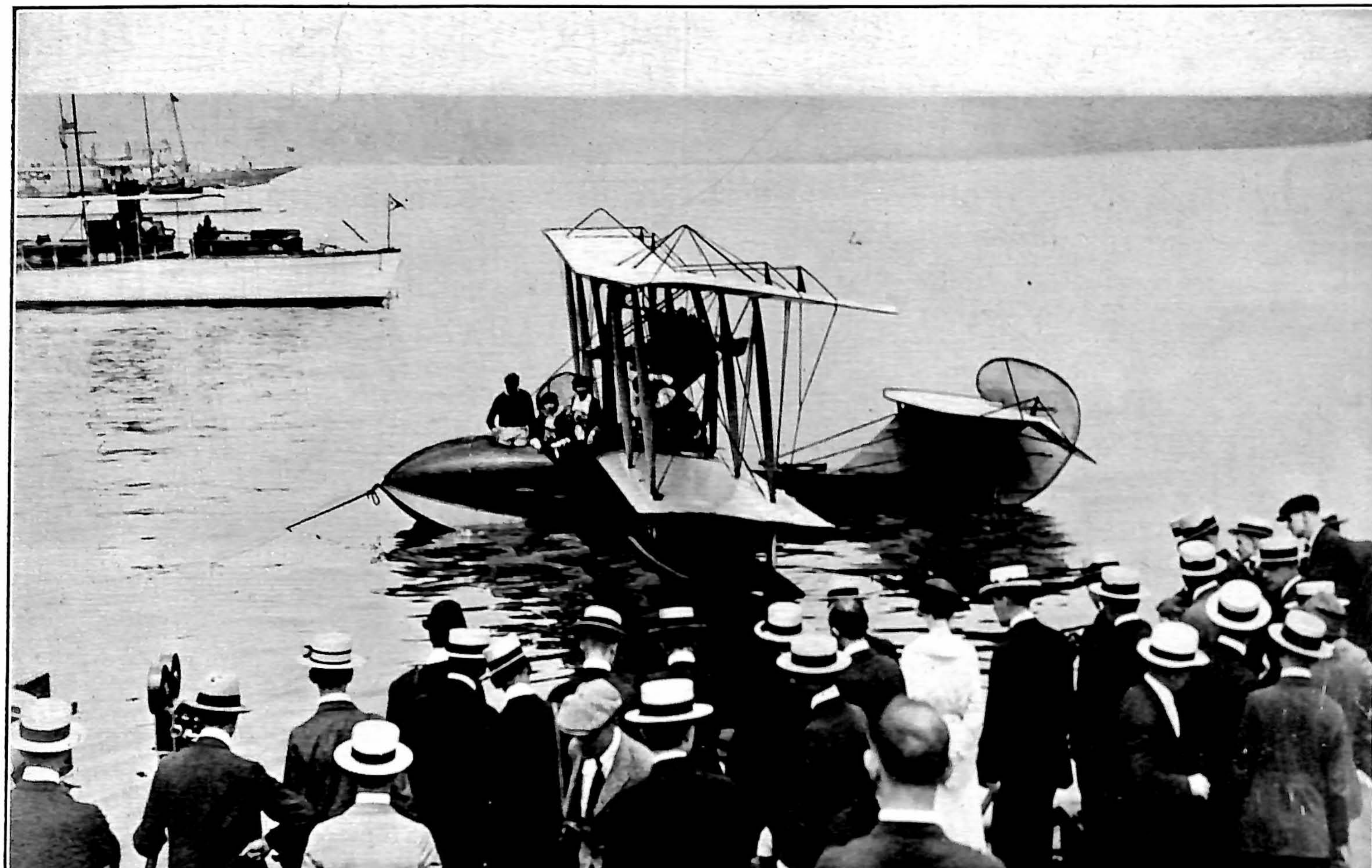
- Advertising and Publicity (Demonstrating general utility in business.)
  - Selling goods.
  - Quick deliveries.
  - News and photographic services.
  - Circulation of publications.

- Extension of Personal Supervision by Executives
  - Interurban
    - Competing with rail and water and being chosen for speed or certainty.
  - Rural
    - Farms.
    - Ranches.
    - Oil Properties.
    - Mining.

- Miscellaneous
  - Exploitation of urban and rural real estate.
  - City planning and improvement, terminal problems, parks, etc.
  - Surveys and railroad routes.
  - Inspection, power, telephone and telegraph lines.
  - Police patrol.
  - Fire patrol.
  - Architectural studies of groups.
  - Reporting of great construction projects.
  - Inspection motion picture "locations."
  - Aerial ambulance.
  - Rescue work: Flood; Fire.
  - Private mapping enterprises.
  - Patrol against depredations of any character.
  - "Locating" timber.

CIVIL USES BY NATIONAL AND STATE GOVERNMENTS

- Aerial Mail and Parcel Post
  - Transcontinental.
  - Transoceanic.
  - Deliveries to and from steamers at sea.
  - United States-Canadian.



The Aeromarine *Flying Limousine*. First passenger service between New York and Atlantic City, Summer, 1919.

Forest Patrol	National. State.
Customs Service	
State Constabulary	Quick movement of guards and troops and patrols for law and order.
Coast Patrol	Rescues. Locating submerged wrecks. Lighthouse tender service.
Mapping (General)	
Fisheries Research	
River and Harbor Projects	
Forest and Field Photography for Isolating Infected Timber or Crop Areas.	
Coast and Geodetic Survey	
Conservation and Engineering Studies	Water supply, power, irrigation, swamp drainage, etc.
Scientific	Exploration of areas superficially examined. Exploration of upper air. Meteorological instrument tests. Geographical study. Astronomy.

Of these varied uses, the transportation of passengers and freight, without doubt, will eventually become the most important. Notwithstanding that development during the first year has been somewhat delayed, due, first to the lack of airdromes — permanent landing fields — and, also, to the fact that American manufacturers were not permitted to attempt commercial designing until well after the signing of the Armistice, the primary steps have already been taken. "Hops" at fairs — were the logical consequence from exhibition flying of pre-war days, the difference being that then the people gazed in wondering disapproval, while to-day they, too, would fly.

Dayton Wright O.W. Aerial Coupe

Commuting by wealthy owners of aircraft began as early as last summer and continued through the winter. There is in this commuting a prediction of the time when cities shall be released from the confines now imposed upon them by inadequate rail transportation. Whereas 17 to 20 miles is the comfortable suburban distance by train at present, the aero commuter does his day's work and — granted the establishment of proper terminals — is a hundred miles in the country an hour or so later.

There has been much commuting and inter-city travel, trips being made with increasing frequency between such points as New York and Washington, New York and Buffalo, Cleveland and Dayton, Cleveland and Chicago and on the Pacific Coast between San Francisco and Los Angeles, and between Portland and Seattle.

Notable flights have been made by civilian aircraft such as the first regular passenger service in Aeromarine flying boats between New York and Atlantic City; the trip which Mrs. S. E. J. Cox made in her Curtiss Oriole from Houston to New York, the frequent trips by Dayton-Wright De Havilands out of Dayton and the Thomas-Morse two-seaters out of Ithaca. The Curtiss Eagle and the Glenn L. Martin army transport, the one seating eight and the other twelve people, have made scores of flights with official and civilian passengers. Out in California a company does a prosperous "ferry" business between the mainland and Catalina Island, in Curtiss boats. An enterprising Seattle man, on missing a coastwise steamer, 'phoned for a Boeing seaplane and in this he overtook the slower water craft.

AERIAL TRANSPORT

The two principal features in which aerial transport differs from other means of rapid transit are high speed and the ability to fly in a straight line between any two points on the earth. It follows that aircraft save time under two headings and it is precisely this feature which gives aerial transportation an immense superiority over vehicles of the road and of the sea.

Aircraft, and in particular heavier-than-air machines have to-day reached a state of finality which make the operation of aerial transport services a question of landing and housing facilities alone. The record of safety and reliability established in the all-year-round operation of the United States Aerial Mail Service proves conclusively that modern airplanes are for all practical purposes independent of weather conditions.

Eight-Passenger Inter-City Liner. The Curtiss Eagle

In Europe, where the importance of aeronautics in its military and civil application is better understood by a large section of the public than in the United States, airplanes are already being widely used for the transportation of passengers and a certain type of goods. In the latter category are included goods relatively light in weight and costly in value where rapid transit is a factor of importance and food supplies which are perishable and highly marketable at certain seasons. As a specific instance a daily passenger service has been operating with marked success between Paris and London since the summer of 1919.

As has been said above, it is the time element which plays an important rôle in aerial transport, that makes this method of travel more desirable for routes of 200 miles and over than any other means of conveyance. At the present stage of aeronautical development the commercial speed of a well designed transport airplane can be taken to average from 85 to 90 miles an hour. This is the speed which an airplane can be counted upon to furnish on the average daily run regardless of adverse weather conditions.

A cruising speed of 90 miles an hour means that the aerial passenger will be able to reach Chicago from New York in about eight hours and San Francisco, with two intermediate stops of one hour each, in about 32 hours as against the 20-hour railroad trip to Chicago and the five days or more required for reaching the Pacific Coast. The time the tourist and business man will save thereby represents 60 per cent. of the time which is to-day wasted in traveling.

During the last railway strike in England airplanes were used on an immense scale for keeping up communication between various cities. Passengers, newspapers and perishable goods such as milk, fruit and vegetables were carried through the air at high speeds and to the satisfaction of all concerned. This was an especially illustrative case of how aircraft can supplement the existing means of transit in case of emergency.

But the usefulness of aerial transport is not limited to this kind of work. Passenger and express airplanes are being put into service and planned all over Europe, and France, Great Britain and Italy are making a powerful effort to assist the development of commercial air fleets with all means at their disposal. This assistance manifests itself chiefly in two ways. On one hand, the British, French and Italian Governments have laid out a compre-

The Thomas-Morse Sport Plane over Cayuga Lake.

hensive plan for a system of airways across their respective countries and linked up with other aerial routes in the Colonial possessions. On the other hand, a system of premiums has been devised to enable air transport companies to face adequately the initial outlay of their services. These premiums will be paid in proportion to the service rendered (number of passengers carried over a minimum distance) and with regard to the rapid adaptability of commercial aircraft to warfare. A regular passenger service already operates between France and Morocco, and it is expected that before the end of 1920 a similar service will exist between Great Britain and India and possibly Australia.

In this country the transcontinental reliability race organized by the Army Air Service was a pioneering achievement of considerable value and served to point out with great forcefulness the utter lack of airdromes in all sections of the United States. A 32-hour passenger airline from New York to San Francisco is entirely feasible to-day with the machines now built. But the operation of such a line is not possible to-day owing to the lack of suitable landing, housing and supply facilities. When this situation will have been remedied nothing will stand in the way of the linking of our principal centers of operation by commercial air services.

PLEASURE AND SPORT

Fly!

Those who have flown will tell you that no sensation of motion previously experienced can equal that of airplaning, they will tell you that no land or water vehicle, though powerful, can give one such a feeling of mastery as aircraft; they will tell you that no mountain, however high, can approach the view of surpassing beauty unrolled beneath the aviator.

Since hostilities ceased in 1918, several thousand army and navy training airplanes have found their way into the hands of sporting and commercial users. While these planes, land machines, hydro-airplanes, and flying boats were of distinct military type, they accelerated the demand for the newer sporting or pleasure designs brought on the market toward the close of 1919.

Long distance cross-country contests, flights for Liberty Loans and for army and navy recruiting, the week-end pleasure runs of government pilots, the day in and day out trips of the Aerial Mail, thousands of casual "hops" by the curious, and the increasing "taxi"

What you will see going South. Hampton Roads, Va., viewed from the air.

passenger-carrying service, cease to astonish; rather do they illustrate the confidence which the public is placing in the airplane as a sporting vehicle.

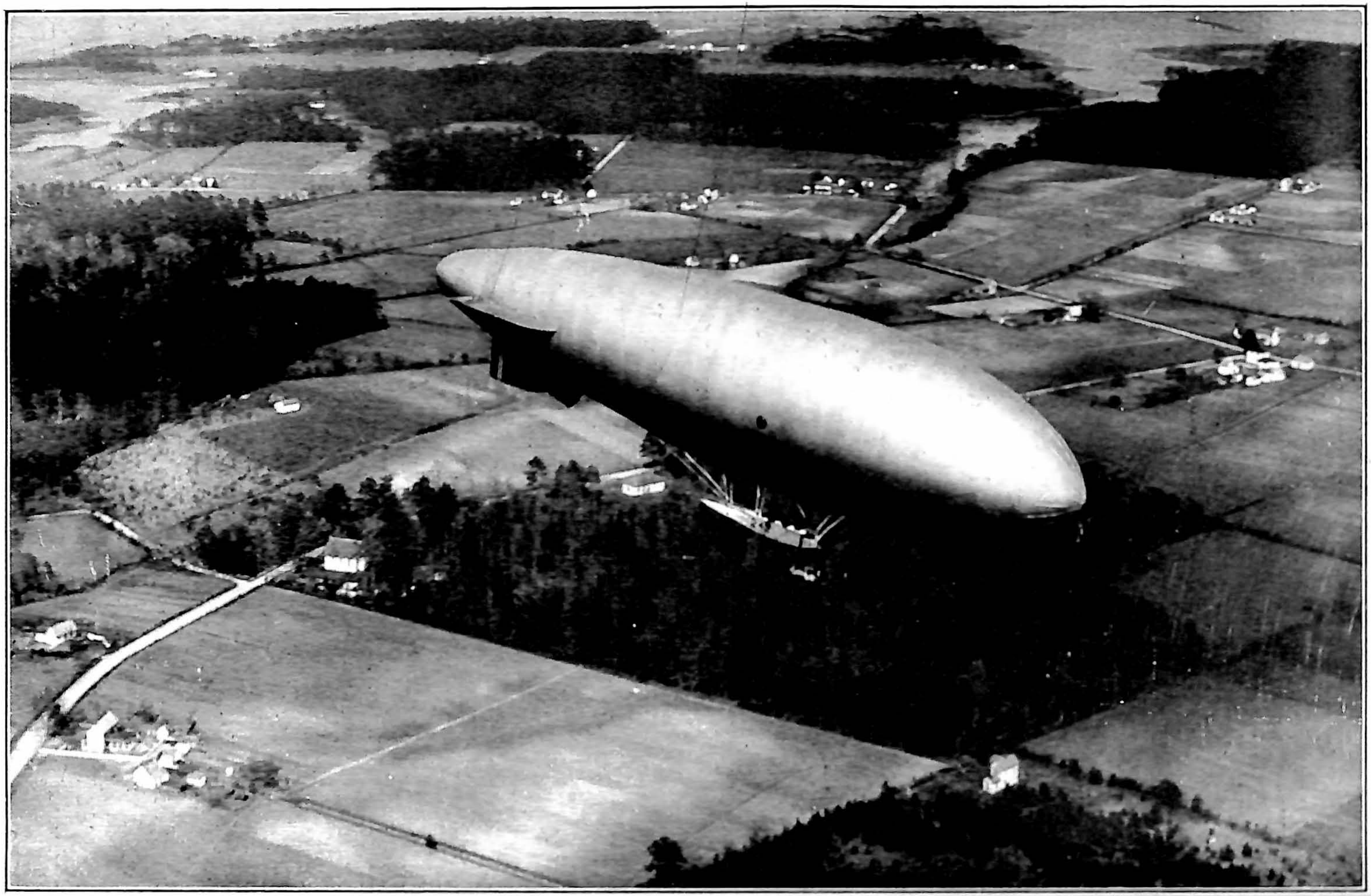
Nor is flying destined to be limited to the rich. Estimates on the cost of operating a typical land or water machine compare favorably with high class and high speed motor cars and motor boats.

During the season of 1919, football games were attended by several parties in flying machines, while seaplanes made trips along the Atlantic Coast to various sporting events. These were prophetic of the time when the polo field will be surrounded by parked single and two-place tractors, flown from long distances by their sportsmen owners. Upon the conclusion of the game they will take off, one by one, from between the lines, for whatever refreshments that replace the cocktail hour. Shark-shooting and duck-hunting, if no law intervenes, will be done from water machines. Aerial clay pigeon shoots will be more stimulating than of old. This year's cup races will be viewed from aloft and the newspapers will carry air pictures of the events. There is now nothing novel in flying in groups, so we may expect sociable tours, just as, in the early days of the automobile, club runs became popular.

After a season at Newport, guided by radio, air lighthouses and balloons, the flying boat and hydroairplane sportsman will start down the coast in easy stages. A brief visit at Old Point. Following the inside route, through canals and small rivers, a few days will be spent in shooting geese in Currituck Sound. Perhaps a stop at Elizabeth City, across the Albemarle, and Pamlico; a visit to the descendants of the "Lost Colonies" and the Indian tepees at Manteo, on Roanoke Island, where Sir Walter Raleigh founded the new empire.

It was only a few miles distant, at Kitty Hawk, where, seventeen years ago, the Wright Brothers solved the age long mysteries of human flight. A few friends will be taken up from Charleston during the stay, and thence on to Daytona and Palm Beach. Later a jaunt across to Cuba, to Porto Rico, and to San Domingo. Perhaps a week's stay in the West Indies and thence down the East Coast of Central America, over through the Panama Canal and up along the West Coast to Seattle. During the summer of 1919 flights to Cuba and up the Pacific Coast were made.

As a sporting vehicle, the dirigible is coming into favor, bearing



"The Ever-fleeing Horizon." The Aerial Express passes over the more leisurely dirigible to the airplane somewhat the same relation as the slower yacht bears to the swift speed boat.

International airship races will come into vogue and rival motor track racing. These will be in classes, the same as motor racing is divided into groups in accordance with cubic displacement, or as yachts are rated, by length. There has been no airship racing since 1909, but foreign governments, late in 1919, were planning competition calculated to stimulate the flying game, not only from the sporting point of view, but for the development of lighter-than-air craft. Airplane racing is definitely established in popular favor.

One obstacle, inadequate landing facilities, which stood in the way of the normal development of sporting aircraft, is being removed. Fortunate is he who has sufficient room on his country estate to construct a hangar and lay out a landing field, or who has a body of water near his home, upon which his flying boat may alight. Realizing both the need and the insistent demand, cities throughout the United States are preparing municipal air harbors for public use. In many places, provision is made for the shelter of land and water aircraft and it is planned to offer maintenance facilities wherever possible.

The flying sportsman has found a way to utilize the inland waters of the United States in a way undreamt of by those who improved them. All the way down the Atlantic Coast there are protected waterways, which were designed to carry slow-moving surface craft. This transportation, however, has never developed and it is entirely probable that, in the near future, these inland waterways will be more generally used by flying boats than by barges or vessels of similar shallow draft. Indeed, many believe that the flying boat and hydroairplane has distinct advantages over the land machine, when it comes to sport. For one thing, one never needs to seek out a landing place but is always within gliding distance of safety. Again, hydroairplaning provides all the thrills of motorboating to which are added rarer joys of actual flight.

However, each type of machine to its proper place. With the development of landing fields and with the improvement of land types, their use for sport is increasing rapidly. Machines have been developed with very low landing speed. This means that instead of a huge field being required, a comparatively small harbor is all that is needed.

All this is in process of evolution. Before long we shall see

The Glenn L. Martin Mail Plane

sportsmen and owners competing among themselves and with army, navy and special pilots, in the establishment of new speed, duration, altitude and climbing records.

Long distance touring, after-dinner spins, morning bracers, will come into vogue. Aircraft for golf, tennis, polo and the games, friendly brushes over the river; flying to the hunt — aircraft offer comfortable pleasure, exhilaration, speed, limited only by the ever-fleeing horizon.

ADVERTISING AND PUBLICITY

Does business believe in advertising?

Does it believe in advertising when such publicity can be combined with selling goods or making quick deliveries? The answer has as its corollary the use of the airplane, as clothing, chewing gum, spark plug, typewriter and fountain pen manufacturers and department stores have proven to their satisfaction. In repeated Curtiss and Aeromarine flights, notably one which the Aeromarine made to Cuba and the Curtiss to New York from Buffalo, the utility of aircraft in advertising and publicity opening the way to general business uses has been demonstrated.

Commercial photography is another of the general business uses to which aircraft are being put. Aerial photography as a whole, including commercial work, is of such importance that a section is devoted to the subject elsewhere in this chapter.

Newspapers have been quick to adopt the airplane in the gathering of news, the taking of photographs and the circulation of the various issues. Immediately after a marine accident of considerable proportion off New York City last summer, the manager of one of the largest press associations called the office of the Manufacturers Aircraft Association.

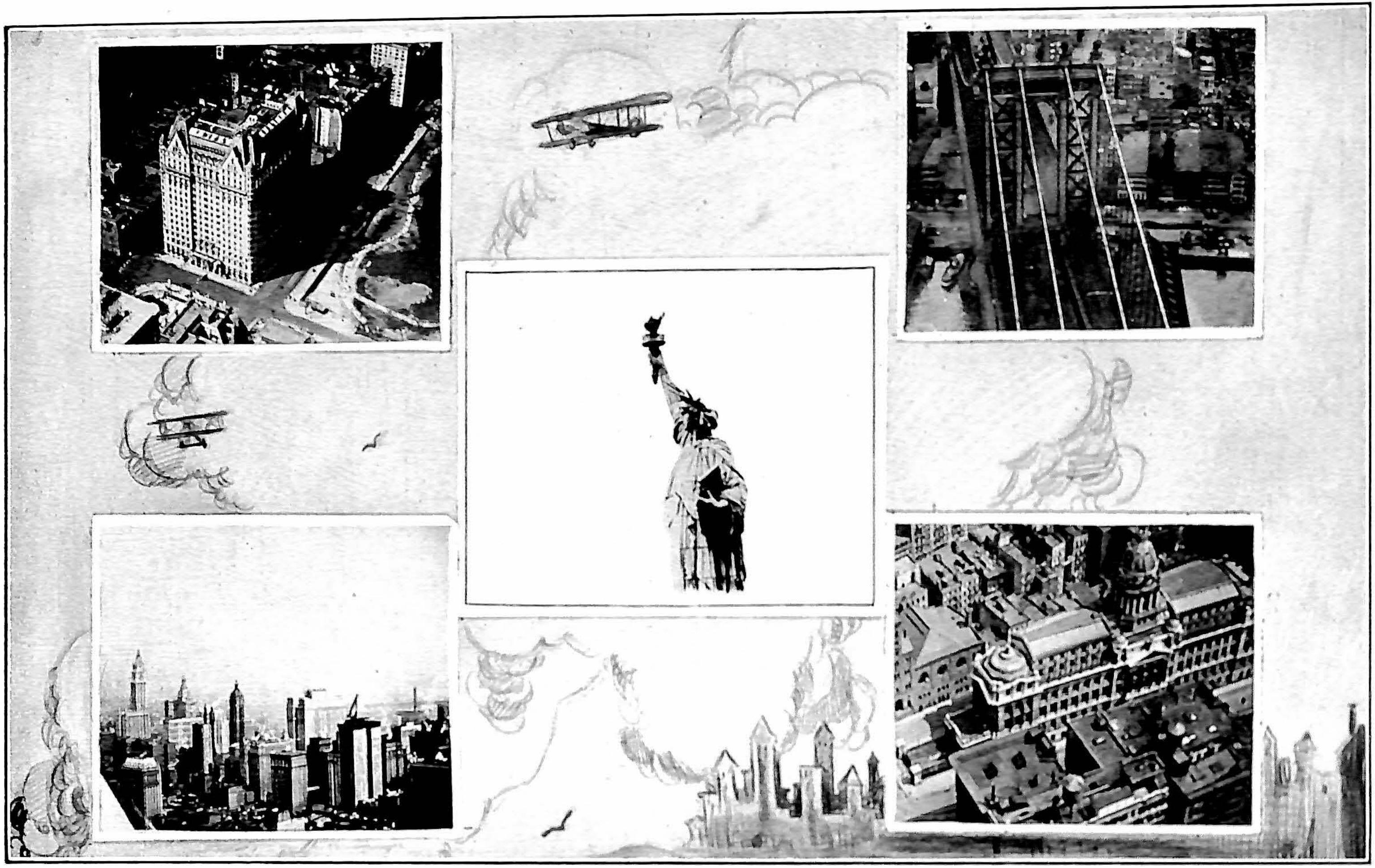
"Sometime we are going to need a flying machine quick," he said, "and we want to know where one can always be had and how soon it can be made ready for our use."

This service is now available.

AIDING THE EXECUTIVE

Why do we pay extra fare to ride on fast trains, or why pay 10 cents additional for a special delivery letter?

In the obvious answer lies the reason executives, who desire to keep in personal touch with branches, have found in the airplane a means of transport superior indeed to rail.



Airplane Architectural Studies — 1. Plaza Hotel, New York City. 2. Manhattan Bridge as seen from the air. 3. Detail Aerial photograph of Statue of Liberty. 4. New York City Sky Line photographed from the air. 5. Airplane view of New York City Police Headquarters. (Courtesy U. S. Air Service.)

In executive work in rural communities, the airplane has already become established. Sales in considerable number have been made to owners of great farms and ranches, and to oil and mining operators.

Among the miscellaneous uses to which business is placing aircraft may be mentioned the exploitation of real estate. A New York firm had a client who wished to build a hotel, but was uncertain as to the location proposed. How would it look when set in surroundings of which he had seen but little, and that from the street or a near-by roof? So the firm employed a commercial aerial photographer, and the trick was done.

Great construction projects are being watched from the air, city improvements are being planned and fire and police patrols carried out. The aerial ambulance has been demonstrated in the Army and in civil practise and in at least one notable instance — at Corpus Christi, Texas — airplanes have been used for flood rescue work.

AERIAL MAIL SERVICE

The Aerial Mail Service of the U. S. Post Office Department has been in operation daily, except Sunday, between New York and Washington for eighteen months; and between New York and Chicago daily for six months. It has been successful from the start.

To-day, the Aerial Mail planes are daily covering a total distance of 1,906 miles of territory and are carrying an aggregate of 2,100 pounds of letters.

During the last fiscal year, only 4.4 per cent. of possible trips were not attempted, and that out of a total of 138,310 miles. There were flown 128,255 miles, a performance of 92.73 per cent. During the same period there were only 37 forced landings due to mechanical troubles in flight.

In the operation of the Aerial Mail for nearly one year and seven months, covering 405,563 miles of flying, there have been lost but four pilots in crashes, a ratio of one fatality to 101,391 miles.

The reception which the Aerial Mail met, when first proposed, March 6th, 1912, was similar to the popular indifference displayed by the American people for years toward the airplane itself. Congress refused to grant an appropriation of $50,000 for aeronautical experimentation requested by the Post Office Department. As a result, it was not until six years later — May 15th, 1918, that the first Aerial Mail route was established between New York and Washington.

L. W. F. Twin-motored D. H. Mail Plane. How army equipment has been transformed for commercial uses

Again following a course similar to that traced by the airplane itself, the Aerial Mail demonstrated its worth, aroused the keenest interest, and, within six months, was sought by representative cities in many parts of the United States. There is no doubt that the Aerial Mail took a major part in awakening the consciousness of America to the fact that commercial aeronautics "had arrived," and was disputing the monopoly hitherto held by rail, road and water transportation. On May 15th, 1919, the Aerial Mail was established between Chicago and Cleveland and on July 1st, 1919, the route between Cleveland and New York was opened. As this book goes to press, Congress is considering a $3,000,000 appropriation for the fiscal year commencing July 1st, 1920, which will permit the operation of one round trip daily by the Aerial Mail between the following points:

New York — San Francisco.

Pittsburg — St. Louis — Kansas City.

Boston — New York.

Washington — Atlanta.

Thus the continent will be spanned from East to West, and from North to South.

STORY OF OPERATIONS

When the Aerial Mail was established, it was conducted by the War Department in connection with its work of training aviators. The service continued under the military until August 10th, 1918, when it was taken over by the Post Office Department and placed under the immediate direction of Otto Praeger, Second Assistant Postmaster General.

The only equipment available at that time — the war still being in progress — was such as could be released by the Army Air Service. A few Curtiss J. N.-4-H training planes, equipped with Hispano-Suiza engines, and having a capacity of 200 pounds of letters were obtained. With the signing of the armistice a number of De Haviland 4s and Curtiss R.-4s were turned over to Mr. Praeger by the Army and in these 400 pounds of mail were carried. The Curtiss machines performed remarkably, but the De Havilands, designed wholly for war purposes, lacked the strength necessary for commercial flying. But the Post Office Department had no funds at that time with which to develop strictly mail-carrying types; it had only the surplus military equipment from which to draw.

The Aerial Mail Service thereupon set about transforming the war machine. Its aeronautical engineers, cooperating with the staff of the L. W. F. Engineering Company, developed changes which resulted in a comparatively satisfactory plane. A much stronger landing gear was substituted, the fuselage was strengthened and the cockpit and cargo compartments were re-arranged. It was this rebuilt "ship" that enabled the Aerial Mail Service to evolve the longer and more hazardous New York-Chicago service out of the Washington-New York laboratory run.

On May 15th, 1919, the anniversary of the establishment of the New York-Washington line and the opening day of the route between Chicago and Cleveland, the public was invited to witness the flight of the mail planes at Belmont Park, New York, and College Park, Washington.

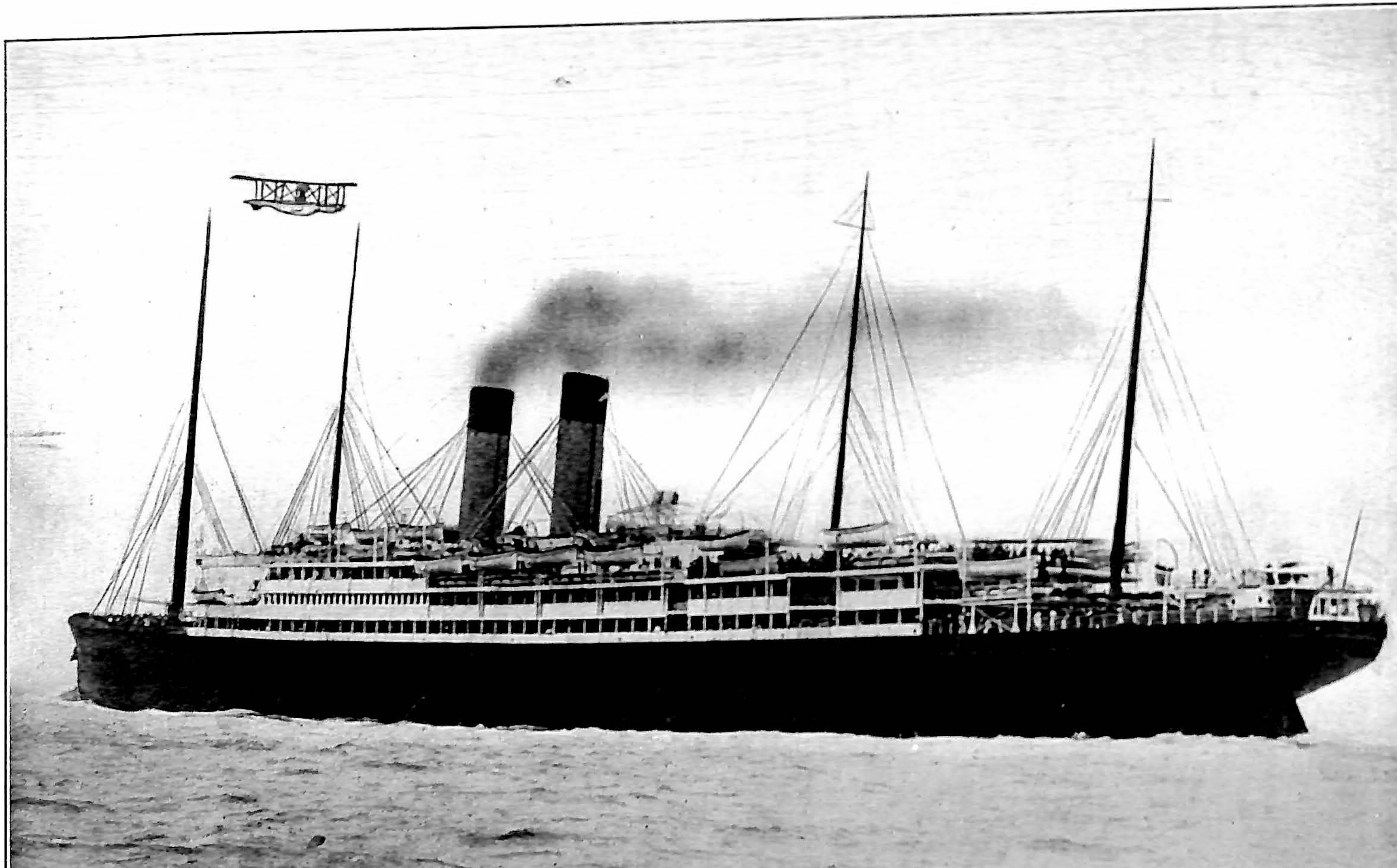
The two airplanes that took to the air on this anniversary, one leaving Washington and one leaving New York, were Curtiss-Hispanos, the same that carried the mail a year before and had been constantly in the service pulled by the same motors. One of these had been in the air 164 hours, flying 10,716 miles, and had carried 572,826 letters. It had cost, in service, per hour, $65.80. Repairs cost $480. The other plane had been in the air 222 hours, flying 15,018 miles, and had carried 485,120 letters. It cost in service, per hour, $48.34. Repairs to this machine cost $1,874.76.

In addition to the six planes with which the service was opened, and which were in operation on June 30th, 1919, there were 42 planes in service on the two routes in operation on that date, namely, between Washington and New York and Cleveland and Chicago—48 in all. On December 1st there were 90 planes in service.

NEW YORK-WASHINGTON ROUTE

The record of the entire service between New York and Washington shows 92 per cent. of performance during the entire year, representing 128,037 miles traveled and 7,720,840 letters carried. The revenues from airplane mail stamps amounted to $159,700 and the cost of service to $137,900.06.

The average flying time between Belmont Park, New York, and College Park, Washington, was 3 hours and 50 minutes, while the time from Washington to New York was 3 hours, 30 minutes. The discrepancy is due to the prevailing winds from a westerly direction. One round trip was made daily, except Sunday. A stop for



First Delivery of Aerial Mail at Sea. Aeromarine Flying Boat overhauls S. S. *Adriatic* and drops pouch on deck, August 14, 1919
(Wide World Photo)

exchange of mail was made at Philadelphia each trip. By this service mail between New York and Washington was advanced 2 and ½ to 3 hours over train service. In addition to airplane mail there is despatched daily from Washington to New York letter mail from southern points, connection made up to carrier districts in New York, which mail is delivered in New York the same afternoon instead of the following morning. On July 19th, 1919, the stop at Philadelphia was discontinued, and by changing types of planes the flying time has been reduced 30 minutes in each direction.

NEW YORK-CHICAGO ROUTE

The Aerial Mail between Chicago and Cleveland, begun May 15th, 1919, advanced the carrier delivery of letters at Cleveland and Boston by 16 hours and at Albany, New York and Springfield, Massachusetts, 6 hours.

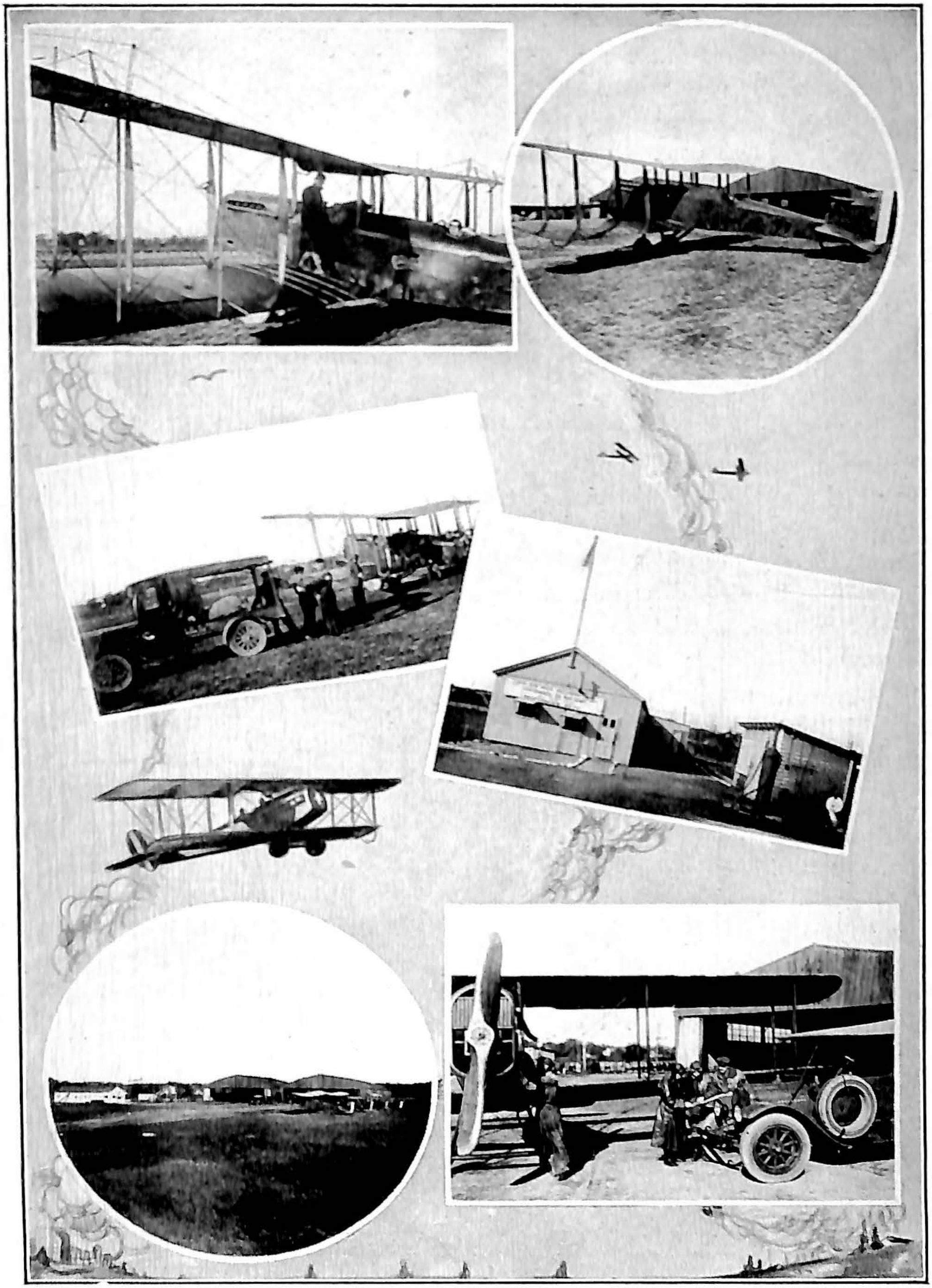
Mail from San Francisco and the entire Pacific Coast states, from South Dakota and Northern Illinois, from Northern Minnesota and Northern Wisconsin, from North Dakota and Montana and from Kansas City and the entire Southwest, put on certain trains, reached Chicago in time to make connection with the Aerial Mail east bound. The Aerial Mail from these trains is taken direct to the Aerial Mail field. Under this arrangement, this mail is delivered in Cleveland and Boston on afternoon deliveries instead of the following morning. At Albany, New York City and Springfield, Massachusetts, this mail catches morning delivery instead of the afternoon following.

Letters mailed in New York City in time for New York Central train No. 19, leaving at 5:31 P. M. reach Chicago in time for 3 o'clock afternoon delivery by carrier instead of the following morning carrier delivery as would be the case if sent through by train.

July 1st, the full airplane route New York-Cleveland-Chicago was officially opened.

NEW ROUTES AND EQUIPMENT

The Aerial Mail Service, by early fall, 1919, was confronted with two problems — the establishment of new routes and the development of new equipment. The engineers of the Aerial Mail Service, cooperating with the Army Air Service and with municipalities had laid out proposed lines to the Northwest and to San Francisco. This was principally a matter of charting and establishing necessary ter-



1. Loading Mail in Curtiss R.-4. 2. D.H. plane with mail compartment. 3. Transferring mail from truck to plane. 4. Headquarters of Aerial mail at Belmont Park, N. Y. 5. General view of mail field, Belmont Park, N. Y. 6. Aerial mail pilots looking over the route.

minals. Then came an interesting and highly significant experiment, conducted with the cooperation of the International Mercantile Marine, Operators of the White Star Line, and the Aeromarine Plane and Motor Company.

The experiment consisted in dropping a mail bag from a flying boat onto the deck of a liner at sea to expedite the movement of overseas mail which arrives too late to be delivered on board outgoing steamships.

A special chute was constructed on one side of an Aeromarine flying boat to permit the dropping of a mail bag which was enclosed in a water proof container. To the latter there was attached a thin steel cable, 200 feet long, the other end of which had seven short branches, each weighted with a two-pound bag of shot. The idea was to have this weighted end wrap itself around the stay running between the fore mast and the fore main mast of the steamship when the trailing cable would strike it, and thus jerk the mail bag out of the chute in which it rested on the flying boat. To lessen the impact on the stay, rubber band shock absorbers were inserted in the cable.

After preliminary experiments, conducted at the works of the Aeromarine Plane and Motor Company, had conclusively proved the feasibility of this scheme, it was decided to test the Aerial Mail delivery under actual operating conditions.

On August 14th, an Aeromarine flying boat, piloted by C. J. Zimmerman, took on board a mail pouch weighing 100 pounds and, despite a 30-mile gale and rain storm, flew out to sea after the liner *Adriatic,* which had left 1½ hours previously.

The pilot caught up with the liner near the end of the Ambrose Channel. After the weighted end of the cable trailing from the seaplane had caught in the liner's rigging, the mechanic pulled the release device and the mail bag fell into the sea along side the vessel as had been expected and was safely hauled aboard.

The importance of this remarkably successful experiment, which was carried out under adverse weather conditions, is obvious. David Lindsay of the International Mercantile Marine Company stated that if this method were adopted by steamship companies, fully 18 hours could be saved by transatlantic liners outward bound. Not only would it be possible to transfer late mail to the steamship in this manner, but the steamers would be able to take on cargo up to the last moment before sailing and then receive the completed manifest by seaplane delivery far out at sea. The experiment caused several steamship lines to take aircraft into consideration in their plans for the future. It undoubtedly hastened the decision to establish United States-Cuba air service, because of the attention that was attracted to aerial transport over the sea.

A CANADIAN EXPERIMENT

The Canadian Government is desirous of promoting the Aerial Mail.

To W. E. Boeing, President of the Boeing Airplane Company of Seattle, goes the distinction of having first carried international mail in North America. On March 3rd, 1919, Mr. Boeing, in one of his seaplanes, accompanied by Edward Hubbard, assistant pilot, flew from Vancouver, British Columbia, to Seattle, a distance of 200 miles, with a bag of letter mail. The trip was authorized by the Canadian Post Office and the bag was officially received in Seattle, by the mayor of that city.

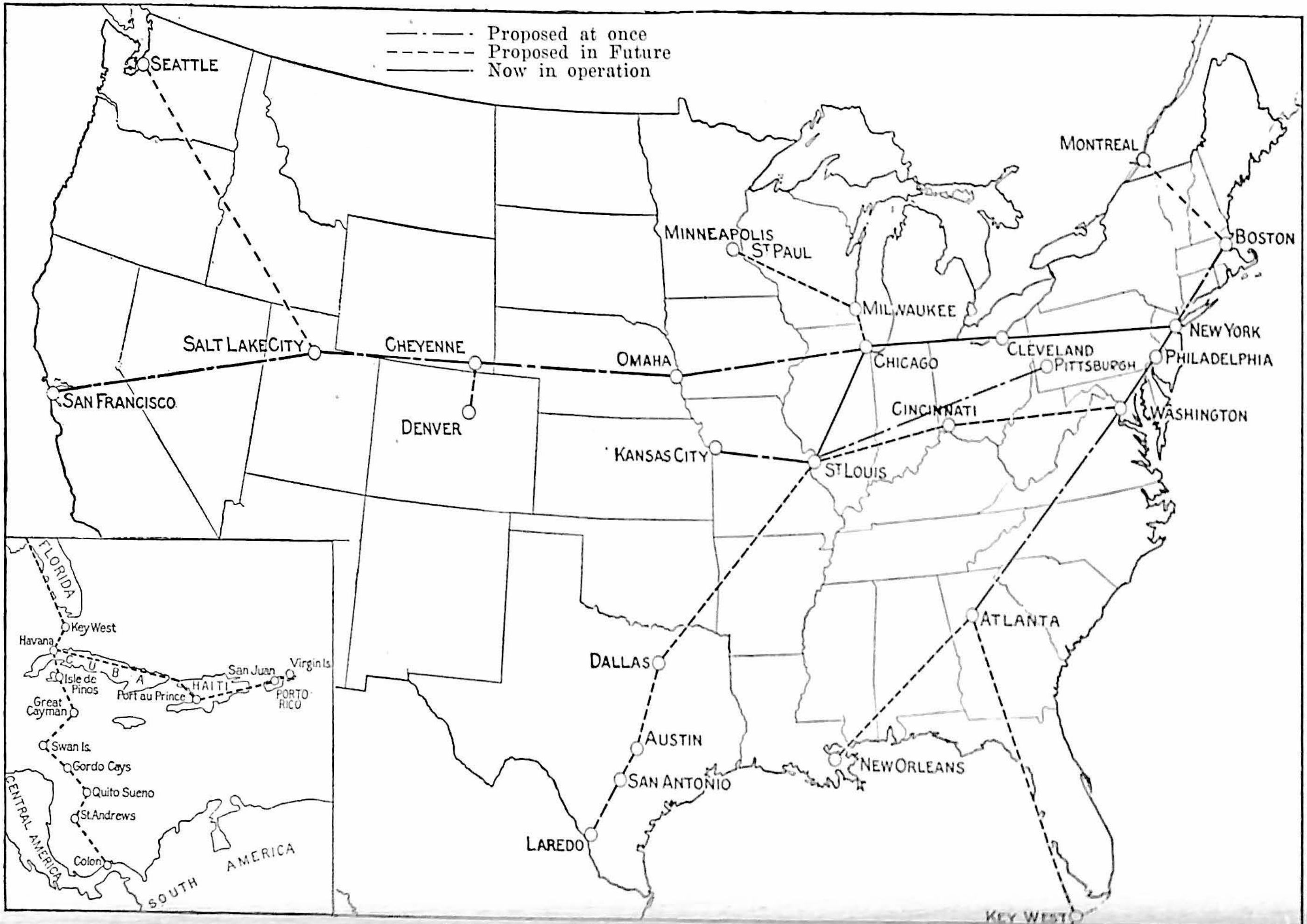
As a result of this flight, mail contractors in Alaska are investigating the possibilities of using the airplane instead of the dog sled.

While oceanic mails were being planned, it became evident that multimotored cargo ships must be provided if the Aerial Mail Service was to reach San Francisco. Thus the Department set about the construction of fourteen two and three Hispano-Suiza or Liberty motored airplanes, ranging in cargo capacity from 1,500 to 6,000 pounds, according to the length of the flight. Six of these great craft have been built and delivered by the Glenn L. Martin Company and four are under construction at the plant of the Thomas-Morse Aircraft Company, while the L. W. F. Engineering Company is building others. Full descriptions of these cargo "ships" are printed in Chapter VIII.

Another notable engineering development carried out by the Department in cooperation with the L. W. F. Company, was the reconstruction of a De Haviland 4 into a twin-motored plane, which has developed a speed of 103 miles an hour, will maintain horizontal flight with one motor and carry 800 pounds of mail. Thus the Aerial Mail provides a commercial use for more of the military equipment accumulated during the war.

The Aerial Mail has been the means of developing scientific aids for commercial aerial transport.

At the suggestion of the Department, the Bureau of Standards has developed a field-marking radio device which will enable a pilot to



AIR MAIL ROUTES

land exactly in the center of this landing field although it may be shut in by clouds, rain, snow or fog, from an altitude of three to four thousand feet within the proximity of the field. As elevated antenna systems are manifestly dangerous to air navigation, the Aerial Mail Service experimented extensively in radio transmission and perfected an antenna only 20 feet high, highly directional and admitting of sharp tuning with remarkable transmission results. The installation of high powered stations in the vicinity of flying fields is, therefore, made possible. Efforts are being made to provide and perfect a practical visual signal which will take the place of the present audible signal. This will greatly enlarge the field of operation.

Complete telegraphic communication will shortly be installed, together with triangulation stations, which will allow the utilization of a complete despatching system whose main function will make it possible for distant points to locate planes accurately at any moment during flight. Distant controls are also being developed in order that the Department at Washington may get in communication with any pilot in flight by means of radio telephone.

Another contribution to aviation is now being worked out with excellent prospects of success in the shape of a non-magnetic and non-gyroscopic compass.

Extensive experimentation has been conducted with respect to a new type of fuel. Airplanes have been flown on regular daily schedule over a period of several months with this fuel with excellent results.

The Department has been keenly alive to the important matter of fire protection and has equipped its planes with fireproof bulk heads and extinguisher systems with crash release device. Improved fire protection systems are being installed in the larger craft now under construction.

BAD WEATHER DEFIED

"The Mail must fly" has been the order; and the Mail has flown. The operation of the service every day in the year except Sunday, between Washington and New York and daily between Cleveland and Chicago, encountering all sorts of weather conditions and meeting them successfully, has further demonstrated the practicability of employing the airplane for commercial service.

The Aerial Mail has been maintained, throughout the year ending May 14th, 1919, with a record of 92 per cent. gales of exceptional violence — from 40 to 68 miles an hour — and heavy snow storms being encountered and overcome. Out of 1,261 possible trips, 1,206 were undertaken, and only 55 were defaulted on account of weather conditions. During rain, fog, snow, gales and electrical storms, 435 trips were made. Out of a possible 138,092 miles, 128,037 miles were flown. Only 51 forced landings were made on account of weather and 37 on account of motor trouble.

Pilot J. M. Miller, who was formerly a naval flier, made the flight from Philadelphia to New York in a Curtiss R-4 with a 400 horsepower Liberty motor, rising from the field against a 43-mile gale and arriving in New York through a blinding snow storm with a wind velocity reported by the weather bureau to be 68 miles an hour and which was 15 per cent. greater at the altitude at which he flew.

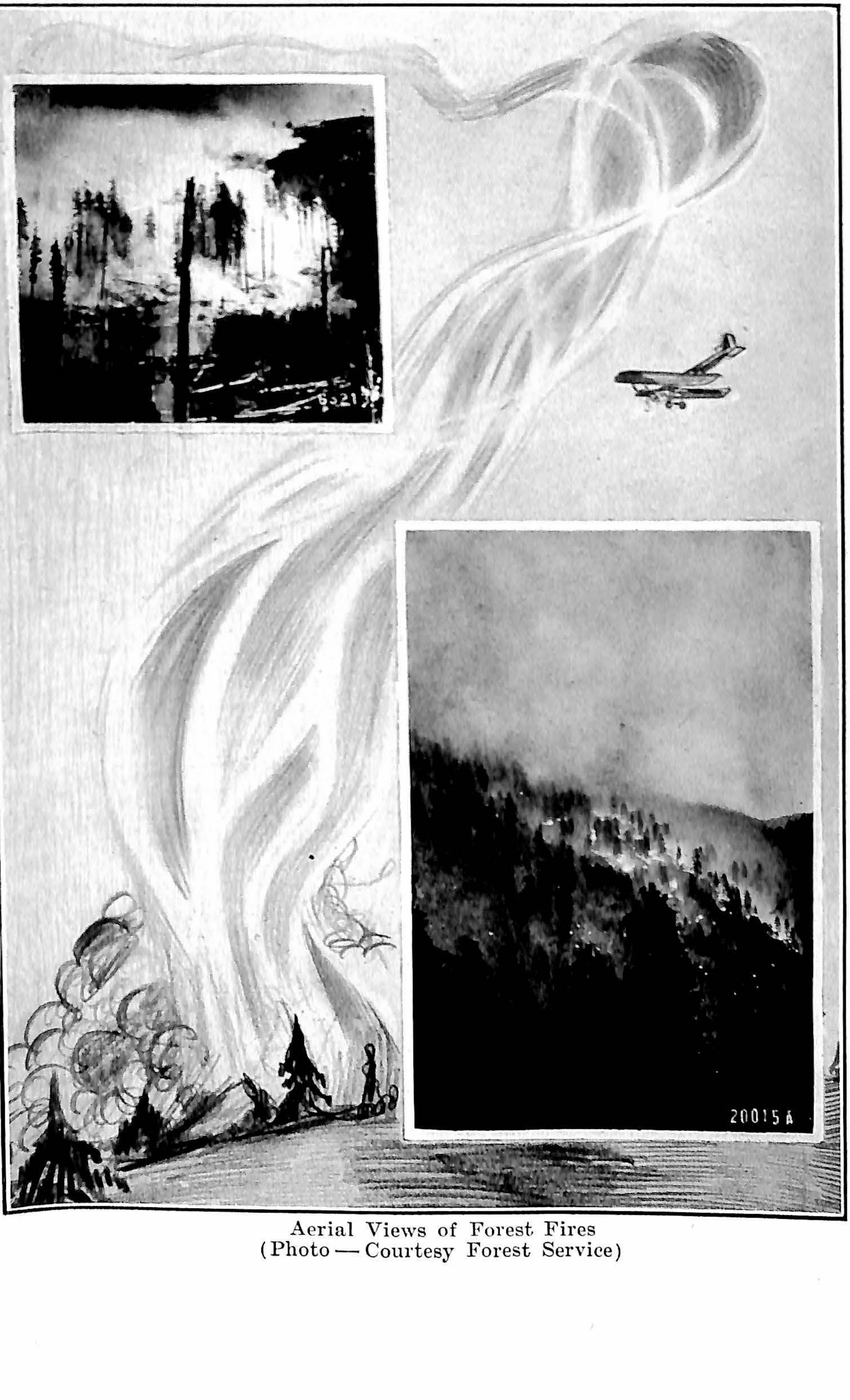
One of the lessons learned from the operation of the Aerial Mail during the year, is that the element of danger that exists in the training of aviators in military and exhibition flying is almost entirely absent from postal — or commercial — flying.

Mr. Praeger, in reporting to the Postmaster General the operations for the year, says that the record of the Air Mail Service, which includes flying at altitudes as low as 50 feet during periods of marked invisibility, throws an interesting light on this question. During the year, more than 128,000 miles were traveled, no airplane carrying the Mail had ever fallen out of the sky, and there had not been a single death of an aviator in carrying the Mail.

Between May 15th, 1919, and November 1st, however, three pilots lost their lives, due to bad weather and low visibility. Directional radio will, in future, eliminate casualties from these causes, it is believed. The only other deaths by accident which have occurred were those of an aviator who made a flight to demonstrate his qualifications as an aviator and of a mechanic who fell against the whirling propeller of a machine on the ground. Only two aviators have been injured seriously enough to be sent to a hospital. Other accidents consisted mainly of bruises and contusions suffered by planes turning over after landing.

Forest Fire Patrol Service

The total surface area of the timber lands in the United States, including national and privately owned forests, is estimated at 550,000,000 acres, that is, about one-fourth the area of the whole



Aerial Views of Forest Fires
(Photo — Courtesy Forest Service)

country. No exact figures are available on the total value of these timber lands, but the National Forests, which on June 30th, 1919 covered 174,261,393 acres, have a total estimated value of roughly $665,000,000.

During 1919 approximately 2,900,000 acres of National Forest lands were destroyed by fire; the damage represented a net loss of $4,500,000, and a cost to the Forest Service of fighting fires of about $3,000,000.

From 1915 to 1919 inclusive fires reduced the area of National Forest lands by 4,196,393 acres, causing a damage of over $7,000,000, to which must be added some $12,000,000 spent in fighting the fires.

It may be seen that fire is gradually felling our wood lands. The burning of approximately 7,000,000 acres of timber during the last five years constituted not only an immediate loss of lives and property, but also menaced the future of the great agricultural and other habitable regions as well.

The Department of Agriculture, through its Bureau of Forestry, endeavored for years to conserve standing timber. It was realized that the denudation of the great water-sheds in the West, permitting erosion and general desolation, would in time, carry ruin to the rich and fertile valleys. Reforestation, so long neglected, could not of itself offset the increasing yearly toll by fire.

The forest ranger was for years the sole, frail barrier between conflagration and American forests. His picturesque figure, afoot or on horseback, was traced over mountain trails. His vision was limited to natural vantage points. Moving slowly, he was unable even to report a fire until it had gained headway. In fighting the flames he was handicapped by his inability to view the menaced territory and station his forces accordingly. The increasing losses in the national forests spoke surely of the inadequacy of the surface patrols.

It was at this critical period that the airplane appeared. The Department of Agriculture took the initiative and requested cooperation from the Air Service. Accordingly, on June 1st, 1919, the aerial forest patrol was established. Its scope of operation since then has steadily increased. So great has been its success, that the fire hazard is now practically eliminated. Daily patrols, at first termed an experiment, are now accepted as indispensable. In five months the people of Oregon and California have come to regard the airplane

The new way of guarding our Forests. Forest Fire Patrol flying over California Canyon
(Photo Courtesy Forest Service)

as absolute protection for life and property in the great timber reaches of the Cascades and the Sierra.

The tests by the Government have convinced the private lumber companies that they, too, must have similar service. In Oregon it is understood that they cooperate with the State in bearing expense incident to the patrol. No one more than the lumberman realizes so keenly the limitations of transportation. He spends days on horseback going to and from the railroad centers. Time is an important element in his work. Here, as in the cities, "time means money." What thing more natural, therefore, than for him to combine his private fire patrol with private transportation? Thus journeys of many days in the old way are reduced to hours in the new.

The aerial forest patrol presents an impressive contrast between generations. The ranger is bound to the earth; the aviator soars above it. At best the ranger's horizon is a few miles; the aviator is lord of a vast domain, yet both are typically American.

In the airplane sit pilot and observer. The pilot follows his set course; the observer, with his glasses and map, scans the landscape. After a few weeks he becomes so skilful that he can spot a fire thirty miles or more distant, determining, not only the location, but classifying it as to degree and possible cause. Traveling at an average speed of a mile and a half a minute, the observer must look and think quickly. But, a fire discovered, he can soon report it.

Then again, in actually fighting fires, airplanes have been of great assistance. From a position above the fire an experienced man who knows how to combat the blaze is able to direct his forces on the ground to much greater advantage than if he were there himself, for from his point of vantage he is able to take in the whole situation and see the progress of all sides of the fire at practically the same time. He knows instantly, without either a journey on foot or horseback, over or around difficult ravines and mountains, just how far the fire has progressed, how serious it is, how best to put it under control and how much importance one section of it bears to the rest.

Two patrols a day were operated out of March Field, Riverside, California, beginning June 1st, 1919. Curtiss army training planes were used in this first experiment. Especially constructed parachutes were taken along. It was planned to attach a message to the parachute immediately after the observer discovered a fire. The parachute would be dropped over the nearest town or base and the message relayed to the Forestry supervisor by telephone. The para-

1. Sunshine above the clouds; a gloomy day below. 2. Taking photographs above the clouds. 3. Squadron formation among low hanging clouds. 4. The beauty of clouds as seen from above.

chute proving unsatisfactory, the wireless telegraph was installed.

In three months and seven days the patrol which operated over the Cleveland National Forest in California covered 46,297 miles in 466 hours and 56 minutes of flying time.

Seventy-five dangerous fires were discovered, and all this by an average of three planes in use daily.

An average of two planes daily covered 36,854 miles out of Rockwell Field, San Diego, California, in the same period of time, discovering 24 dangerous fires in the 410 hours of flying time.

Meanwhile, the training planes were superseded by American built De Haviland 4 planes which had greater climbing ability and could cover greater areas by reason of their higher speed and larger fuel capacity.

On September 8th, 1919, the two patrols were consolidated along with that from Mather Field, Sacramento, California, which since June 1st had patrolled 31,128 miles of territory and discovered 85 fires. From September 3rd until October 31st, 1919, the two planes from Mather Field discovered 70 fires. Other patrols operated from Fresno and Red Bluff, California, and it is planned to establish additional ones.

By the first of August the remarkable success of the California patrols had attracted the attention of Oregon state officials as well as the Forestry Bureau of Oregon, and Governor Ben. W. Olcott requested similar protection for the great national forests in his State.

Accordingly, an average of two planes daily set out from Salem and Roseburg, Oregon, and later worked from a common base at Eugene. The patrol maintained a cruising radius of 100 miles with the training planes and later, when the bigger ships were substituted, they were able to fly 350 miles, thus penetrating more deeply into the mountains and protecting the more heavily timbered areas. As a result of this work, accomplished under many difficulties, such as lack of facilities for emergency landings and repair, 33,715 miles of the Oregon forests were flown over in the course of 127 patrols in two months and eight days. In all, 128 fires were discovered in Oregon, fires which, once started, would have reduced thousands of acres to ashes.

The detailed summary of the season's entire activities is of great interest. The total number of miles traversed by the seventeen airplanes used for fire patrol work was 235,724 miles, which were covered in 2,872 hours. They were instrumental in putting out 570 fires in California and Oregon. All this with the small average of seventeen ships in use daily.

There was only one fatality on all these patrols, and only eight accidents involving major repairs to airplanes. It is this efficiency of the flying machine that has aroused enthusiasm in the heretofore flame swept areas of the far West.

The airplane forest patrol is said to have had a peculiar disciplinary influence on campers. Instances have been known where persons who had carelessly set fires to the undergrowth, hurried to a telephone and informed the forest supervisor of a fire, immediately on the approach of an airplane overhead.

The cost of operating the patrol is slight. The saving it effects is enormous. Plans are now under way for its extension throughout the Northwest.

PEACE TIME USES OF AERIAL PHOTOGRAPHY

One of the most important and interesting aeronautical developments which the World War brought about is aerial photography. The vertical aerial photograph, made from a high altitude, resembles a portion of a map so closely that it was natural that aerial mapping should be thought of first as one of the fields in which aerial photography can be used commercially.

A beginning in this line has already been made in this country. When hostilities ceased, the Air Service assigned a number of pilots and observers to the duty of making photographic maps in various parts of the country. An area is mapped from the air by flying over it, making the while enough photographs to form a composite picture of the tract. This composite photograph, when mounted, is known as a photographic mosaic or map.

Minor difficulties that interfered with the making of suitable photographs for mapping purposes have been overcome. Larger cameras, covering greater areas on the ground and using film that permits of making of hundreds of exposures, include some of the newer developments. Photographs taken from a mile in the air, over strange, impassable territory permit actual vision unobtainable by other means.

Aerial surveying possesses many distinct advantages over land surveying. Land survey of marshy areas, thickly wooded tracts or other primitive regions is not only difficult and hazardous, but also very expensive. To do the same work an aviator and camera man need only fly over these difficult regions, making a record so perpect that it could not be duplicated. The former method requires days and weeks; the latter, hours and minutes.

A complete aerial photographic survey of the United States could be accomplished in a few years at considerably less expense than would be entailed by a ground survey; whereas at the present rate of progress by ground surveying it will take one hundred years to complete such a survey. Such an aerial survey would be one of the most useful of army peace time training activities.

This type of map, although on the whole theoretically less accurate than the present government survey map, is usually on such a large scale that when reduced to usable size the percentage error, while still in existence, is unmeasurable.

Instrumental problems are being gradually solved and within the near future, it will be possible to carry out a complete topographical survey by means of aerial photography with a minimum of ground control.

Accuracy equal to that now obtaining in the majority of maps published has already been accomplished regularly and it is felt that with proper equipment and experiment, the accuracy of the most minute maps now published can be obtained.

MUNICIPAL AND BUSINESS USES

It is difficult to list fully the applications that can be made of aerial photography in peaceful pursuits, because this branch of photography is so new and its range of usefulness so extensive that almost daily some one thinks of another field in which it can be employed.

For city planning, reclamation, forestry, and many other uses aerial photographic surveying is beyond approach by any other existing method and will undoubtedly come into common use within the next few years.

Owners of large tracts can actually explore their property by having the land photographed from the air and then perusing the photographs, which constitute permanent records. In the case of a timber tract, for instance, an accurate estimate of the quantity and location of each species of timber available can be made in less time than it would take the owner to ride over his property.

Another field of utility would be the photographing of real estate for advertising purposes. An aerial photograph not only permits of the comprehensive presentation of large tracts of land, but it can be used as an attractive advertisement. Chambers of Commerce should turn to photography from the air for securing photographs of their cities; to show railroad lines, harbor facilities, well-arranged streets for hauling manufactured products, residential sections for workmen's homes, factory districts, groups of large business buildings and for other purposes.

Photographs of the same city, taken at intervals of a few months or years, would illustrate more eloquently than an array of charts the statistics as to its growth. Fire insurance companies will inevitably become interested in these aerial surveys as they would in fact be inspections from the air that would give the companies a bird's-eye view of the conditions and surroundings of buildings in various sections of the city and thus enable them to realize and keep check on the fire risk involved.

The progress made in the construction of engineering projects, such as buildings, canals, railways, as well as the comparative merits of various types of city planning, can be better shown by aerial photographs than by any other means.

AERIAL GEOGRAPHY

Aerial photographs also provide an excellent means for teaching more easily both elementary and advanced geography. Here realism is remarkably approached. Next to the actual relief map is the oblique aerial photograph. Ground photography restricts one to a very narrow field and the big relationships are missed. In oblique views we get the relative topography of the physiographic provinces of the world, a new means and viewpoint to study topographic features, economic geographic influences, the development of physical geographic forms, and a new means to study and teach geography in its academic, commercial and economic phases.

One photograph shows mountain "spurs" with streams eating back into them, another shows river terraces, or how man overcomes natural barriers when they get in the way of progress and how natural barriers divide a city.

METEOROLOGY AND EXPLORATION

The employment of free balloons has become an acknowledged factor in the observation and photography of eclipses and other celestial phenomena. In astronomical investigation the airship will be found of immense advantage over the free balloon, and over the airplane as well, for it is in a position to remain motionless over a

What you see when you take the "Round Manhattan Flight." (Courtesy of Photo Section A. S., Hazelhurst Field, Mineola, N. Y.)

given point. Furthermore, aircraft are able to reach a level beyond the belt of dust which surrounds the earth and hinders vision. Progress in power plant accessories will soon enable the attainment of altitudes far beyond the six mile limit of yesterday's airplane. The sounding of the upper air, which has been going on for many years by every meteorological station in the world under international cooperation using kites and small sounding balloons, will now be possible with human observers, reaching definitely known altitudes over definite locations.

Exploration of unknown lands at well nigh inaccessible spots opens up further possibilities of trade and scientific study, as a result of which new flora and fauna may be added to the world's collection.

AIRCRAFT AND FISHERIES RESEARCH

Aerial observation over any given territory in which fisheries research work is to be carried on gives the investigator an excellent idea of the character and extent of the region, much more vivid and detailed than any that could be obtained by charts, descriptions, or ordinary means of inspection. It places the natural features of the region in their proper perspective and relation to one another. It makes clear at once the inter-relation of land and water and the character and extent of tidal currents. Even when the observer is familiar with the territory, the view from aircraft shows him clearly many things which were either unknown or imperfectly understood before.

In the case of new territory, aerial observation is an essential part of fisheries investigation work.

Both airplanes and airships may be utilized in this work, and photography follows as a natural result. Already experiments have been made, on July 28th, 1919, by a representative of the Bureau of Fisheries which will result, in 1920, in renewed trials and, doubtless, in the practical application of aircraft, thus opening another field in commercial aeronautics.

A GLIMPSE INTO THE FUTURE

Standard airplanes of to-day fly upward of 400 miles at one jump. Fuel consumption, a vital factor, is being reduced to the minimum, for commercial and sport flying. Engines throttle to that point where efficiency is at its maximum. Modern machines are built from specifications and to designs of engineers, just as automobiles or boats. They may be speed machines, weight carriers, or all-round touring craft, as one wishes. Only a little sacrifice of speed to carry one's friends,— just as with your motor car. There is no more guess work or cut-and-try, to their construction, than there is to the building of a bridge.

Built, too, they are, for quick replacement. A demountable power plant with the whole unit on the ground for quick exchange if necessary. Instantly removable axles, a few minutes and a tire is changed or a new wheel replaced. A wing does not take too long to attach.

The cockpits are leather-padded, with windshields; the instrument board with incident indicator, speedometer, slip indicator, tachometer, motormeter, clock, shut-off cocks for oil and gasoline; oil, gasoline and air pressure gages, ignition switch, electric lights — the whole as complete as the driving compartment of any high grade motor car. A self-starter has not been forgotten and the same current furnishes the dashboard lights, those at the wing tips, the signal lights for night flying and the landing flares as well. A telephone from pilot to passenger, if you wish, and from pilot to the world below. In the big passenger carriers, there are comfortable wicker chairs or velvet cushions, in a heated compartment protected from the passing air. A vanity case to match the upholstery, silken curtains at the windows, room for a game and folding tables for a bite of luncheon. Fiction? No.

What, then, of the future. During the war, thousands of minds were concentrated upon the development of military aircraft. A troubled period of uncertainty followed the signing of the Armistice: then a readjustment. Now it may be safely said, more minds are at work on the development of peace time aircraft, than were concentrated on the production of fighting machines. The results are already made visible, as recorded in the preceding pages, and one may now be quite certain that in the near future, great and startling progress will be made.

Aircraft will be further simplified in construction. They will be considerably lowered in price, with grades to suit one's pocketbook or the uses to which the craft is to be put. Just as the demand for the Aerial Mail has brought forth new and remarkable types of mail and parcel post carriers, so the increasing demand for general passenger and freight transportation is evolving new and interesting types of extraordinarily large dimension and multiple power plants. The aerial transport of the near future will be much larger, much more stable, and much more comfortable than that at present. With the increase in the number of landing fields, their flying range will extend. Progress is the fundamental law in aeronautics. Competition is a stimulant. And just as this Aircraft Year Book for 1920 justifies what was said in the preceding volume, so greater confidence may now be expressed in the general use of aircraft to the every day business of mankind.

The world has been two-thirds flown around. Continents have been crossed and oceans spanned. But the greatest body of water in the world, the Pacific Ocean, remains to be conquered, and in conclusion it may be forecast that before the passage of another year, America will be linked by air on the west with Asia, as she was on the east to Europe in the year just closed.

CHAPTER II

CROSS-COUNTRY FLYING AND LANDING FIELDS

THE comprehensive aircraft program which the United States Government was compelled to adopt in 1917 to satisfy one of the requirements of modern warfare, had as a corollary the establishment of a fair number of land and water air stations throughout the country.

At the time of the Armistice, the number of army flying fields had thus increased from three to fifty, and the number of naval air stations from one to seventeen. These new air harbors constituted a rough system of airways which enabled pilots to complete their elementary training by long distance cross-country or shore-wise flying.

The ending of the war caused as sharp a cleavage in aeronautics as it did in other national activities. Military needs ceased to be paramount and the resumption of normal economic conditions assumed primary importance. As a consequence of the demobilization of our armed forces, a large number of these air harbors had to be dismantled. The number of army fields was thus reduced to sixteen and that of the naval air stations to nine.

Government and civilian aviation authorities alike realized the baneful effect such a huge reduction of the ground establishments would have on flying in general. It became obvious that the safe development of commercial aviation would depend directly upon a comprehensive system of air harbors, suitably marked to enable the pilot to undertake a journey with comparatively little concern.

With a view to remedying this unfavorable situation, the Army Air Service, first under the direction of former Major General William L. Kenly and latterly under Major General Charles T. Menoher, adopted a landing field policy which is based upon a cooperative plan between the Army and municipalities desirous of establishing air harbors. In its constructive work, the Army proceeded as far as was possible without special legislation.

This plan, essentially transitory, was made public at the Southeastern Aeronautical Congress, held at Macon, Georgia, from May 2nd to May 10th, 1919, at which thirty-two important cities were invited to establish municipal landing fields. These must be laid out according to specifications drawn up by the Air Service and the municipalities receive in return steel hangars from the Government. The maintenance of the air harbor is assumed by the municipalities.

This policy met with great favor in progressive communities, and many cities not comprised in the original Air Service program are now laying out air harbors to government specifications and in co-operation with the Air Service.

AIR-SERVICE SPECIFICATIONS FOR LANDING FIELDS

January 1st, 1920, the Air Service issued revised landing field specifications, which are as follows:

In the selection of landing fields at a city, special attention should be given to the following points:

1. *LOCATION:*
   (a) The Field should be situated close to transportation facilities, both passenger and freight, and electric power and water supply should be available.
   (b) An effort should be made to select a location in a place where the field is unlikely to be later surrounded by building operations.
   (c) If the city is unable to provide for a field of the ideal size, if possible, a site should be selected which is capable of expansion to a larger size, when the development of aviation makes such expansion necessary.
   (d) A special effort should be made, if possible, by cities on the main aerial routes, as the development of trans-continental aviation depends upon the establishment of fields at such points.
2. *SIZE:*
   (a) The size of municipal landing fields depends upon so many factors that it is impossible to prescribe exact regulations concerning it, and it is realized that a great many cities will not be able to establish airdromes to meet the requirements of the specifications set forth herein. The minimum size recommended by this office at the present time and with the present types of machines, is one that will allow 600 yards "Runway" in any direction from which the wind may be likely to blow. Such a field would permit any type of machine at the present day to be landed by an average pilot, and to be taken off without accident, should there be no failure of the motor. To have a field large enough to enable the average pilot to take any and all types of machines away from the field and to keep the machine always in such a position with reference to the field as to be able, in case of failure of the motor, to return to it and to land the plane without accident, it is necessary that there should be a "Runway" of at least 1,000 yards in any direction from which the wind is likely to blow. Fields complying with these specifications are designed to take care of airplanes of all types under all conditions of traffic, weather, etc. These specifications are not intended to discourage the establishment

of small fields, as the presence of small fields en route are of vital importance, and as such, they will function as emergency fields for airplanes that need a great deal of room to take off and land, and as landing stations for small or slower planes. In the establishment of these fields, the general specifications should be followed in regards to shape, character of ground, approaches, obstacles, etc. Should there be obstacles around the field, the portion of the field available for use will be shortened by a distance depending upon the height of the obstacle. An obstacle 100 ft. high will make at least 700 ft. of the field unavailable for use. The length of the "Runway" available for use should be computed by subtracting seven times the height of the obstacle surrounding the field from the length of the field in the direction in which the "Runway" is being computed.

(b) Another factor which enters into the size of fields is the question of the surrounding country. Should a field be located in a locality where there are fields available for emergency landings immediately adjacent to the municipal landing field, the danger of accident due to failure of motor, immediately in the vicinity, will be much lessened and the need of the 1,000-yard "Runway" is not so urgent. Should the country surrounding the field, however, be covered with buildings or be of such a character that it is impossible to land upon it with safety, the best interests of aviation demand that the field should be large enough to enable the pilot to circle the field in any type of machine, keeping always in such a position as to be able to return to the field in case of the failure of the motor.

(c) It would thus seem, that it is impossible to make a classification of landing fields according to size, which would show their relative suitability for aviation purposes and, accordingly, all classifications heretofore made are withdrawn.

(d) In addition it may be further noted that there are types of machines with which it is possible for the average pilot to land in a field, without chance of accidents, with much less than a 600-yd. "Runway." It is also possible, with *average luck*, for good pilots to land any present type of machine in fields of smaller dimensions than 500 yards.

3. *SHAPE:*

The best shape for a field is that of a square, but an "L" shaped field will suffice, providing each arm provides a satisfactory length of "Runway." It must be pointed out, however, that an "L" shaped field does not provide all the advantages for a return to the field in case of failure of motor, which are possessed by a square field.

4. *CHARACTER OF GROUND:*

The ground should be firm under all weather conditions. A light, porous soil with natural drainage is recommended as the most suitable. A field with clay soil invariably demands special drainage and is unsatisfactory as a rule during wet weather. It is possible, however, to lay a system of tiling which will drain any field after the hardest rain. The field should be covered with sod. The surface should be level and smooth, so that airplanes can normally land upon and taxi across without injury.

5. *APPROACHES:*

Surrounding obstacles, such as high buildings, high-tension power lines, trees, etc., limit the amount of field available for landing by the amount indicated above, and in addition provide an element of danger for the pilot in case of misadventure.

6. *MARKING:*

A white circle, 100 feet in diameter with a band 3 feet wide has proven by experience to be an excellent distinctive marking for a landing field. This can be seen at almost any attainable height with clear visibility. By digging out the earth to a depth of about six inches and filling in with crushed rock, a very substantial and economical marker can be made. It is necessary to keep the marking clear white to make it show up well. This can be done by white-washing from time to time. The name of the station should be marked in chalk letters 15 feet long by 3 feet wide. A wind indicator, such as the standard aviation wind cone, should be placed at one corner of the field 30 feet off the ground.

7. *ACCOMMODATIONS:*

Municipal landing fields should provide communication by telephone, transportation facilities, gasoline, oil and sundry supplies. Hangars, guards, and shop facilities will be needed in addition with the development of the use of the field.

8. *CLASSIFICATION:*

No classification for municipal landing fields will be published. However, for the purpose of consolidating information in a concise form and for the purpose of furnishing statistics, and furnishing pilots information as to cross-country routes, the following divisions will be made:

(a) Field from which it is possible for the average pilot to operate every type of machine, even in case of motor failure.

(b) Field from which it is possible for the average pilot to operate every type of machine without danger to the pilot so long as the motor functions.

(c) Field from which it is possible for the average pilot to operate only certain types of machines without danger so long as the motor continues to function. The most skilful pilots will be able to land any type of machine in fields of this classification.

(d) Fields, which of necessity, must be classed as "emergency fields," inasmuch as they are of such a type that only under the most favorable conditions can successful operations be effected.

LANDING FIELDS MEAN SAFETY

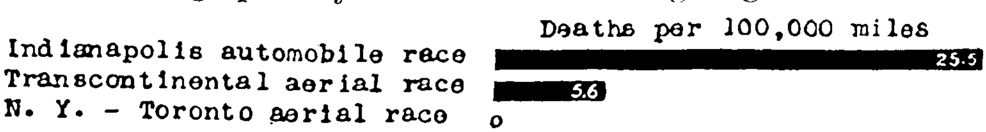
The landing field movement derives its great importance from the relation it bears to the safety of flight. The impression prevailed up to the spring of 1919 that cross-country flying was extraordinarily dangerous. Multiplied flights by government and private airplanes disabused the public mind of this false belief, but it was not until the two first practical cross-country races were held, that indisputable proof was given of the relationship which an air harbor within gliding distance bears to safe mechanical flight.

The winners of both the New York-Toronto and New York-San Francisco races agreed that the greatest need of aviation to-day is the establishment of adequate landing facilities, not only in the thickly populated areas, but along well defined routes across country, which are certain, in years to come, to be followed as commercial highways of the air.

The transcontinental airplane race demonstrated that aerial racing is of itself not nearly as dangerous, even where adequate landing fields are missing, as automobile racing on specially prepared tracks and with ample facilities for repairs and replacement. That this is true may be seen from the following table, in which the New York-Toronto and the transcontinental airplane races, the greatest aerial events of 1919 in the United States, are compared with the 500-mile race on the Indianapolis motor speedway.

	INDIANAPOLIS AUTOMOBILE RACE	N.Y.-TORONTO AERIAL RACE	TRANS-CONTINENTAL AERIAL RACE
Distance of race in miles	500	1,042	2,710
Highest speed, miles per hr.	110	135	135
Winning average, miles per hr.	88	128	120
Machines started	33	52	62
Machines finished	15	30	31
Deaths	3	0	7

Inasmuch as the aerial races in question covered more than ten times the distance of the automobile race referred to, they theoretically gave opportunity for more than ten times as many accidents. Moreover, expert pit service was available for the automobiles and not for the airplanes. Yet more than 54 per cent. of the airplanes finished and only 45 per cent. of the automobiles finished. The fatality rates are graphically shown in the following diagram:



Graph Landing Fields

Transportation authorities all over the world are agreed as to the finality the problem of air transport has assumed as a result of the development in aeronautics. That the advent of commercial air services on a wide scale is imminent, no one having studied the question can doubt for a moment. Chambers of Commerce throughout

AIR ROUTES OF THE WORLD

(Land flights in statute miles, sea flights in nautical.)

UNITED STATES

	One Way Miles	Round Trip Miles
Transatlantic flight of N.C.-4	2925	
New York-Toronto Race	525	1042
Transcontinental Race	2701	5402
Rim Flight (Martin Bomber)		9823
San Diego-Washington	4000	8000
Keyport, N. J.-Havana (Aeromarine)	1421	2842

CANADA

Lethbridge-Vancouver	600	

EUROPE

London-Port Darwin, Australia	11500	
Transatlantic flight of R-34	3200	6400
Transatlantic flight of Vickers-Vimy	1936	
Astrakhan-Baku	470	
Berlin-Constance	437	
Berlin-Stockholm	540	
Brussels-London	235	
Constantinople-Cairo	875	
Marseilles-Constantinople	1250	
St. Raphael-Tunis	550	
London-Brussels	235	
London-Calcutta	6500	
London-Copenhagen	640	
London-Glasgow	515	
London-Madrid	900	
London-Rome	950	
Paris-Algiers	875	
Paris-Brussels	163	
Paris-Cairo	2500	
Paris-Casablanca	1200	
Paris-Copenhagen	690	
Paris-Dakar	2600	
Paris-Hindon	1200	
Paris-London	250	
Paris-Madrid	675	
Paris-Marseilles	425	
Paris-Prague	565	
Paris-Rabat	1116	
Paris-Rome	700	
Paris-St. Raphael	480	
Vienna-Kominetz	600	
Ystad-Haparanda	890	

SOUTH AMERICA

Buenos Aires-Valparaiso	800	
Buenos Aires-Asuncion	650	
Santiago-Buenos Aires	750	

AUSTRALIA

Melbourne-Gulf of Carpentaria	3000	

the United States have accepted aerial transportation as a factor of highest public utility.

But commercial air services cannot safely function if the country flown over does not offer to the aerial navigator a comprehensive chain of airdromes, that is, *permanent air harbors.* These must be properly laid out and marked to permit of safe landing; they must also be equipped with hangars, for sheltering airplanes in transit, and contain stores and repair facilities for emergencies.

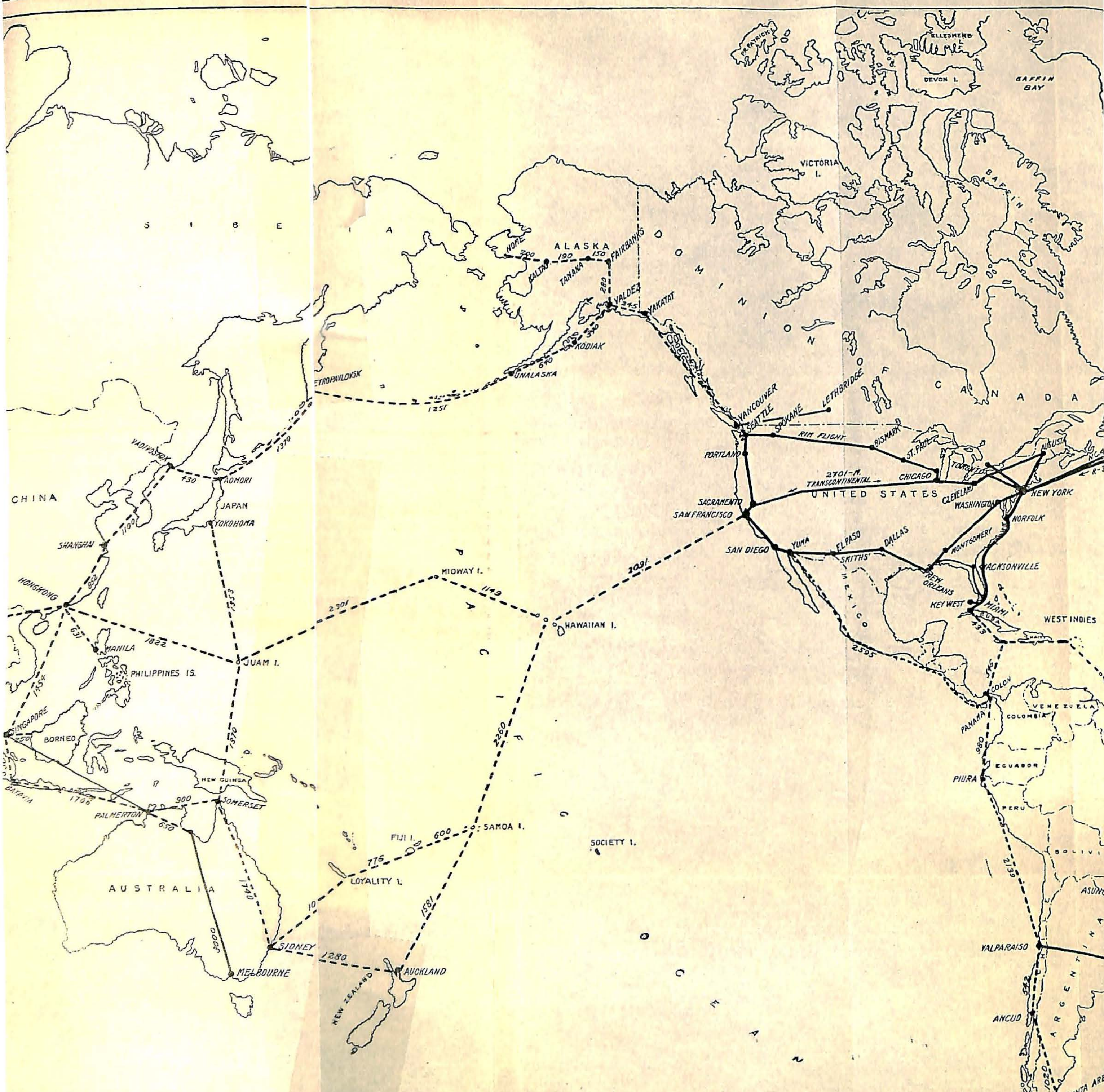
An airdrome plays the same rôle in aerial navigation that the harbor plays in marine navigation. A level field merely permitting landings in case of *emergency,* no more deserves the name "airdrome" than an inlet or roadstead can be termed a harbor.

In comparison with the principal European nations, the United States sadly lacks airdromes. The list of airdromes and landing fields which is printed in the appendix shows that there are only 115 permanent airdromes in the United States and Dependencies, which number comprises 13 seaplane stations. This is to say that there is only one airdrome for every 26,300 square miles of continental area of the United States.

The spirit of civic progress, if not of common forethought, should urge every important community to have its municipal airdrome. At the date of writing only seventeen American cities have airdromes.

Many a city, through delinquency in past years to provide adequate terminal facilities for rail and water transport, has ultimately paid a high price for such a lack of foresight. However, judging from the large number of inquiries received by the Army, Navy and Postal Air Services, American municipalities are to-day far more progressive in questions relating to transportation than they were a few generations ago. It may be confidently expected that, before another year goes by, hundreds of cities throughout the country will have provided landing, housing and supply facilities for airplanes.

All persons interested in the encouragement of cross-country flying and in the advantages that may accrue to communities from this source should at once cooperate in the landing field program of the Air Service by reporting such landing fields of which they have knowledge. Correspondence is invited along the lines suggested by the following questionnaire. This questionnaire should be mailed to the Manufacturers Aircraft Association, which will see that it is promptly referred to the proper authorities.



MANUFACTRRERS' AIRCRAFT ASSOCIATION MAP OF AIR ROUTES OF THE WORLD

The map shov in heavy lines the recent major flights which connect the first world air line The dotted lines show main and connecting routes proposed by Governnt and other recognized authorities, or those which are likely to follow as gical developments. This map does not include hundreds of short routes alrady flown and in immediate prospect, the intent being to show only the grea international lines of aërial communication.

GREENLAND
GREENLAND SEA
BARENTS SEA
NOVA ZEMBLA
KARA SEA
ICELAND
BRITISH ISLES
NORWAY
SWEDEN
CHRISTIANIA
STOCKHOLM
PETROGRAD
MOSCOW
RUSSIA
GLASGOW
COPENHAGEN
DANZIG
BERLIN
GERMANY
LONDON
BELGIUM
PARIS
PRAGUE
VIENNA
KOMINETZ
AUSTRIA-HUNGARY
FRANCE
LYON
ST. RAPHAEL
MARSEILLE
ROME
CONSTANTINOPLE
ASTRAKHAN
BAKU
CLIFDEN
IRELAND
PLYMOUTH
NEW FOUNDLAND
ST. JOHNS
R-34
VICKERS-VIMY
N.C.4
FERROL
PORTUGAL
MADRID
SPAIN
LISBON
AZORES
MADEIRA
RABAT
MOROCO
MOROCCO
CANARY I.
TUNIS
MALTA
MISRATA
LIBIA
FEZZAN
TURKEY
CAIRO
EGYPT
ARABIA
BASRA
PERSIA
AFGHANISTAN
CHINA
KARACHI
BRITISH INDIA
BOMBAY
MADRAS
CALCUTTA
HONGKONG
FRENCH INDO CHINA
SIAM
SINGAPORE
BORNEO
BATAVIA
ATLANTIC OCEAN
C. VERDE I.
FRENCH WEST AFRICA
DAKAR
FREETOWN
CAPE PALMES
LAGOS
NIGERIA
KAMERUN
FRENCH CONGO
BELGIAN KONGO
SUDAN
SUAKIN
ADEN
ABYSSINIA
ITALIAN SAMOLIA
BRITISH EAST AFRICA
GERMAN EAST AFRICA
ZANZIBAR
BARBADOS
GEORGETOWN
GUYANA
PARA
ST. PAUL I.
PERNAMBUCO
ASCENSION I.
KABINDA
ANGOLA
RHODESIA
BRAZIL
BAHIA
PINDA
GERMAN SOUTH WEST AFRICA
UNION OF SOUTH AFRICA
POR. E. AFRICA
MADAGASCAR
DURBAN
RIO JANEIRO
BUENOS AIRES
CAPE TOWN
PORT ELIZABETH
FALKLAND I.
ORKNEYS I.

INFORMATION SHEET ON LANDING FIELDS

(Use a separate sheet for each landing field reported on)

1. Name ....
2. Town and State..
3. Local name of field...
4. Shape and dimensions in feet....................................
5. Direction of long axis..
6. Direction of prevailing wind....................................
7. Markers, if any...
8. Contour of the field..
9. Condition of surface and drainage...............................
   ....
   ....
   State if wet weather landing possible...........................
   ....
10. Obstruction in and around field, including fences, telegraph wires, trees, ditches, etc.; suitability for small airdrome.
   ....
   ....
   ....
11. Availability and quality of supplies, with name of firm supplying
   ....
   ....
   ....
12. Location of field in respect to town with reference to features that can be found upon post-office or commercial maps; that is, railroads and rivers. Population of city.
   ....
   ....
   ....
   ....
13. Altitude above sea level in feet...............................
14. Organization operating field...................................
15. Names of officials interested..................................
16. Is this field open to all pilots?...............................
17. Names and addresses of firms engaged in commercial aeronautics using this field.
   ....

The appended landing field map of the United States shows the odd hundred airdromes and seaplane stations mentioned before and some thousand emergency landing fields which have been surveyed by government or private agencies. In connection with the latter work mention should be made of those pioneers of the Air Service who, under the inspiration of General Kenly and General Menoher, have covered some 300,000 miles since the Armistice and have thus

PRINCIPAL LONG DISTANCE CROSS COUNTRY AIRPLANE, SEAPLANE AND DIRIGIBLE FLIGHTS IN THE UNITED STATES

Date — *Principal Cities on the Route* — *Approximate Statute Miles*

July 11th, 1911 BOSTON–WASHINGTON 461

Harry N. Atwood in a Burgess-Wright Biplane landed at College Park after flying from Boston, with stops at New London, Astoria, Governor's Island, New York City, Asbury Park, Sea Girt, Tuckerton, Atlantic City, Farnhurst, Stemmer's Run, College Park. Three days later he landed in the White House grounds for a call.

August 26th, 1911 ST. LOUIS–NEW YORK WORLD'S CROSS COUNTRY DISTANCE RECORD 1155

Harry N. Atwood in a Burgess-Wright Biplane won the Victor J. Evans prize of $10,000 for the St. Louis-New York trip to be done in 4 days. Route: St. Louis, Springfield, Pontiac, Chicago, Elkhart, Pettisville, Toledo, Venice, Sandusky, Cleveland, Swanville, Erie, Buffalo, Lyons, Auburn, Belle Isle, Fort Plain, Castleton, Garrison, Nyack, Governor's Island, New York City.

October 21st, 1911 MINNEAPOLIS–ROCK ISLAND SEAPLANE MAIL FLIGHT 314

Hugh Robinson in a Curtiss hydroairplane carried mail a record distance.

November 5th, 1911 FIRST TRANSCONTINENTAL FLIGHT 3390

Calbraith P. Rodger crossed from New York in a Wright Biplane to Binghamton, Akron, Dayton, Decatur, Chicago, Peoria, Springfield, Centralia, Kansas City, Vinita, Muskogee, Ft. Worth, Waco, San Antonio, Del Rio, El Paso, Tucson, Imperial Junction, Pasadena.

February 17th, 1912 SECOND TRANSCONTINENTAL FLIGHT 2520

Robert G. Fowler flew his Wright Biplane from Los Angeles, Pasadena, Yuma, Tucson, Douglas, El Paso, Sweetwater, Ft. Worth, Houston, Orange, New Iberia, New Orleans, Biloxi, Flomaton, Evergreen, Troy, Bainbridge, Quitman, Pablo Beach.

December 15th, 1912 FIRST GREAT SEAPLANE FLIGHT 1500

Antony Jannus flew his Benoist seaplane from Omaha, St. Louis, New Orleans.

1918–1919 NEW YORK–WASHINGTON

Daily, except Sunday, trips of the Air Mail.

Begun May 15th, 1919 NEW YORK–CHICAGO

Daily trips of the Air Mail: New York, Cleveland, Chicago.

1918–1919 SAN DIEGO–WASHINGTON AND RETURN 7000

Major A. D. Smith's Squadron of army airplanes flew from San Diego, Phoenix, Tucson, El Paso, Marfa, Del Rio, San Antonio, Houston, Baton Rouge, New Orleans, Mobile, Montgomery, Americus, Jacksonville, Daytona-Arcadia, Daytona, Savannah, Raleigh, Petersburg, to Washington. Returning to Petersburg: Raleigh, Pinehurst, Columbia, Fayette, West Point, Dallas, El Paso, Tucson, San Diego.

March 12th, 1919 HAMPTON ROADS–ROCKAWAY AND RETURN. NON-STOP BETWEEN POINTS

Navy H-16—1 pilot, 5 passengers; *Navy F-5*—1 pilot, 4 passengers. Return trip made in 195 minutes, a distance of 300 miles. Record distance in America for a *flying boat* with this number aboard. Total time round trip, 16 hours, 5 minutes.

April 9, 1919 CHICAGO–NEW YORK NON-STOP FLIGHT 725

Captain C. E. White.

April 10th to May 10th, 1919 LIBERTY LOAN FLYING CIRCUSES 4338

Eastern Flight. Army Air Service teams of flyers covered the following cities, giving exhibitions in each: New York, Philadelphia, Baltimore, Washington, Richmond, Raleigh, Charleston, Savannah, Jacksonville, Atlanta, Birmingham, Chattanooga, Nashville, Louisville, Lexington, Cincinnati, Indianapolis, Columbus, Toledo, Detroit, Cleveland, Pittsburgh, Buffalo, Syracuse, Albany, Concord, Portland, Boston, Providence, Hartford, Mineola.

Middle Western Flight. Similar flying was done at Houston, New Orleans, Jackson, Memphis, Little Rock, St. Louis, Springfield, Chicago, Milwaukee, Madison, Duluth, Minneapolis, St. Paul, Fargo, Aberdeen, Redfield, Sioux Falls, Sioux City, Omaha, Kansas City, Wichita, Tulsa, Oklahoma City, Muskogee, Fort Smith, Shreveport, Houston. 7747

Far Western Flight. These teams covered San Diego, Los Angeles, Fresno, San Francisco, Sacramento, Reno, Salt Lake City, Boise, Pocatello, Walla Walla, Portland, Tacoma, Seattle, Yakima, Spokane, Helena, Butte, Miles City, Sheridan, Alliance, Cheyenne, Denver, Pueblo, Trinidad, Albuquerque, El Paso, Tucson, Phoenix, San Diego. 6626

April 25th, 1919 HAMPTON ROADS—ENDURANCE FLIGHT 1437

Navy F.5-L, flying boat, flew a non-stop course. One pilot and 3 passengers. The duration was 20 hours, 10 minutes.

May 7th, 1919 WASHINGTON–MACON AND RETURN 1300

.... in a Martin Bomber with 3 other passengers from Washington, via Asheville, North Carolina, to Macon and return via Asheville, North Carolina. Duration, 14 hours, 10 minutes.

July 7th, 1919 SAN FRANCISCO–SAN DIEGO NON-STOP 610

Captain L. H. Smith in a D-H-4 made this non-stop flight in record time of 246.5 minutes.

July 11th, 1919 AKRON–LANGLEY FIELD 407

Army's Goodyear airship A-4.

August 22nd, 1919 BUFFALO–MINEOLA NON-STOP 440

J. D. Hill in Curtiss Oriole flew the distance in 4 hours, 10 minutes.

August 25th, 1919 NEW YORK–TORONTO RACE 1042

Contests between 32 military and civilian pilots who completed the course—Mineola, Albany, Syracuse, Buffalo, Toronto.

1919 AIR MAIL PATHFINDING TOUR 1250

Major O. M. Baldinger, from Philadelphia, Pittsburgh, Coshocton, Columbus, Dayton, Indianapolis, Chicago, Madison, La Crosse, St. Paul.

Begun October 8th, 1919 TRANSCONTINENTAL RACE (10 pilots flew New York–San Francisco and return) 5402

Army Air Service contests covering Mineola, Binghamton, Rochester, Buffalo, Cleveland, Bryan, Chicago, Omaha, Cheyenne, Salt Lake City, Sacramento, San Francisco.

November 9th, 1919 RIM FLIGHT (Around the "Rim" of the United States) 9823

Lieutenant-Colonel R. S. Hartz and crew flew an Army Martin bomber airplane from Washington, Hazelhurst Field, Augusta, Jay, Plattsburg, Gasport, Buffalo, Niagara, Buffalo, Willoughby, Cleveland, Detroit, Camp Custer, Chicago, Milwaukee, La Crosse, St. Paul, Montevideo, Fargo, Bismarck, Glendive, Miles City, Billings, Helena, Missoula, Dixon, Missoula, Spokane, Coeur D'Alene, Spokane, Loveland, Camp Lewis, Portland, Medford, Sacramento, San Francisco, Fresno, Los Angeles, Santa Ana, San Diego, Los Angeles, San Diego, El Paso, Fort Worth, Dallas, Houston, Lake Charles, New Orleans, Montgomery, Pinehurst, Raleigh, Pinehurst, Washington.

December 4th, 1919. NEW YORK TO HAVANA AND RETURN 3000

C. J. Zimmerman flew his Aeromarine flying boat from Keyport, New Jersey, down the coast to Havana and return, via Cape Charles, Charleston, St. Augustine, Palm Beach, Key West, Havana, Cuba.

CLEVELAND–WASHINGTON

.... in Martin bomber.

flown over almost every part of the United States in their quest for landing fields that would be available in cases of emergency. As a result of this survey work, valuable information has been gathered with respect to about 1,000 emergency fields. These as well as the permanent airdromes will be found in the appendix, arranged alphabetically under states. The letter, or group of letters, following each state name and the numbers following in parentheses indicate the state symbol and field numeral assigned to it by the Air Service. These symbols and numerals will be permanently and visibly displayed on all airdromes established in accordance with Air Service specifications. In addition to the cities shown in this list, numbers are being assigned by the Air Service to thousands of cities all over the United States, regardless of whether or not they are provided with a landing field. These numbers will appear on vacant lots, city roofs, parks and golf courses. Aviators will thus be enabled promptly to identify a city while passing over it even though the aviator may be unfamiliar with the territory.

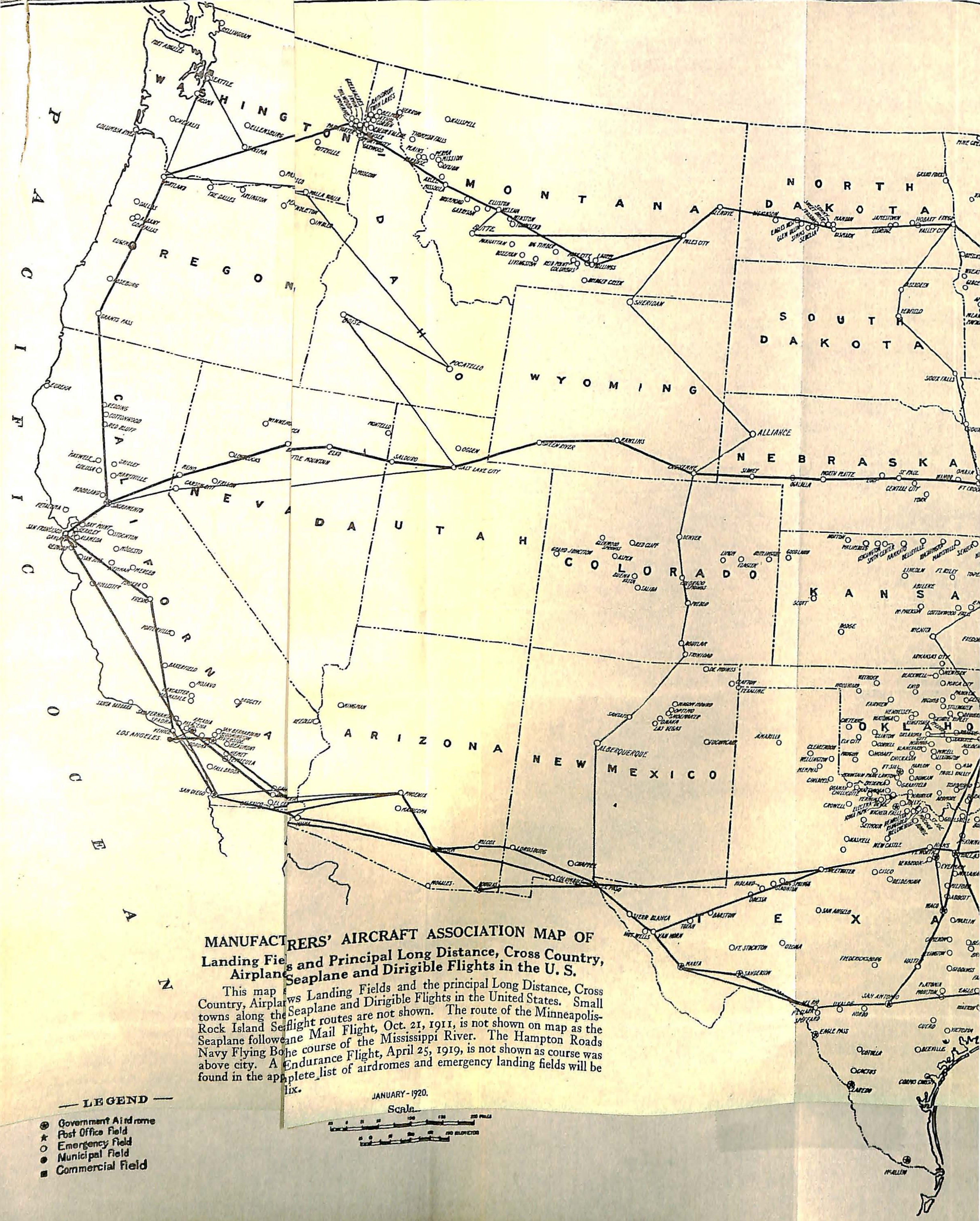
IMPORTANCE OF THE WEATHER FORECAST

Weather conditions, present and prospective, are of direct concern to the aerial navigator. Though the airplane and the airship are largely independent of atmospheric disturbances and can, if necessary, disregard them in most cases, a pilot "forewarned is forearmed." On the other hand, the pilot wants to take the utmost advantage of favorable *conditions*, such as following winds.

The aerial navigator of the present is somewhat of a meteorologist himself. He knows what certain types of clouds mean, he knows how to read a weather map, is conversant with the general laws of weather changes and appreciates the value of forecasts and flight charts.

Climatic conditions are of interest in connection with the location of airdromes, the placing of these and the buildings thereon. From meteorological study, one learns what sort of an aerial harbor may be expected at any proposed point.

Official cooperation between the United States Weather Bureau and aeronautics began at least as early as 1907 in connection with the balloon races then held at St. Louis. Lieutenant-Colonel Henry B. Hersey, of the Weather Bureau, was one of the contesting pilots and Lieutenant-Colonel William R. Blair, also of the Bureau, was there in an official capacity.



MANUFACTRERS' AIRCRAFT ASSOCIATION MAP OF

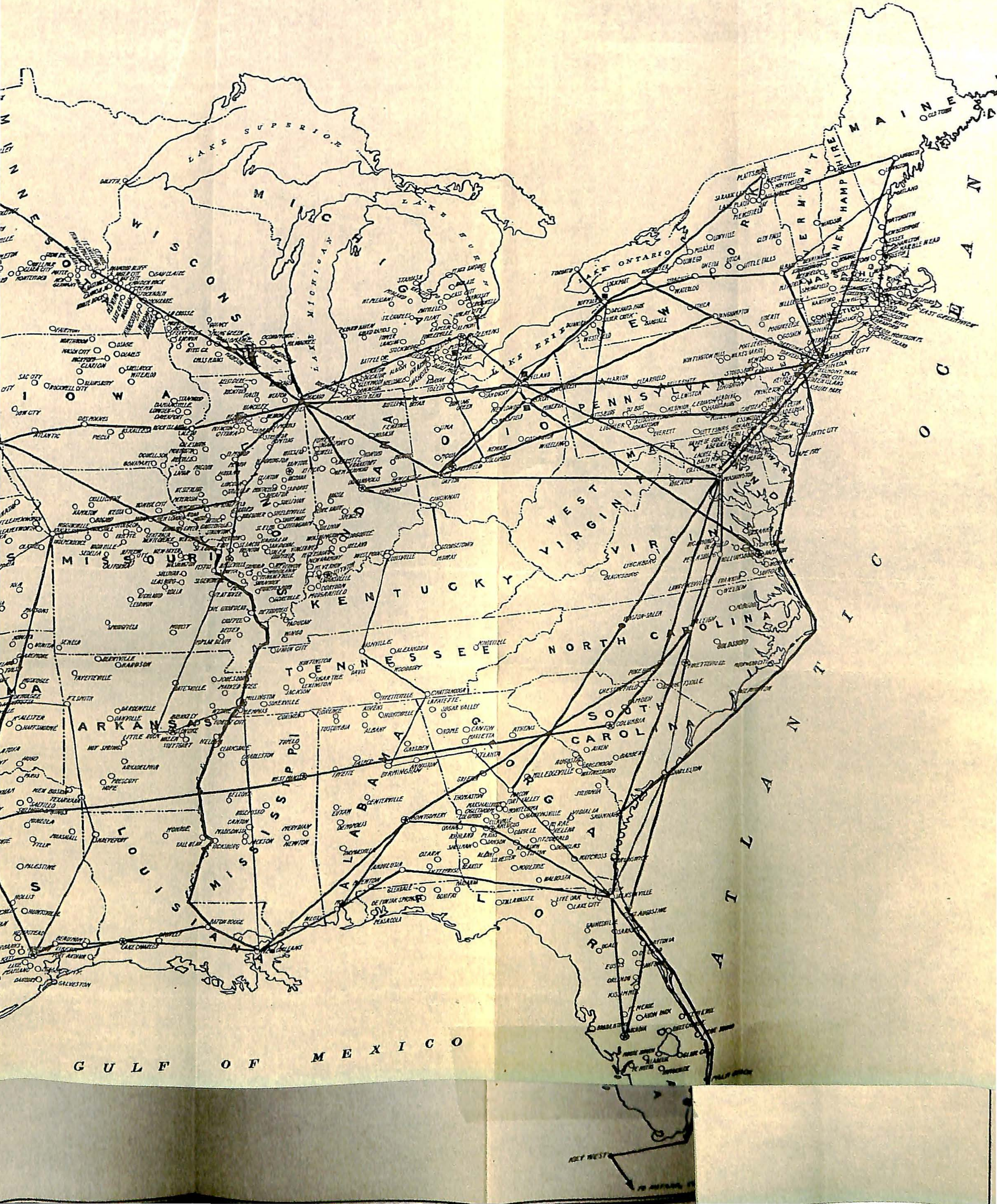
Landing Fie s and Principal Long Distance, Cross Country, Airplane Seaplane and Dirigible Flights in the U. S.

This map ws Landing Fields and the principal Long Distance, Cross Country, Airplar Seaplane and Dirigible Flights in the United States. Small towns along the flight routes are not shown. The route of the Minneapolis-Rock Island Se ane Mail Flight, Oct. 21, 1911, is not shown on map as the Seaplane followe he course of the Mississippi River. The Hampton Roads Navy Flying Bo Endurance Flight, April 25, 1919, is not shown as course was above city. A plete list of airdromes and emergency landing fields will be found in the ap lix.

JANUARY-1920.

— LEGEND —

- ⊛ Government Airdrome
- ★ Post Office Field
- ○ Emergency Field
- ● Municipal Field
- ■ Commercial Field


LAKE SUPERIOR
LAKE MICHIGAN
LAKE HURON
LAKE ONTARIO
LAKE ERIE
WISCONSIN
MICHIGAN
IOWA
MISSOURI
KENTUCKY
TENNESSEE
ARKANSAS
LOUISIANA
MISSISSIPPI
ALABAMA
GEORGIA
FLORIDA
SOUTH CAROLINA
NORTH CAROLINA
VIRGINIA
WEST VIRGINIA
PENNSYLVANIA
OHIO
INDIANA
ILLINOIS
NEW YORK
VERMONT
NEW HAMPSHIRE
MAINE
CONNECTICUT
MARYLAND
ATLANTIC OCEAN
GULF OF MEXICO

In 1913 at the request of the Secretary of War, Dr. W. J. Humphreys gave a course of lectures on meteorology in aeronautics to classes in aviation at the Signal Corps School, San Diego. These lectures were subsequently expanded into a series of articles entitled "Physics of the Air," which were printed in the *Journal of the Franklin Institute*. An extended article, "Effects of Winds and Other Weather Conditions on the Flight of Airplanes," was published in the *Monthly Weather Review*, Weather Bureau, Washington, D. C., August, 1919, Vol. 47, pp. 523–532.

During the Army's cross-country flights between San Diego and Los Angeles in 1916 the local bureau provided forecasts and it continued so to do until meteorology became part of the ground school course for government pilots and this science became a recognized aid to flight.

During the World War, the Meteorological Section of the A. E. F. under Lieutenant-Colonel Blair furnished the Air Service and our armies, detailed forecasts for each succeeding 24 hours, with special forecasts at intervening periods. Information was circulated by radio as to the speed and direction of the wind at various altitudes, and utilized by the pilots in the various airplane operations.

In the Trans-Atlantic flights of May and July, 1919, the Weather Bureau and the U. S. Navy cooperated in making immediate ocean weather maps and forecasts for the air pilots.

In the transcontinental race of October, 1919 forecasts were wired by the Weather Bureau, in cooperation with the Air Service, to all controls and to points where pilots made emergency landings. These enabled contestants, not only to avoid the risk of impending storm conditions, but, in several cases, to take advantage of favoring winds which not only increased their flying speed, but often brought them so advantageously to certain controls that they gained a day in elapsed time over less lucky contestants, weather-bound at other points.

A daily general forecast service for aviators is maintained by the Weather Bureau, and special forecasts are issued as requested. Correspondence with the Manufacturers Aircraft Association as to flight meterological data is invited.

RADIO DIRECTION FINDER

While in early days of flying local weather conditions had to be "just right" before an airplane would take off, with the development of the radio direction finder, the pilot has become literally master of the elements.

Imagine a lighthouse with guiding rays surging through space in every direction over a radius of six hundred miles or more! Yet such a beacon is by no means a figment of imagination. It is the lighthouse of the immediate future, wherein electro-magnetic waves will take the place of searching beams of light, and safeguard navigators of the air. Its successful development is the outcome of one of the most remarkable scientific achievements of the war period and its universal use is one of the promises of commercial aviation.

What is the nature of this modern lighthouse? How does it work? How has it been developed? What we have termed a "lighthouse" is nothing but a high-power wireless telegraph station, which sends out electric signals arranged, like the rays of marine lighthouses, in alternate flashes of varying length.

It is in the reception of these signals on board aircraft that the function of direction finding exists, thus enabling the airdrome wireless station to act as a beacon. This invention constitutes one of the greatest tributes to the ingenuity and observation of man, and like so many other aeronautical inventions its rapid development is due to the concentration of many minds upon one idea during the war.

In the course of this development it was found that an enclosed coil of wire — or "loop aerial"— had directional effect; that is, if the edge of the loop were pointed directly toward the transmitting station, audible signals would be recorded in the receiver. The moment the edge of the coil was turned in either direction away from the sending station, the signals would rapidly die down until they disappeared entirely. It followed then that at the point of maximum signals, the coil was pointing directly at the sending station — hence it was easy to locate the station.

At the present time two general types of direction finder are used on aircraft. On small machines there is installed what might be called the fixed type of finder. This is built rigidly into the airplane itself at the time of construction. The coil — or loop aerial — is built into the wings of the machine, in the form of a rectangle, along the main wing spars. The two ends from the back of the loop are then connected to the receiving apparatus in the fuselage. Telephone head pieces connected to the receiver are provided for both pilot and observer.

In this case the operation is as follows: Assume that a wireless lighthouse is erected at Mitchel Field, Long Island, and the machine is flying there from Buffalo. The lighthouse is sending out two short flashes every thirty seconds, the international signal that will designate Mitchel Field (assumed).

At the beginning of the flight the pilot will maneuver his ship until he hears this signal. Then throughout the remainder of the flight, he will keep these signals in his ears, knowing that so long as he hears them, his ship is pointed in a direct airline to Mitchel Field. He cannot get lost, no matter how bad the weather, because weather conditions have no serious effect upon the transmission of wireless waves. Even in fog he will proceed without hesitation toward his destination.

The other type is for larger aircraft, including airships. Though rather more complicated, it has a wider range of navigational possibilities. It consists of two coils, one rigid, and the other moving in a complete circle within it. The moveable coil is the "searcher," and its function is to search for a known wireless station.

Any aircraft equipped with such a finder is independent of an airdrome wireless station for the following reasons. Its navigator listens for any of the well known wireless stations, and then having found one in operation obtains from it with aid of his compass his direction bearing. He knows the exact location of the wireless station he has listened to, so upon a chart he draws a line representing his bearing from it. It follows as a logical proposition that his aircraft is located somewhere upon that line. Now by the simple process of triangulation he can locate the exact position. This he does by turning his coil around until he locates another wireless station, repeating the process of obtaining his direct bearing from it. Then drawing a line upon the chart representing this bearing, the line will intersect the first line at the exact spot above which the airplane is located. It is then easy to lay a course to any point the navigator desires to go. The remarkable thing about this system is that it becomes more accurate as the aircraft approaches its objective.

CHAPTER III

AIRCRAFT IN WARFARE

The Airplane in National Defense

Use of aircraft as a separate arm to attack all enemy air forces and his forces in land and sea.

Liaison with our own land forces by aerial units attached to them and under their control.

Liaison with our own sea forces by aerial units attached to them and under their control.

SOME DETAILED MILITARY AND NAVAL USES

Aerial messenger service.
Visual reconnaissance.
Artillery surveillance.
Artillery adjustment.
Communication between fleet commander and cooperating force on shore.
Adjustment of shore batteries.
Adjustment of fire from ships.
Bombardment raids.
Coast patrol.
Offensives against submarines and torpedo boats.
Attacks on ground troops.
Incendiary bombardment.
Destruction of battle ships.
Raids on hostile batteries that cannot be reached by artillery.
Location and destruction of enemy submarines.
Destruction of enemy lines of communication and enemy supplies.
Photographic reconnaissance.
Photography of results of bombardment.
Photography of friendly works to improve camouflage.
Prevention of enemy air attacks on friendly ground troops.
Assisting in naval blockades.
Location and destruction of mines.
Dropping maps, locations, orders, food, munitions and information to friendly troops.
Dropping propaganda.
Supplying food and ammunition to isolated posts.
Guide to advancing troops.
Landing raiding parties back of lines.
Landing agents in enemy territory.

(Through the courtesy and cooperation of officers in the Air Services of the War and Navy Departments, the Manufacturers Aircraft Association is able to present the following discussion of the development of aircraft during the World War. It is believed that they include the first comprehensive account of the progress of combat in the air from 1914 to 1918, as followed by those who have in mind our future national security. The application of aircraft during the conflict had such astonishing consequences that its further development along even more remarkable military lines may be expected. In uniting the elements of destruction and transportation, the airplane introduced a situation comparable only to such a period as would have appeared had man, at the same moment, produced gun powder and the steam locomotive. The increased use of aircraft during the World War, leads to the conclusion — which to many appears inevitable — that a Separate Arm is necessary. Aircraft, traveling in three dimensions, immersed in the element in which they move, are not merely an adjunct to the land and sea forces — they form an independent weapon, destined to command the decision in any future war.— EDITOR.)

MILITARY AVIATION

THE science of military aeronautics is strictly a development of the World War. Although the Great Powers, with the exception of the United States and Japan, had organized fairly large flying services within the general scheme of their armament policy, the military airplane, properly speaking, did not exist when the war began. The air fleets of both belligerents were made up merely of sport type, single and two-seaters, which were not only devoid of armament (guns and bombs) but furthermore were not constructed with this end in view.

In those early days of military aeronautics, the army chiefs had assigned to the airplane one duty, *reconnaissance*. Conditions of warfare, however, soon caused a change in these views. It was realized that it was not sufficient to see what was happening within the enemy lines; it was essential to prevent the enemy from doing likewise. This fundamental conception, which ultimately brought about highly specialized aerial fighting, led to the mounting of machine guns on airplanes, as carbines and automatics had proven of little use in bringing down enemy aircraft.

The early efforts toward utilizing military airplanes were, nevertheless, confined to making low altitude reconnaissance of short duration over the enemy and to reporting in person the information gathered. This was deemed so important, that in those days pilots were instructed to avoid combats so as not to endanger the transmission of their observation. The loss of time involved in personally reporting however, led to such inefficiency that great efforts were made to improve transmission of reports. This resulted in the development of despatch bag dropping, visual signals (such as streamers, smoke bombs, Very lights, etc.) and finally airplane wireless.

The introduction of high-angle ordnance for fighting airplanes (anti-aircraft guns) forced the improvement of airplane performance in the matter of ceiling (attainable altitude) and maneuverability.

The requirements of aerial fighting soon determined the type of machine most adapted to this purpose, namely, the single-seater tractor. This type was so maneuverable that it became possible to discard complex gun mountings and to fit the machine gun rigidly to the fuselage. With this arrangement, the pilot only needed to aim the airplane, instead of the gun alone, against the enemy machine. The presence of a propeller in front of the gun proved a problem of great difficulty, but this was overcome by synchronizing the machine gun with the engine so that the firing mechanism would function only when the muzzle was not covered by the propeller blades.

The value of aerial bombardment also became evident after satisfactory bombs, bomb dropping gears and sighting apparatus were perfected. The growing importance of this phase of aerial warfare forced the development of machines of considerable flight range, carrying capacity and speed. This was attained by a general increase in size and horse-power, and from 1915 on by the use of twin engines from which greater safety of operation resulted. If one engine was put out of action, and the airplane had dropped its load of bombs, the other engine would be sufficient for bringing the machine safely home.

The requirements of aerial observation resulted in the development of special airplane cameras by means of which the ground could be photographed with such precision that no movement of troops or of supplies could take place without it being recorded by the unfailing eye of the photographic machine. Aerial photographs were arranged together so as to form a comprehensive map which was daily kept up to date, weather permitting.

The three main war functions of the airplane in its relation to operations with the Army that were conclusively brought out by the war are:

1.— To assist the Army in successfully performing its operation.

2.— To attack enemy aircraft operating against our own or allied troops or air forces attached to the Army.

3.— To attack and harass enemy troops in the field and destroy his communications, stores and ammunition dumps.

As the type which was designed to perform the function under the first heading, we may place the "observation" airplanes, whose duty it is to direct fire from the artillery, perform general reconnaissance work over tactical areas, obtain photographs of territory of interest in the vicinity of the lines and beyond, and carry on contact patrols, that is, keep commanders and other officers informed of the position of advancing or retreating troops. In addition to these uses, observation planes have also been employed for the rapid transportation of staff officers and the quick transmission of important messages.

Under the second heading we find the "combat and pursuit" types, whose duty, is to prevent enemy aircraft from doing damage to our own or allies territory or aircraft. There must be two types of planes to fulfil such requirements. To successfully combat enemy machines specially built for aerial fighting, a type of plane is required which must have above all other things maneuverability, whereas for the pursuit type, whose duty it is to attack raiding (bomber) airplanes on sight, speed — for overtaking the enemy — must be the supreme quality. The pursuit type does not need the great climbing ability of the combat machine, though it requires just as great, or greater, ability to dive. It must, furthermore, have great strength to withstand unusual strains of combat maneuvers, carry powerful and absolutely reliable armament, and be capable of operating at great altitudes. In other words, the combat machine must be the boxer and the pursuit machine the runner with the attending characteristics of each.

Under the third heading are comprised "the bombers" whose duty it is to drop explosives upon territory occupied by enemy troops. The bombing class consists of two types, one for night, and one for day bombing. The main distinction between the two is that day bombers carry out their work on objectives too small to be practicable for night bombers, but of very great strategic importance, such as roads, railways, ammunition dumps, headquarters, etc. The night bombers operating with the Army are used for bombing objectives difficult to miss on account of their size, such as manufacturing plants and important enemy towns. The characteristics of both types of bombers must necessarily be reliability of power plant, great lifting capacity and reasonably good speed. In the day bomber, ability to protect itself somewhat from enemy aircraft and in the night bomber effectual provision for accurate navigation regardless of adverse weather conditions.

Toward the end of the war, an additional function was assigned to the pursuit airplane, namely, the harassing of the enemy on the ground with machine gun fire. This ground attack work exerted a greatly demoralizing effect on the troops and its use became so general in the last year of the war that special defense patrols of airplanes had to be organized. On the other hand, the Allies as well as the Germans were ready to put into service, at the time of the Armistice, ground attack airplanes which carried a very complete armor plating around the vital parts for protection against machine gun fire. These were the machines referred to as "flying tanks."

Aerial observation, with its various subdivisions, retained up to the end of the war, its primary importance with regard to army operations and it has become an axiom that an army deprived of observation machines is simply blinded and at the mercy of the adversary. That the proper execution of this observation work required fighting machines for its protection is obvious, just as is the coordinate employment of bombers against targets of tactical importance.

INDEPENDENT AIR FORCE

Aside from these three functions of military airplanes with which the operation, safety and efficiency of armies is directly concerned, there developed in the last year of the war a new scope for war airplanes through the development of an Aerial Force, *properly speaking*. This was carried on against strategic objectives such as armament and manufacturing centers, important railroad junctions and large cities acting as the nerve centers of enemy resistance. It soon became evident that this kind of warfare was beyond the local scope of field armies — though related to it — and must, therefore, be removed from the latter's immediate control and organized and commanded as a separate unit. Not only did the law of concentration demand such a measure, but also the wholly novel nature of this warfare which, in order to be carried out effectually, had to be organized and directed by airmen rather than by army men. The aerial offensive must be conceived from the air down and not from the ground up.

The French were the first to put this conception into concrete form with the organization of their "Aerial Division" which was composed of some 800 day bombardment and pursuit machines. This unit formed the strategical reserve of the French Aviation and was used with telling effect in the major engagements of the latter part of the war.

In regard to the coordinated employment of the various branches of military aviation in land battles, the plan of operations of the United States Army Air Service in the battle of St. Mihiel affords an example of the most up-to-date nature.

The plan of operations of a modern battle provides for three distinct phases of combat:

First, the preparation of the attack. Here, in order to insure secrecy, the enemy must be prevented from carrying out reconnaissance flights over our lines, while we must find out all we can about him. This must be done, however, without showing unusual activity, else the enemy might suspect our preparation.

Second, the attack up to the objective assigned beforehand. Here the function of aviation is to destroy all hostile air forces encountered, after which ground troops are attacked. Beside this work, proper cooperation must be insured with the infantry and artillery in the matter of observation and *liaison*.

Third, the exploitation of the battle, that is, the advance beyond the original objective. In this phase the enemy is relentlessly pursued in the air as well as on the ground, every hostile aircraft being attacked on sight and the more important ground organizations of the enemy being bombed and machine-gunned from the air.

In the battle of St. Mihiel, the execution of this plan involved the use of some 1,500 American, French, British and Italian airplanes. It was decided to assign to the army of operation the aviation units which it needed for local observation and protection, and to concentrate the remaining aviation, which made up the bulk of the air forces available, into a huge Aerial Shock Force. This Force was composed of pursuit and day bombardment machines and operated in brigades of about 500 airplanes each. The mode of attack was to deliver a succession of blows by having a fresh brigade take the place of those brigades which had exhausted ammunition and fuel.

As a result of these tactics the Germans were literally driven out of the skies and the reduction of the St. Mihiel salient was carried out according to schedule.

Although the operation of kite balloons is of a much less spectacular nature than that of airplanes, lighter-than-air craft have played a very important rôle in the World War.

Kite balloons, owing to their immobility and steadiness in high winds, usefully supplement the work of airplanes in artillery observation and local surveillance. On the Western front alone several hundred kite balloons were in daily use on each side of the lines. The value of these aerial observatories was so great that special pursuit units were assigned for their destruction with incendiary bullets. To guard against these attacks, balloons were protected by anti-aircraft guns, machine guns and special protective squadrons, and this system made it so difficult to burn enemy balloons that the American Air Service introduced the idea of night attacks. These met with great success, seventeen German balloons being shot down by one American officer alone within a week.

Since the Armistice, the Air Service has drawn up a plan for the use of small airships in the ranging of coast batteries and general observation work hitherto performed by kite balloons. With this end in view, the Army acquired in the late fall of 1919, four American made nonrigid airships of 100,000 cu. ft., and five foreign built ships of about 150,000 cu. ft.

AIR SERVICE STRENGTH

The Air Service of the United States Army originally came into being on July 18th, 1914, when the Aviation Section was created within the Signal Corps, with an allotted strength of 60 officers and 260 soldiers. Its equipment then consisted of six airplanes. The normal development of the Air Service — which was separated from the Signal Corps in 1918 — was retarded by inadequate appropriations until the United States declared war on Germany. On that day the personnel of the Aviation Section numbered only 65 officers and 1120 enlisted men, while the entire equipment comprised about 55 airplanes, none of which was the equal of European service types. It was a tremendous task to build up matériel and personnel.

On November 11th, 1918, the American Army had on hand in the A. E. F., 3,538 service airplanes and in the United States 4,865 service airplanes; and more were coming through rapidly. With the American Expeditionary Force 2,698 airplanes were in the Zone of Advance, together with 77 kite balloons.

The personnel of the Air Service on the same date numbered 20,568 officers and 174,456 enlisted men, a total of 195,024. Of this number 78,726 were overseas, distributed as follows: 58,828 in France, 19,724 in Great Britain and 174 in Italy.

American aviators flew for 35,747 hours over the enemy, covering a distance of 3,574,700 miles. Of the flights 12,830 were for pursuit, 6,672 were for observation and 1,174 were for bombing. In the latter work 275,000 pounds of explosive was dropped. The Air Service in France shot down altogether 776 airplanes and 72 balloons of the enemy and lost but 289 American aircraft — a ratio of superiority of more than two and two-thirds to one.

The present strength of the Army Air Service is limited by an Act of Congress to 1,923 officers and 21,853 men.

AIRPLANE AND BALLOON LOSSES DUE TO ENEMY ACTION

LOSSES	U. S.			ENEMY		
	PLANES	BAL-LOONS	TOTAL	PLANES	BAL-LOONS	TOTAL
1st Army	203	48	251	510	54	564
2nd Army	2	0	2	6	1	7
17th Sqdn. attached to RAF	19	0	19	51	3	54
148th Sqdn. attached to RAF	8	0	8	71	0	71
Individuals attached to RAF	36	0	36	75	11	86
Individuals attached to IAF	9	0	9	9	0	9
Individuals attached to Italians	3	0	3	3	0	3
Individuals attached to French	9	0	9	51	3	54
Totals	289	48	337	776	72	848

NOTE: The foregoing tabulation shows the losses sustained in aircraft by these divisions of the American Air Service, with the enemy losses inflicted by these same branches respectively.

NAVAL AVIATION

The adaptation of heavier-than-air craft to the requirements of naval warfare is a development in which America has been the pioneer. The first attempts with this end in view, date back to the latter part of 1910, when land machines were repeatedly flown from, and to United States warships which, for this purpose, had been equipped with a false deck or landing platform. The planes carried besides the usual landing gear, compressed air bags for emergency resting on the sea.

But it was the invention of the hydroairplane early in 1911 which marked the real beginning of American naval aviation. That year, four naval officers were trained as aviators and a few machines were purchased by the Navy for its newly created Aviation Section. From then on up to 1917, the principal efforts of Naval Aviation centered in the development of a seaplane which would couple a fair degree of seaworthiness with good flying qualities.

The invention, in 1912, of the flying boat and the development of a compressed air catapult for launching seaplanes from warships were the most notable achievements of this experimental period.

When the United States declared war on Germany in April, 1917, the Naval Air Service had a personnel of 38 officers and 163 men and one naval air station, at Pensacola, Florida. The aircraft in commission comprised 45 float seaplanes, 6 boat seaplanes, 3 land airplanes, 2 kite balloons and a small nonrigid airship. The seaplanes were mostly obsolescent, capable only of short flights, and lacking in seaworthy qualities.

In the latter part of that year, however, improvements in hull design and construction had so far progressed that the first practical flying boat was turned out for use of the United States Navy.

The problem of insuring the supply of naval seaplanes was solved by the cooperation of the manufacturers and the creation of the naval aircraft factory at Philadelphia.

A chain of naval air stations was established along the Atlantic seaboard and additional schools for the instruction of the flying personnel were organized.

At the same time, a program was laid down for the construction of lighter-than-air craft — airships for anti-submarine defense and kite balloons for gun spotting.

European development work up to the outbreak of the World War was just as experimental as it was in this country. The most important European contribution in this field was the development by the British of a seaplane, the wings of which could be folded back, which greatly reduced the space required for housing.

The expansion of naval aviation was comparatively slow in the early part of the war, and assumed momentum only when the growing menace of submarine warfare was realized. At first the poor seaworthiness and small carrying capacity of seaplanes greatly limited their usefulness in naval warfare. However, as more powerful and more reliable engines became available, the general progression in performance became noticeable and permitted the specialization of seaplanes for a large range of duties.

The main functions of aircraft in connection with naval warfare, considered apart from the operation of aircraft as a Special Arm, are in the order of their importance:

1.— Scouting and gun spotting in connection with fleet work at sea.

2.— Coast patrol work in liaison with the fleet.

3.— Offensive action against enemy aircraft, surface craft and ship establishments (coast batteries, dock yards, etc.) operating against or menacing the fleet.

Naval scouting subdivides into two branches, strategic and tactical. Strategic scouting requires long flights for observation far in advance of the possible point of conflict; this is, in particular for our country, a problem which can be solved by large rigid airships possessing a flight range of several thousand miles. In such duties airships possess an advantage because sustentation is independent of forward motion. The great buoyancy of large rigid airships furthermore allows the equipment of such vessels with elaborate apparatus for radio communication and with comfortable quarters for the crew — an important requirement for efficient service. During the better part of the war, Germany alone possessed aircraft of this kind in the Zeppelin. Since 1918, however, Great Britain has followed suit and the United States is planning to do likewise. Development of this service may possibly follow the British plan of assigning these airships to the Air Service operating as an Independent Arm.

Tactical scouting for fleets at sea was effected in the World War by "ship planes." These are small land machines which are launched from a track mounted on the main gun turrets, and are equipped with an emergency floatation gear.

This practise, which the British successfully introduced in the battle of Jutland, has been adopted on the latest American battle ships. Its importance lies in the fact that a flying machine can be carried on board and launched without interfering with the gun turrets.

As to the value of aerial observation for naval work suffice it to say that aircraft from an altitude of 5,000 ft. can see more than four times as far as the lookout post on a cruiser.

In the matter of gun spotting, that is, the directing of artillery fire, both seaplane and kite balloons have been employed at various times. In the case of the seaplane, mobility is the advantage; in the case of the kite balloon it is stability.

It has been said that scouting and gun spotting form the most important functions of naval aircraft for all kinds — seaplanes, airships, and kite balloons. However, owing to the peculiar naval situation during the World War, with the enemy fleet bottled up and the submarine assuming the chief offensive rôle, aircraft had particular prominence in coast patrol and convoy work, as well as giving direct battle to the under-sea boats themselves.

The considerable extension which Germany gave to submarine warfare forced the Allies and later the United States to devise a very complete aerial patrol system to cope with this menace. The anti-submarine warfare was carried out in four modes of operations, namely, routine patrol, escort patrol to convoys, emergency patrol and special bombing patrols for submarine bases.

Large seaplanes with an extensive cruising area were generally used for routine patrol. These planes carried either one or two bombs weighing either 230 or 500 pounds each, and were also provided with machine guns. As a rule smaller type aircraft were used for convoy escort. These were armed like the patrols. Specially designated seaplanes were always kept in readiness or maintained at all times at emergency patrol stations.

For bombing operations against submarine bases, land planes were mainly used, and these were divided into day and night bombing squadrons. Day bombing was carried out by the United States Naval Aviation through the Marine Corps, while the night bombing was effected by the Navy personnel. All of the four mentioned types of patrol were mainly offensive in character as they required the bombing of all enemy submarines encountered and might therefore be mentioned under the third main function of seaplanes. However, their primary purpose was not essentially offensive in that they merely cooperated with the surface patrol assigned to convoy service.

The extraordinary effectiveness of aerial craft in submarine defense is a matter of regard; during the last ten months of the war, only three ships were torpedoed or destroyed by cannon in the American patrol area in France, whereas, one year previously, an average of one ship a day was lost.

The United States Naval Aviation in France sighted 27 submarines, attacked 25, damaged 12 and probably sank 4. Besides, 477 convoys were escorted and numerous enemy ships were destroyed.

The United States Naval Aviation abroad flew altogether 791,398 nautical miles on patrol, 416,767 miles being covered in 4,314 patrols carried out in France.

In coast patrol and convoy work, lighter-than-air craft — both airships and kite balloons — rendered very valuable service during the war. Airships were used mainly for patrols of longer duration, while kite balloons, attached to convoy vessels, provided an effectual protection against submarines. The United States Naval Aviation abroad operated mainly French airships, while American built airships were used for training for patrol on these shores.

With regard to offensive action against aircraft, surface craft, and shore establishments, comparatively little has been done during the war outside of bombing raids already mentioned. However, certain new types of seaplanes have been developed in an experimental way, and these are likely to assume considerable importance in future naval wars. The most interesting development along this line is afforded by the torpedo seaplane, a "ship" equipped with a suitable cradle from which a regulation torpedo is dropped into the sea, whence it propels itself against the chosen target. The use of this kind of seaplane has been extremely limited during the war, although promising results have been obtained by the British as well as by the Germans.

Probably the most notable development of naval aviation during the war was the powerful N. C. type of offensive seaplane. This craft was originally designed for long distance patrols, with provision for heavy armament to fight submarines. The first of these craft was completed shortly before the Armistice. The fourth of the series — N. C.–4 — demonstrated its potentialities by making the first trans-Atlantic flight in the world's history, thus justifying the hopes of the designers and builders than the N. C. flying boats would be able to reach the scene of conflict under their own power and thereby relieve shipping. Had not the officers of naval aviation supported the development of the N. C. boats, combining remarkable seaworthiness and flying power, the honor of first crossing the Atlantic undoubtedly would have been lost to the United States.

Another remarkable performance made by a naval airplane was that of an F.–5–L boat fitted with two Liberty engines which made a non-stop flight of 20 hours 10 minutes, during which time a distance of approximately 1,250 nautical miles was covered. This boat carried a crew of four.

The development of naval aeronautics in the United States had made enormous strides at the time the Armistice was signed, when the personnel of the Naval Air Service was composed of 3,117 officers and 45,632 men; 42 air stations were in commission, 25 of which were located in France, Great Britain and Italy.

After demobilization was started, shortly after the Armistice, Naval Aviation was limited by an Act of Congress to six seaplane stations within the continental limits of the United States, and a corresponding reduction of personnel and equipment ensued.

At the present time, the problems of aviation are mainly experimental, looking forward to the development of new types of seaplanes for offensive purposes and of large rigid airships for fleet scouting.

As above indicated, possibly future development of aviation in the United States will concentrate many of the aerial activities of the Navy in a united Air Service similar to the plan already adopted by Great Britain and other European countries.

CHAPTER IV

CONVENTION RELATING TO INTERNATIONAL AIR NAVIGATION

THE following convention relative to International Air Navigation was drafted by the Aeronautical Commission of the Peace Conference.

The Commission was composed of the following delegates:

Two representatives of each of the principal Powers, United States of America, British Empire, France, Italy and Japan.

One representative of each of the following seven Powers with limited interests, designated by the Supreme Council, namely Belgium, Brazil, Cuba, Greece, Portugal, Roumania and Serbia, who were to represent all the Powers with limited interests assembled at the Peace Conference.

The representatives designated by the United States were: — on the Commission, Rear Admiral H. S. Knapp, U. S. N., and Major General M. M. Patrick, U. S. A.; on the Military Sub-committee, Brigadier General B. D. Foulois, U. S. A., and Captain Luke MacNamee, U. S. N.; on the Technical Sub-committee, Lieutenant-Colonel A. D. Butterfield, U. S. A., Lieutenant-Commander J. L. Callan, U. S. N., and Lieutenant Ralph Kiely, U. S. N.; on the Legal, Commercial and Financial Sub-committees, Commander Pollock, U. S. N., and Major H. S. Bacon, A.S., U. S. A.

On October 13th, 1919, delegates representing sixteen of the Allied Powers, namely, Belgium, Bolivia, Brazil, Great Britain, China, Cuba, Ecuador, France, Italy, Panama, Poland, Portugal, Roumania, Siam, Czecho-Slovakia and Uruguay, signed the International Air Navigation Convention.

Germany, Austria and Bulgaria, under the terms of the peace treaties of Versailles, St. Germain and Neuilly, are held to observe the stipulations of the Convention.

If the United States becomes signatory to the Convention it will become the foundation of a body of law governing aerial activity in this country. It is hoped that before another year this important question will be settled and that we may publish in the next "Year Book" the complete text of the approved International Convention, as well as additional laws governing domestic operation of aircraft.

At the request of the American Aviation Mission a special committee of the Manufacturers Aircraft Association made a thorough study of an early draft of the Convention and the later draft of this instrument incorporated several of the changes suggested by this committee.

CONVENTION RELATING TO INTERNATIONAL AIR NAVIGATION

CHAPTER I

GENERAL PRINCIPLES

ARTICLE 1.—The High contracting Parties recognise that every Power has complete and exclusive sovereignty over the air space above its territory.

For the purpose of the present Convention the territory of a State shall be understood as including the national territory, both that of the mother country and of the colonies, and the territorial waters adjacent thereto.

ARTICLE 2.—Each contracting State undertakes in time of peace to accord freedom of innocent passage above its territory to the aircraft of the other contracting States, provided that the conditions laid down in the present Convention are observed.

Regulations made by a contracting State as to the admission over its territory of the aircraft of the other contracting States shall be applied without distinction of nationality.

ARTICLE 3.—Each contracting State is entitled for military reasons or in the interest of public safety to prohibit the aircraft of the other contracting States, under the penalties provided by its legislation and subject to no distinction being made in this respect between its private aircraft and those of the other contracting States, from flying over certain areas of its territory.

In that case the locality and the extent of the prohibited areas shall be published and notified beforehand to the other contracting States.

ARTICLE 4.—Every aircraft which finds itself above a prohibited area shall, as soon as aware of the fact, give the signal of distress provided in Paragraph of Annex D and land as soon as possible outside the prohibited area at one of the nearest airdromes of the State unlawfully flown over.

CHAPTER II

NATIONALITY OF AIRCRAFT

ARTICLE 5.—No contracting State shall, except by a special and temporary authorization, permit the flight above its territory of an aircraft which does not possess the nationality of a contracting State.

ARTICLE 6.—Aircraft possess the nationality of the State on the register of which they are entered, in accordance with the provisions of Section I (*c*) of Annex A.

ARTICLE 7.—No aircraft shall be entered on the register of one of the contracting States unless it belongs wholly to nationals of such State.

No incorporated company can be registered as the owner of an aircraft unless it possess the nationality of the State in which the aircraft is registered, unless the President or chairman of the company and at least two-thirds of the directors possess such nationality, and unless the company fulfils all other conditions which may be prescribed by the laws of the said State.

ARTICLE 8.— An aircraft cannot be validly registered in more than one State.

ARTICLE 9.— The contracting States shall exchange every month among themselves and transmit to the International Commission for Air Navigation referred to in article 34 copies of registrations and of cancellations of registration which shall have been entered on their official registers during the preceding month.

ARTICLE 10.— All aircraft engaged in international navigation shall bear their nationality and registration marks as well as the name and residence of the owner in accordance with Annex A.

CHAPTER III

CERTIFICATES OF AIRWORTHINESS AND COMPETENCY

ARTICLE 11.— Every aircraft engaged in international navigation shall, in accordance with the conditions laid down in Annex B, be provided with a certificate of airworthiness issued or rendered valid by the State whose nationality it possesses.

ARTICLE 12.— The commanding officer, pilots, engineers and other members of the operating crew of every aircraft shall, in accordance with the conditions laid down in Annex E, be provided with certificates of competency and licences issued or rendered valid by the State whose nationality the aircraft possesses.

ARTICLE 13.— Certificates of airworthiness and of competency and licences issued or rendered valid by the State whose nationality the aircraft possesses, in accordance with the regulations established by Annex B and Annex E and hereafter by the International Commission for Air Navigation, shall be recognised as valid by the other States.

Each State has the right to refuse to recognise for the purpose of flights within the limits of and above its own territory certificates of competency and licences granted to one of its nationals by another contracting State.

ARTICLE 14.— No wireless apparatus shall be carried without a special licence issued by the State whose nationality the aircraft possesses. Such apparatus shall not be used except by members of the crew provided with a special licence for the purpose.

Every aircraft used in public transport and capable of carrying ten or more persons shall be equipped with sending and receiving wireless apparatus when the methods of employing such apparatus shall have been determined by the International Commission for Air Navigation.

This Commission may later extend the obligation of carrying wireless apparatus to all other classes of aircraft in the conditions and according to the methods which it may determine.

CHAPTER IV

ADMISSION TO AIR NAVIGATION ABOVE FOREIGN TERRITORY

ARTICLE 15.— Every aircraft of a contracting State has the right to cross the air space of another State without landing. In this case it shall follow the route fixed by the State over which the flight takes place. However, for reasons of general security it will be obliged to land if ordered to do so by means of signals provided in Annex D.

Every aircraft which passes from one State into another shall, if the regulations of the latter State require it, land in one of the airdromes fixed by the latter. Notification of these airdromes shall be given by the contracting States to the International Commission for Air Navigation and by it transmitted to all the contracting States.

The establishment of international airways shall be subject to the consent of the States flown over.

ARTICLE 16.—Each contracting State shall have the right to establish reservations and restrictions in favour of its national aircraft in connection with the carriage of persons and goods for hire between two points on its territory.

ARTICLE 17.—The aircraft of a contracting State which establishes reservations and restrictions in accordance with Article 16, may be subjected to the same reservations and restrictions in any other contracting State, even though the latter State does not itself impose the reservations and restrictions on other foreign aircraft.

ARTICLE 18.—Every aircraft passing through the territory of a contracting State, including landing and stoppages reasonably necessary for the purpose of such transit, shall be exempt from any seizure from on the ground of infringement of patent, design or model, subject to the deposit of security the amount of which in default of amicable agreement shall be fixed with the least possible delay by the competent authority of the place of seizure.

CHAPTER V

RULES TO BE OBSERVED ON DEPARTURE WHEN UNDER WAY AND ON LANDING

ARTICLE 19.—Every aircraft engaged in international navigation shall be provided with:

(*a.*) A certificate of registration in accordance with Annex A;

(*b.*) A certificate of airworthiness in accordance with Annex B;

(*c.*) Certificates and licences of the commanding officer, pilots and crew in accordance with Annex E;

(*d.*) If it carries passengers, a list of their names;

(*e.*) If it carries freight, bills of lading and manifest;

(*f.*) Log books in accordance with Annex C;

(*g.*) If equipped with wireless, the special licence prescribed by Article 14.

ARTICLE 20.—The log books shall be kept for two years after the last entry.

ARTICLE 21.—Upon the departure or landing of an aircraft, the authorities of the country shall have, in all cases, the right to visit the aircraft and to verify all the documents with which it must be provided.

ARTICLE 22.—Aircraft of the contracting States shall be entitled to the same measures of assistance for landing, particularly in case of distress, as national aircraft.

ARTICLE 23.—With regard to the salvage of aircraft wrecked at sea the principles of maritime law will apply, in the absence of any agreement to the contrary.

ARTICLE 24.—Every airdrome in a contracting State, which upon payment of charges is open to public use by its national aircraft, shall likewise be open to the aircraft of all the other contracting States.

ARTICLE 25.— Each contracting State undertakes to adopt measures to ensure that every aircraft flying above the limits of its territory and that every aircraft wherever it may be, carrying its nationality mark, shall comply with the regulations contained in Annex D.

Each of the contracting States undertakes to ensure the prosecution and punishment of all persons contravening these regulations.

CHAPTER VI

PROHIBITED TRANSPORT

ARTICLE 26.— The carriage by aircraft of explosives and of arms and munitions of war is forbidden in international navigation. No foreign aircraft shall be permitted to carry such articles between any two points in the same contracting State.

ARTICLE 27.— Each State may, in aerial navigation, prohibit or regulate the carriage or use of photographic apparatus. Any such regulations shall be at once notified to the International Commission for Air Navigation, which shall communicate this information to the other Contracting States.

ARTICLE 28.— As a measure of public safety, the carriage of objects other than those mentioned in articles 26 and 27 may be subjected to restrictions by any contracting State. Any such regulations shall be at once notified to the International Commission for Air Navigation, which shall communicate this information to the other contracting States.

ARTICLE 29.— All restrictions mentioned in Article 28 shall be applied equally to national and foreign aircraft.

CHAPTER VII

STATE AIRCRAFT

ARTICLE 30.— The following shall be deemed to be State aircraft: —

(*a.*) Military aircraft.

(*b.*) Aircraft exclusively employed in State service, such as posts, customs, police.

Every other aircraft shall be deemed to be a private aircraft.

All state aircraft other than military, customs and police aircraft shall be treated as private aircraft and as such shall be subject to all the provisions of the present Convention.

ARTICLE 31.— Every aircraft commanded by a person in military service detailed for the purpose shall be deemed to be a military aircraft.

ARTICLE 32.— No military aircraft of a contracting State shall fly over the territory of another contracting State nor land thereon without special authorisation. In case of such authorisation the military aircraft shall enjoy, in principle, in the absence of special stipulation the privileges which are customarily accorded to foreign ships of war.

A military aircraft which is forced to land or which is requested or summoned to land shall by reason thereof acquire no right to the privileges referred to in the above paragraph.

ARTICLE 33.— Special arrangements between the States concerned will determine in what cases police and customs aircraft may be authorised to cross the frontier. They shall in no case be entitled to the privileges referred to in Article 32.

CHAPTER VIII

INTERNATIONAL COMMISSION FOR AIR NAVIGATION

ARTICLE 34.— This chapter arranges for a permanent International Commission for Air Navigation, placed under the League of Nations and composed of two representatives of the United States, France, Italy and Japan, each: one representative of Great Britain and one of each of the British Dominions and India; and one representative of each of the other contracting states.

"Each of the five states first named (Great Britain, the British Dominions and India, counting for this purpose as one state) shall have the least whole number of votes which, when multiplied by five, will give a product exceeding by at least one vote the total number of the votes of all the other contractnig states."

The functions of this Commission are to carry out the provisions of the Convention, to alter and amend it as deemed convenient and generally to administrate the International Air Navigation.— EDITOR.

CHAPTER IX

FINAL PROVISIONS

ARTICLES 35–43.— The articles under this chapter relate to the cooperation of contracting states in international measures concerning the collection and d' semination of statistical, current and meteorological information, the publica of standard aeronautical maps and the establishment of a uniform syster ground marks for flying, and of the necessary wireless stations for air naviga Provision is made for allowing special agreements between states in respec customs, police, mails, etc.: for procedure in case of disagreement between tracting states; and the adherence of new states to, and the withdrawal of con tracting states from, the Convention.— EDITOR.

ANNEX A

THE MARKING OF AIRCRAFT

Annex A provides generally for the marking of aircraft, to show the tionality, location of these marks on the aircraft, means of identification, s of markings and spacing.

Section VIII of this annex presents a table of marks which is given below i part. The nationality mark of each state named, applies to the aircraft of i' dominions, colonies, protectorates, dependencies, or of countries over which it the mandatory state.— EDITOR.

COUNTRY	NATIONALITY MARK	REGISTRATION MARKS
UNITED STATES OF AMERICA	N	All combinations made in accordance with the provisions of Section I (a) of this Annex, using a group of 4 letters out of the 26 of the alphabet, each group containing at least one vowel, e. g., ADCJ, PURX.
BRITISH EMPIRE	G	
FRANCE	F	
ITALY	I	
JAPAN	J	
BOLIVIA	C	All combinations made with B as first letter.
CUBA	C	All combinations made with C as first letter.
URUGUAY	C	All combinations made with U as first letter.
GUATEMALA	L	All combinations made with G as first letter.
BRAZIL	P	All combinations made with B as first letter.
PERU	O	All combinations made with P as first letter.
HONDURAS	X	All combinations made with H as first letter.
HAITI	H	All combinations made with H as first letter.
ECUADOR	E	All combinations made with E as first letter.
PANAMA	S	All combinations made with P as first letter.
NICARAGUA	A	All combinations made with N as first letter.

ANNEX B

CERTIFICATES OF AIRWORTHINESS

The following main conditions govern the issue of certificates of airworthiness: —

1. The design of the aircraft in regard to safety shall conform to certain standard minimum requirements.
2. A satisfactory demonstration must be made in flying trials of the actual flying qualities of the type of aircraft examined, provided that machines subsequently manufactured which conform to the approved type need not be subject to such trials. The trials shall conform to certain standard minimum requirements.
3. The construction of every aircraft with regard to workmanship and ma-

terials must be approved. The control of the construction and of the tests shall be in accordance with certain standard minimum requirements.
4. The aircraft must be equipped with suitable instruments for safe navigation.
5. The standard minimum requirements of paragraphs 1 to 3 inclusive shall be fixed by the International Commission for Air Navigation. Until they have been so fixed each contracting State shall determine the regulations under which certificates of airworthiness shall be granted or remain valid.

ANNEX C

LOG BOOKS

SECTION I

JOURNEY LOG

This shall be kept for all aircraft and shall contain the following particulars: —

(*a.*) Category to which the aircraft belongs: its nationality and registration marks; the full name, nationality and residence of the owner; name of maker and the carrying capacity of the aircraft.
(*b.*) In addition for each journey —
(i.) The names, nationality and residence of each of the members of the crew.
(ii.) The place, date, and hour of departure, the route followed, and all incidents *en route* including landings.

SECTIONS II–V

In these sections, Aircraft, Engine, and Signal Logs are provided for in detail and instructions are given for their use.— EDITOR.

ANNEX D

RULES AS TO LIGHTS AND SIGNALS — RULES OF THE AIR

DEFINITIONS

The word "aircraft" comprises all balloons, whether fixed or free, kites, airships, and flying machines.

The word "balloon," either fixed or free, shall mean an aircraft using gas lighter than air as a means of support, and having no means of propulsion.

The word "airship" shall mean an aircraft using gas lighter than air as a means of support, and having means of propulsion.

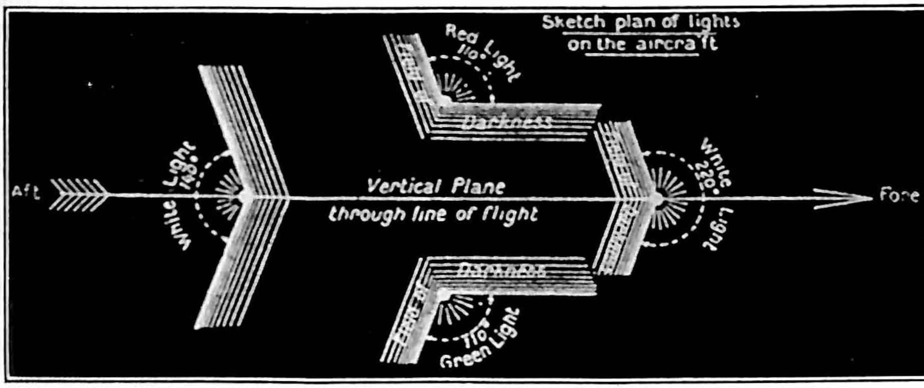
The words "flying machine" shall mean all airplanes, seaplanes, flying boats, or other aircraft heavier than air, and having means of propulsion.

An airship is deemed to be "under way" within the meaning of these rules when it is not made fast to the ground or any object on land or water.

SECTION I

RULES AS TO LIGHTS

The word "visible" in these rules when applied to lights shall mean visible on a dark night with a clear atmosphere. The angular limits laid down in these rules as shown in the sketch (attached) shall be determined when the aircraft is in its normal attitude for flying on a rectilinear horizontal course.



1. The rules concerning lights shall be complied with in all weathers from sunset to sunrise, and during such time no other lights which may be mistaken for the prescribed lights shall be exhibited. The prescribed navigation lights must not be dazzling.

2. A flying machine, when in the air or manœuvring on land or water under its own power, shall carry the following lights: —

(a.) Forward, a white light visible in a dihedral angle of 220 degrees bisected by a vertical plane through the line of flight, and of such a character as to be visible at a distance of at least 8 kilometres.

(b.) On the right side, a green light so constructed and fixed as to show an unbroken light between two vertical planes whose dihedral angle is 110 degrees when measured to the right from dead ahead, and of such a character as to be visible at a distance of at least 5 kilometres.

(c.) On the left side, a red light so constructed and fixed as to show an unbroken light between two vertical planes whose dihedral angle is 110 degrees when measured to the left from dead ahead, and of such a character as to be visible at a distance of at least 5 kilometres.

(d.) The said green and red side lights shall be fitted so that the green light shall not be seen from the left side nor the red light from the right side.

(e.) At the rear, and as far aft as possible, a white light shining rearwards and visible in a dihedral of 140 degrees bisected by a vertical plane through the line of flight and of such a character as to be visible at a distance of at least 5 kilometres.

(f.) In the case where, in order to fulfil the above conditions, the single light has to be replaced by several lights, the field of visibility of each of these lights should be so limited that only one can be seen at a time.

3. The Rules determined for the lighting of flying machines shall apply to airships subject to the following modifications: —

(a.) All lights shall be doubled; the forward and aft lights vertically, and the side lights horizontally in a fore and aft direction.

(b.) Both lights of each pair forward and aft shall be visible at the same time. The distance between the lights comprising a pair shall not be less than 2 metres.

The rest of this paragraph, numbers four to thirteen, of rules as to lights, is covered with the regulation for airships and balloons in flight and at rest, with a note dealing with precautionary measures to avoid collisions with surface craft. It also regulates the lights on flying machines, stationary or not anchored.—EDITOR.

SECTION II

RULES AS TO SIGNALS

Extremely detailed regulations are provided in paragraphs 14 to 20 for the showing of lamps, flares and smoke signals by aircraft about to land or when in distress.— EDITOR.

SECTION III

RULES OF THE AIR

21. Flying machines shall always give way to balloons fixed or free and to airships. Airships shall always give way to balloons, whether fixed or free.

22. An airship when not under its own control shall be classed as a free balloon.

23. Risk of collision can, when circumstances permit, be ascertained by carefully watching the compass bearing and angle of elevation of an approaching aircraft. If neither the bearing nor the angle of elevation appreciably change, such risk shall be deemed to exist.

24. The term "risk of collision" shall include risk of injury due to undue proximity of other aircraft. Every aircraft that is required by these rules to give way to another to avoid collision, shall keep a safe distance, having regard to the circumstances of the case.

25. While observing the rules regarding risk of collision contained in paragraph 24, a motor-driven aircraft must always manœuvre according to the rules contained in the following paragraphs, as soon as it is apparent that, if it pursued its course, it would pass at a distance of less than 200 metres from any part of another aircraft.

26. When two motor-driven aircraft are meeting end on or nearly end on each shall alter its course to the right.

27. When two motor-driven aircraft are on courses which cross, the aircraft which has the other on its own right side shall keep out of the way of the other.

28. An aircraft overtaking any other shall keep out of the way of the overtaken aircraft by altering its own course to the right, and must not pass by diving.

Every aircraft coming up with another aircraft from any direction more than 110 degrees from ahead of the latter, *i. e.*, in such a position with reference to the aircraft which it is overtaking that at night it would be unable to see either of that aircraft's sidelights, shall be deemed to be an overtaking aircraft, and no subsequent alteration of the bearing between the two aircraft shall make the overtaking aircraft a crossing aircraft within the meaning of these rules, or relieve it of the duty of keeping clear of the overtaken aircraft until it is finally past and clear.

As by day the overtaking aircraft cannot always know with certainty whether it is forward or abaft the direction mentioned above from the other aircraft, it should, if in doubt, assume that it is an overtaking aircraft and keep out of the way.

29. Where by any of these rules one of the two aircraft is to keep out of the way, the other shall keep its course and speed. When, in consequence of thick weather or other causes, the aircraft having the right of way finds itself so close that collision cannot be avoided by the action of the giving-way aircraft alone, it shall take such action as will best aid to avert collision.

30. Every aircraft which is directed by these rules to keep out of the way of another aircraft shall, if the circumstances of the case admit, avoid crossing ahead of the other.

31. In following an officially recognised air route every aircraft, when it is safe and practicable, shall keep to the right of such route.

32. All aircraft on land or sea about to ascend shall not attempt to "take off" until there is no risk of collision with alighting aircraft.

33. Every aircraft in a cloud, fog, mist or other conditions of bad visibility shall proceed with caution, having careful regard to the existing circumstances and conditions.

34. In obeying and construing these rules due regard shall be had to all dangers of navigation and collision and to any special circumstances which may render a departure from the above rules necessary in order to avoid immediate danger.

SECTION IV

BALLAST

35. The dropping of ballast other than fine sand or water from aircraft in the air is prohibited.

SECTION V

Detailed instructions are given in this section for the observance of air traffic regulations on and in the vicinity of airdromes.— EDITOR.

SECTION VI

GENERAL

This section states that aircraft on the water under its own power will perform to the usual marine regulations for preventing collisions at sea.— EDITOR.

ANNEX E

MINIMUM QUALIFICATIONS NECESSARY FOR OBTAINING CERTIFICATES AS PILOTS AND NAVIGATORS

SECTION I

CERTIFICATES FOR PILOTS OF FLYING MACHINES

(A.) PRIVATE PILOT'S FLYING CERTIFICATE
(not valid for purposes of public transport)

1. *Practical Tests:*

In each practical test the candidate must be alone in the flying machine.

(*a.*) *Test for Altitude and Gliding Flight.* A flight without landing during which the pilot shall remain for at least an hour at a minimum altitude of 2,000 metres above the point of departure. The descent shall finish with a glide, the engines cut off at 1,560 metres above the landing ground. The landing shall be made without restarting the engine and within 150 metres or less of a point fixed beforehand by the official examiners of the test.

(*b.*) *Tests of Skill.* A flight without landing around two posts (or buoys) situated 500 metres apart making a series of five figure-of-eight turns, each turn reaching one of the two posts (or buoys). This flight shall be made at an altitude of not more than 200 metres above the ground (or water) without touching the ground (or water). The landing shall be effected by:

(i.) Finally shutting off the engine or engines at latest when the aircraft touches the ground (or water).

(ii.) Finally stopping the flying machine within a distance of 50 metres from a point fixed by the candidate before starting.

2. *Special Requirements:*

Knowledge of rules as to Lights and Signals, and Rules of the Air. Rules for Air Traffic on and in the Vicinity of Airdromes. A practical knowledge of international air legislation.

(B.) PILOT'S FLYING CERTIFICATE FOR FLYING MACHINES USED FOR PURPOSES OF PUBLIC TRANSPORT

1. *Practical Tests:*

In each practical test the candidate must be alone in the flying machine.

(*a.*) The tests for altitude and gliding flight and for skill are the same as those required for a private pilot's flying certificate. Candidates already in possession of the latter certificates are not required to pass these tests again.

(*b.*) Test of endurance consisting of a cross-country or oversea flight of at least 300 kilometres, after which the final landing shall be made at the point of departure. This flight shall be made in the same flying machine within eight hours. It shall include two obligatory landings (during which the machine must come to rest), which shall not be at the point of departure, but which shall be fixed by the judges.

At the time of departure the candidate shall be informed of his course and furnished with the appropriate map. The judges will decide whether the course has been correctly followed.

(*c.*) *Night Flight.* A thirty minutes' flight made between two hours after sunset and two hours before sunrise, at a height of at least 500 metres.

2. *Technical Examination:*

After satisfactory practical tests have been passed, candidates will, when summoned, sumbit themselves to examination on —

(*a.*) *Flying Machines:*

Theoretical knowledge of the resistance of the air as concerns its effects on wings and tail planes, rudders, elevators, and propellers; functions of the different parts of the machine and of their controls.

Assembling of flying machines and their different parts.

Practical tests on rigging.

(*b.*) *Engines:*

General knowledge of internal combustion engines, including functions of the various parts: a general knowledge of the construction, assembling, adjustment, and characteristics of aero-engines.

Causes of the faulty running of engines and of breakdown.

Practical tests in running repairs.

(*c.*) *Special Requirements:*

Knowledge of Rules as to Lights and Signals and Rules of the Air, and Rules for Air Traffic on and in the Vicinity of Airdromes.

Practical knowledge of the special conditions of air traffic and of international air legislation.

Map reading, orientation, location of position, elementary meteorology.

REMARKS

The practical tests shall be carried out within a maximum period of one month.

They may be carried out in any order, and each may be attempted twice. They shall be witnessed by properly accredited examiners, who will forward the official reports to the proper authorities.

The official reports will give the different incidents, especially those of landings. The candidates shall furnish before each test proper identity forms.

A barograph shall be carried on all practical tests, and the graph, signed by the examiners, shall be attached to their report.

Pilots who hold the military pilot's certificate shall be entitled to the private pilot's flying certificate, but, in order to obtain the pilot's flying certificate for purposes of Public Transport it will be necessary to pass the technical conditions for navigation as required by B (2) (c.).

SECTION II

Certificates for pilots of balloons are provided for in this section, by a series of practical tests, together with theoretical knowledge and special requirements. —EDITOR.

SECTION III

This section provides for three classes of airship officer pilots. The holder of a first class certificate is qualified to command any airship. The holder of a second class certificate is qualified to command airships under 20,000 cubic meters capacity. The holder of a third class certificate is qualified to command airships under 6000 cubic meters capacity. All military and naval airship officer pilots are entitled to a third class certificate. All military and naval officer pilots who have commanded airships over 6000 cubic meters capacity are entitled to a first class certificate.— EDITOR.

SECTION IV

This section provides for certificates for navigators of aircraft. They must first pass a theoretical and practical examination in many points of which the following are the more important — true and apparent movements of the celestial bodies: method of determining latitude, longitude, time and azimuth, maps and charts, how to read them, compass, magnetic meridians, variations, deviations, aeronautical navigation instruments, and so forth.— EDITOR.

SECTION V

This section is devoted to international medical requirements for air navigation. It provides an exhaustive physical examination for candidates as pilots or navigators.— EDITOR.

ANNEX F

INTERNATIONAL AERONAUTICAL MAPS AND GROUND MARKINGS

SECTIONS I AND II

This annex illustrates an international system of aerial maps on the scale of 1: 1,000,000; and all local maps on a scale of 1: 200,000. The details of what the maps will show are given in this section. SECTION II provides for an international system of ground marks. These marks differ widely from those now in use in the United States.— EDITOR.

ANNEX G

A system of exchange of meteorological information — statistical, current and forecast — is arranged for in this Annex.

In Appendices I–IV, provision is made for the issuance of meteorological reports with instructions as to the general form in which the reports are to be rendered. A very complete system of standard and special symbols is laid out for the telegraphic transmission of such reports.— EDITOR.

ANNEX H

CUSTOMS

This Annex contains general provisions and regulations relating to customs.

Aircraft departing from one country en route for another must start from a specially designated customs airdrome and cross the frontier between points fixed by the contracting states.

Aircraft landing in foreign countries are in principle liable to customs duties.

The provisions of this Annex do not apply to military aircraft visiting a state by special authorization nor to police and customs aircraft.— EDITOR.

CHAPTER V

REPORT OF AMERICAN AVIATION MISSION

IN the summer of 1919 a step was taken by the United States Government which was destined to help place the Aviation Industry in America first among the nations of the world.

Under instructions from Secretary of War Baker, the American Aviation Mission was formed, consisting of: Hon. Benedict Crowell, the Assistant Secretary of War; Howard E. Coffin, Member of the Council of National Defense; Henry C. Mustin, Captain, U. S. Navy; Halsey Dunwoody, Colonel, Air Service, U. S. A.; James G. Blair, Jr., Lieutenant-Colonel, General Staff, U. S. A.; George H. Houston, President, Wright Aeronautical Corp.; C. M. Keys, President, Curtiss Aeroplane & Motor Corp.; S. S. Bradley, General Manager, Manufacturers Aircraft Assn.

The members of this mission went to Europe and conferred with various ministers of the Governments of France, Italy and England, also ranking Army and Navy Commanders, and the foremost aircraft manufacturers.

A thorough study and investigation was made by the Mission of all forms of organization, production and development. As a result of these studies the Mission emphasized the unanimous opinion of its members that immediate action was necessary to safeguard the air interest of the United States to preserve for the Government some benefit of the great aviation expenditures made during the period of the war, and to prevent a vitally necessary industry from disappearing. It was stated that 90 per cent. of the industry created during the war had been liquidated and that unless some definite policy was adopted by the Government it was inevitable that the remaining 10 per cent. would also disappear.

In submitting their report the subject was divided into three important heads: 1. General Organization, 2. Development, Commercial, 3. Development, Technical.

The report is as follows:

I. GENERAL ORGANIZATION

The findings of the American Aviation Mission and its recommendations are submitted after a careful review of the situation in the allied countries mentioned, but always keeping in mind the situation in the United States. Under

AMERICAN AVIATION MISSION

Top, left to right — James A. Blair, Jr., Colonel, General Staff, U. S. A.; Howard E. Coffin, Council of National Defense; Henry C. Mustin, Captain, U. S. N.; Hon. Benedict Crowell, the Assistant Secretary of War; George H. Houston, President, Wright Aeronautical Corp.; C. M. Keys, Vice President, Curtiss Aeroplane and Motor Corp.; S. S. Bradley, General Manager, Manufacturers Aircraft Association.

the above sub-heads the results of these investigations are presented to you. which, in the opinion of the Mission, demand the most earnest and immediate consideration along the broadest lines, with a view to establishing some fixed policy which will save the aircraft situation in the United States and give the United States an equal place with the great powers of Europe in this great new commercial development.

The American Aviation Mission therefore recommends *the concentration of the air activities of the United States, military, naval and civilian, within the direction of a single Government agency created for the purpose, co-equal in importance with the Departments of War, Navy and of Commerce, to be called in this report, for the purposes of identification, the National Air Service.*

In making the above recommendations, the following views and data of the Mission are presented:

Visits were made by the Mission to England, France, Italy and conferences have been held with those largely responsible for the successful prosecution of the war and especially with those men most experienced in the aerial development within those countries. Among others, interviews have been had with:

FRANCE: Maréchal Foch, Commandant-en-Chef des Armées Alliées; André Tardieu, Ministre des Affaires Franco-Américaines; Général M. Duval, Chef de Service de l'Aeronautique; Jacques Dumesnil, Deputé, formerly Sous-Secrétaire de l'Aeronautique; M. Loucheur, Président du Conseil de Guerre, now Minister of Reconstruction; Daniel Vincent, Deputé, formerly Sous-Secrétaire de l'Aviation; Gaston Minier, Deputé, Chef du Comité Aeronautique au Senat; and Major d'Aiguillon, of the Commission Interministerielle de l'Aviation Civile.

ENGLAND: Honorable Winston Churchill, M. P., Secretary of State for War and Secretary of State for Air; Field Marshal Sir Douglas Haig, Commander-in-Chief of the British Army; Admiral Sir David Beatty, R. N., Admiral of the Fleet; Major General Right Hon. J. E. B. Seely, Under Secretary of State for Air; Major General Hugh M. Trenchard, Chief of Air Staff, Royal Air Force; Major General E. L. Ellington, Director General, Supply and Research, Royal Air Force; Major General Sir Frederick H. Sykes, Controller General Civil Aviation, Royal Air Force; Sir W. A. Robinson, Secretary, Air Ministry; and Major General Sir W. S. Brancker, Royal Air Force, now with the Aircraft Manufacturing Co., Ltd.

ITALY: G. Grassi, Chief of the Italian Aviation in Paris; Colonel Guidoni, Italian Foreign Aeronautical Mission; Admiral Orsini, Chief of Italian Naval Aviation; Colonel Crocco, Chief of the Technical Bureau; and Signor Conti, Secretary of State for Aviation.

In all countries visited, and in the minds of all persons met in conference, appears an extraordinary similarity in condition and in conclusions drawn from the experiences of the five difficult years of mistake and achievement in the prosecution of the war. Perhaps no stronger or more simple presentation of the regard in which the future of aviation is held in allied countries can be given than by quotation from two letters of M. Clemenceau, copies of which were obtained in France. The first is addressed to the President of the United States, urging upon him the immediate consideration of matters aeronautical and in connection with the Peace Conference. The second is addressed to the President of the Republic of France, submitting the draft of a decree creating a separate department of Aeronautics placed transitorily under the Ministry of War — an intermediate step possible without legislation and looking to the early creation of an Independent Ministry of the Air:

LETTER FROM M. CLEMENCEAU TO PRESIDENT WILSON.

"February 16th, 1919.

"The President of the Council, and

"The President of the Interallied Peace Conference.

"To the President of the Republic of the United States.

"Interallied Aviation Committee:

"Mr. President:

"I have the honor to acknowledge the receipt of your answer of February 7th, to my letter of January 24th. I enclose herewith, copies of the letters which I have received from Lord Milner and from Monsieur Orlando, as well as my replies.

"I am pleased to note that you agree in principle with my proposition to create an Aviation Committee for after the war. I take the liberty of insisting on the necessity of creating this Committee without delay, in order to be able to utilize it as an advisory organ for the Peace Conference. Indeed, the clauses for aerial protection seem to have at least an importance equal to the clauses for military and naval protection; and it is of the greatest interest to have a study made by competent personalities of the measures to take against the eventual constitution of a German military fleet. I cannot insist too strongly on the imperious necessity of this study, on account of the proximity of Germany to London, Brussels, Paris and Rome.

"Likewise, I adhere entirely to the British proposition which seems to me practical and effective, and I request you likewise to give it attention. In case it seems acceptable to you, I wish you would let me know if you could delegate two representatives to the next meeting of the new Interallied Committee, which will take place on Thursday, March 6th, at ten o'clock, at the Directory of Aeronautics, 260 Boulevard St. Germain.

"Please accept, Mr. President, the assurance of my highest consideration, etc.

(Signed) "CLEMENCEAU."

"REPORT TO
"THE PRESIDENT OF THE FRENCH REPUBLIC.

"Paris, June 6, 1919.

"Mr. President:

"Aircraft has developed considerably during the war. It should at this time adapt itself to a no less important part in peace time. But because of the many initiatives which cooperate in its new use and development, the efforts and means are dispersed in various ministerial departments.

"The future aviation in France will only be assured by the coordination of all efforts and the unification of the general services. Also, it will give the advantage of better work from the personnel and credits which are actually effected to similar objects in different ministries.

"With this object in view, and according to the propositions of an interministerial conference which I am able to assemble, I have the honor to submit for your signature, the following decrees creating an organ of general coordination of aviation.

"This should not be confused with any of the particular aviations of the various ministerial departments. At its origin, it will be attached transitorily to the Ministry of War.

"I am, Sir, yours respectfully,
"GEORGES CLEMENCEAU,
"President of the Council, War Ministry."

Even before the report of this Mission can be given consideration, a step similar to that proposed by France will have been taken by Italy. Here, however, the Department of Aeronautics is being placed under the Ministry of Transportation — a make-shift arrangement frankly acknowledged transitory and immediately possible without the legislation needed to create the clearly foreseen ultimate — the Italian Ministry of Air.

England more than two years ago began the coordination of her aircraft activities — an effort which has resulted in placing her well in the lead in practically every phase of aerial development and which has resulted in bringing her months ago to the establishment of a Ministry of Air, co-equal with her Ministries of War and of the Navy. That the present Ministries both for war and for air are centered in the same individual has no significance other than that of momentary expediency.

The whole trend of events touching the art of aeronautics in its broad relation to world progress, the experience in all Allied countries (including the United States) during the five years past, the frankly discussed future plans under present consideration in foreign quarters and the views everywhere encountered by us, leave your Mission impressed with these inescapable conclusions:

1. That Italy, France and England realize fully the importance of aircraft in the military-naval and civil-commercial aspects and propose to encourage the general development of the art through Governmental aid to commercial industry.

2. That Great Britain has come to consider the dominance of the air as at least of equal importance with that of the seas, and is frankly and avowedly planning a definite policy of aerial development to that end.

3. That any future war will inevitably open with great aerial activity far in advance of contact either upon land or sea, and that victory cannot but incline to that belligerent able to first achieve and later maintain its supremacy in the air.

4. That for economic reasons, no nation can hope in time of peace, to maintain air forces adequate to its defensive need except through the creation of a great reserve in personnel, material and producing industry through the encouragement of civil aeronautics. Commercial aviation and transportation development must be made to carry the financial load.

5. That no sudden creation of aerial equipment to meet a national emergency already at hand is possible. It has been proven within the experience of every nation engaged in the war that two years or more of high pressure effort have been needed to achieve the quantity production of aircraft, aircraft engines, and

accessory equipment. The training of personnel including engineering, production, inspection, maintenance and operating forces — covering some fifty distinct trades and some seventy-five industries, has proved in itself a stupendous task when undertaken upon the basis of the war emergency alone.

6. That the rapid adaptation of aircraft to the commercial uses of peace is everywhere being studied and planned. Under the forced draft of war, this newest and fastest agency of transportation has been brought to a high state of development. It must now be redesigned to meet the progressive demands of a civilization at peace.

7. That because of its great speed and range of operation, oceans, states and even countries are being passed over with a greater facility than are townships and counties traversed by the motor car. The need for international agreements governing the construction, operation and safety of aerial apparatus of all kinds is immediately before us.

8. That for the first time in the world's history, the stage is set for a close international cooperation in the development of a great art at the very threshold of its era of commercial utility. Great Britain, France, Italy and Japan not only invite but urge the United States to share in this work.

9. That just as we now have National, International and Interstate regulations, laws and agreements covering rail and steamship travel and the safety and navigation of the seas, so must we have similar regulations governing aircraft and the uses of aerial navigation throughout the world. The International Committee sitting in Paris, under the Peace Conference, gives the first long step in this direction.

10. That the need in each country for a single authoritative point of contact for the conduct of all International aviation affairs, legal, operational, technical and political, is imperative. Such agencies have already been set up in England, France and Italy. The United States has under the terms of the International Convention no option but to follow these leads.

11. That in England, France and Italy sentiment is undoubtedly in favor of the centralization of aircraft development under one authoritative head. Difference of opinion has been encountered only in the matter of Army and Navy personnel and in the question of the Independent Fighting Force.

England holds the initiative and is building her Royal Air Force co-equal with the Army and Navy. France and Italy follow England's lead but seem inclined to leave questions of operating personnel for the present to War and Navy Departments and to debate the need of an Independent Fighting Air Service. In all cases, forces operating in conjunction with Military and Naval units, function under the Military or Naval High Commands.

12. That among the many considerations of early moment requiring governmental direction may be mentioned the following:

(a) Federal and International laws governing the use of air routes.

(b) Federal and International control of pilots' licenses; examination and tests required.

(c) Federal inspection of all commercial aircraft for airworthiness, or suitability for service.

(d Customs and other regulations for crossing State and National boundaries.

(e) International standards for methods of communication and signaling.

(f) International standards covering the marking or charting of air routes and of landing places for both day and night use.

(g) International specifications and rules governing the construction, equipment and operation of standard airdomes, landing stations, signal towers and other aids to aerial navigation.

(h) Port regulations and fees covering seaplanes.

(i) Federal taxation of aircraft and license for its use.

(j) Safety measures and devices; legislation forcing adoption.

(k) Fire underwriter standards, regulations and safeguards; insurance of machines, of material and of persons in transit (property and life).

(l) The legal status of privately owned aircraft; the property rights of the air; liability for damage inflicted and incurred.

(m) International standards and specifications covering accepted practice in quality of materials, in factors of safety, and in methods of construction; an engineering literature of this new art must be created by International approval.

(n) Maps and navigation charts of the United States and its territories.

13. That we of today are conceivably no more qualified to judge as to the scale and development of the aircraft of ten years hence than were we of even five years ago able to foretell the achievements of today. We must bear in mind always that for every one mind focussed upon things aeronautical in this earlier period, some thousands of keen minds are now versed in the aircraft art. With proper Governmental encouragement, rapid progress seems inevitable.

14. That the broadest consideration for the ultimate welfare of American aviation must be given in the constitution of any organization set up for the coordination and control of aeronautics within the United States. The prerogatives and ambitions of Governmental departments and of individuals must be assayed at true value.

15. That past experience and every economic consideration point to the vital need for the formulation by the United States, of a definite, comprehensive and continuing policy for the development of every phase of the aircraft art. Our Government is now faced with the task of nursing and actively encouraging a new transportation industry, whose healthy growth is vital to the future progress and defense of the nation.

Because of the lack of a definite, intelligent and sympathetic policy in our Governmental aircraft organization since the armistice, our American aeronautical industry, built up at such great expense of money and of effort, is rapidly disappearing. No sensible business man is justified in keeping money invested in the aircraft industry under the conditions which have maintained in the United States since November 11th.

16. That the closest possible relations must continually exist between the aircraft agency of the Government and the production and commercial industry engaged in aircraft development.

17. That the industries involved in the production and commercial use of aircraft must be given recognition and representation in connection with all national and international activities bearing upon the direction and control of aeronautics.

In the foregoing brief presentation of its conclusions, your Mission has touched upon the aeronautical policies already in effect or under present discussion in

England, France and Italy. Great Britain's plan of organization certainly warrants our most careful consideration. Its salient points are clearly set forth in the chart herewith attached. It is not argued that the British method is perfect, but it can be stated without fear of contradiction in any quarter, that it stands today the most comprehensive governmental mechanism yet set up by any nation in the world for the encouragement, upbuilding, direction and control of its air resources. This organization has been born of five bitter years of trial, mistake, experience and progress. It is the product of the best brains in the British Empire focussed under the spur of national need and the demand of the British people. We in America may well study it carefully.

Your Mission, in presenting its recommendations, desires to emphasize the view everywhere encountered that the future of aerial navigation and of aerial development generally, is in only a limited sense a function of military and naval establishments. The air is a medium for commerce and communication and its direction to the peaceful uses of civilization must be unhampered by the necessarily restrictive views of these specialized departments.

RECOMMENDATIONS

A. The concentration of the Air activities of the United States, Civilian, Naval and Military, within the direction of a single Governmental agency, created for the purpose co-equal in importance and in representation with the Departments of the War, Navy and of Commerce.

B. That the agency thus created be charged with full responsibility for placing and maintaining our country in the front rank among nations, in the development and utilization of aircraft for the national security, and in the advancement of the civil aerial transportation and communication arts.

C. That this governmental organization be formed in general as follows:

1st. A civilian Secretary for Air.

2nd. An assistant secretary, a civilian, responsible directly to the Secretary for Air, for the management and operation of the Department.

3rd. Five or more Divisional heads acting as chief of the sub-departments of (a) Civil Aeronautics, (b) Military Aeronautics, (c) Naval Aeronautics, (d) Supply and Research, (e) Finance, etc.

4th. An Air Council, advisory in character, which shall be constituted by the Secretary of Air, including the Assistant Secretary of Air, the chiefs of the several sub-departments, and such other personnel as may be deemed advisable.

We desire especially to invite attention to the complexity and newness of the whole development of the aviation art, and to urge the broadest possible treatment of the subject during this formative period. We suggest that the lesser details of organization may well be left to the judgment and initiative of those called to assume the responsibility of directing this work. We desire also, in this connection, to call attention to the aircraft interests of the Allied Governments, and to emphasize the necessity for careful discrimination in the selection of men of industrial experience and broad vision.

D. The establishment of Governmental institutions of education and training, including an air college, all open alike under proper restriction, to military, civilian and naval personnel.

E. Such curricula and such arrangement of promotion in the National Air Service, and such assignment and pay as to insure to the young man an attractive career whether he elect to remain permanently in the "National Air Service" or return to Army or Navy, or to civil life.

F. The adoption of a system whereby Army, Navy and civil personnel can be circulated in proper proportion through the National Air Service. This personnel would, unless permanently assigned to Air work, be automatically returned to the Military and Naval sources, or to civil life as an Air Service reserve after the educational and service periods in the National Air Service have expired.

It is felt that such a circulating system is vital to the coordination and ultimate efficiency of the three services, and to the desired dissemination of a knowledge of and interest in the air among our people. The young officers of to-day will command the military and naval forces of to-morrow, and will carry with them into the highest ranks an intimate knowledge of aircraft, and of the strategy of its varied uses, in connection with operations on land or sea. The direction of civilian and commercial activities of all kinds will be made possible, and the closest contact and cooperation between the Government and the aeronautical industries assured.

All international relations touching aerial matters fall naturally within the jurisdiction of the Secretary for Air.

All responsibility for the supply of aircraft material and equipment of all kinds, and for the training of personnel for all branches of the service, is, in accordance with these recommendations of your Mission, placed with the Secretary for Air. As some twenty-seven thousand items are involved in the equipment and maintenance of each Air Squadron on active duty, the need for a single responsible direction seems undebatable.

Upon the plan of organization here recommended, all squadrons and all equipment assigned by the National Air Service to meet the stated requirements of the Military and Naval establishments, pass automatically under Army and Navy command. Under National Air Service operational direction, remain only those independent projects unrelated to the activities of the Military and Naval fighting fronts and such personnel and equipment as forms a surplus to the needs of the sea and land fighting arms.

The question of governmental organization for the development and utilization of our country's air resources has been given consideration by your Mission, seemingly from every angle. The recommendations made are general. No report could be made effective, if burdened with the mass of details involved in the setting up of any governmental mechanism such as proposed.

There has been and will continue to be advanced many objections to the establishment of a Department of the Air. We believe none of them prove insurmountable. We believe the advantage gained to be such as to entirely overshadow any temporary difficulties.

Always in the past, in war by land or by sea, and in the transportation activities of peace, we have thought in two dimensions only. We must now readjust our minds to think for all future time in three.

When this Mission left the United States in May, its members thought the Atlantic Ocean might be crossed before January 1, 1920. Within three months of our absence, four successful crossings have been made and without the loss of a single life.

There must be no over-optimism. There are years of development and experimentation ahead. As in the case of all the other great agencies of civilization, the commercial and financially profitable use will come slowly. But here the immediate welfare and safety of our nation is involved and an intelligent and efficient direction of our aeronautical affairs will be demanded by the American people. American genius has given to the world the airplane, a new instrument of commerce and of war. But America has left its development to other nations, and too late, realized the mistake of this neglect. She has paid the price! America now again has the opportunity, if not to lead, at least to take her place in the front rank and to gain to herself the full benefit which will surely accrue from an active and sincere cooperation in the engineering activities, and in the scientific and commercial aircraft developments of those nations associated with us in the war.

But this will be impossible, in the future as in the past, if our aircraft activities remain dispersed among the several governmental departments and impossible of coordination for decisive action.

Upon the breadth of view and the vision of those in control of America's policies, depends our future as an air power.

II. COMMERCIAL DEVELOPMENT

With reference to the commercial development of aviation your Mission makes its recommendation based upon the following conclusions which have been formed, first, through knowledge of conditions existing at present in America, and second, the knowledge gained by its investigations abroad.

The investigations in England included visits to a number of factories, airdromes and other points of particular interest, and interviews with the following gentlemen:

ENGLAND: Major General Hugh M. Trenchard, K. C. B., D. S. C., Chief of staff, Air Ministry; Major General Sir Frederick H. Sykes, K. C. B., C. M. G., Controller General, Civil Aviation; Major General E. L. Ellington, C. B., C. M. G., C. B. E., Director General Supply and Research; General Huggins; Douglas Vickers, Vickers Co. Ltd.; Capt. P. D. Ackland, Vickers Co., Ltd.; Sir Percy Gerouard, Armstrong, Whitworth & Co.; Sir Samuel Waring, of Waring & Gillow, who is also interested in five other aeronautical companies in England; Holt Thomas, Aircraft Manufacturing Company; General Sir W. S. Brancker, K. C. B., D. F. C., Aircraft Manufacturing Co.; White Smith, British and Colonial Airplane Co.; J. A. Taylor, Cosmos Engineering Co.; Fadden, Cosmos Engineering Co.; Handley-Page, Handley-Page Co., Ltd.; Graham White, Graham White Co.; C. V. Allen, Secretary of the Society of British Aircraft Constructions; and Leslie P. Langton, Black and Manson Insurance Underwriters, who have specialized in aircraft insurance.

Members of the Mission also visited the airship factory of Armstrong, Whitworth & Co., located at Selby, and the dirigible airdrome of the British Navy located at Pulham, where they examined the R 33, which is a replica of the R 34, and several smaller airships.

The Mission's investigation in France included visits to a number of French factories and flying fields, and interviews with the following gentlemen:

FRANCE: Général M. Duval, Directeur du Service Aeronautique; Senateur Gaston Minier, Chef du Comité Aeronautique au Senat; Pierre Etienne Flandin, Deputé, formerly Chef de l'Organe Interallié de l'Aeronautique; Commandant d'Aiguillon of the Commission Interministrielle de l'Aviation Civile; Commandant de St. Quentin, Chef du Service de Fabrication de l'Aviation; Louis Breguet, of the Breguet Company and Compagnie des Messageries Aeriennes; Bleriot, of the Bleriot Company; Maurice Leblanc, Bleriot Spad Company; Kaherer, Société Astru; Bazaine, Société Nieuport; Maurice Farman, of the M. and H. Farman Company; Granet, Secrétaire du Chambre Syndicale de l'Industrie Aeronautique; Esnault-Pelleterie, Président du Chambre Syndicale de l'Industrie Aeronautique; Lieut. Réné Fonck, premier French ace; Maurice de St. Blanchard, Secretary of the Aero Club de France; and Comte de Libersee, former pilot and at present much interested in the development of civil aeronautics in France.

Among the factories visited were: Morane-Saulnier, Breguet, Bleriot, Farman, Hispano-Suiza and Renault, all of which are engaged in the manufacture of airplanes and motors.

The investigation in Italy included interviews by representatives of the Mission with the following gentlemen:

ITALY: G. Grassi, Deputy, ex-Chief of the Italian Aeronautical Mission in France; Colonel Guidoni, Italian Foreign Aeronautical Mission; Admiral Orsini, Commander of Italian Aviation; Captain Bursaglia, Chief of Staff to the Minister of Marine; Peroni, Director of the Ansaldo Co.; Casatti, of the Caproni Co.; and Buzio, of the Macchi Co.

Representatives of the Mission also visited the following factories in Italy, all of which are engaged in the manufacture of airplanes, balloons and motors: Pomilio Co., Ansaldo Co., at Torino; Caproni Co., at Milan; Isotta Franchini, which was shut down due to a strike.

1. One of the most important problems to be considered in the rehabilitation of the world's commerce, following the close of the war, is the development of aerial transportation for commercial purposes. Its one invaluable service, and that in which it surpasses all other means of transportation, is speed, that time-saving element which the world has always striven for, and for which America, with its great distances, has such serious need. Reliability, safety, economy, and those other qualities of transportation service which are of value, will steadily improve as the use of aircraft increases and experience accumulates.

2. It is as impossible to forecast the future of this new medium of transportation as it would have been to describe the speed, comfort and safety of the modern steamship at the time the first steamship crossed the Atlantic. It is safe to say, however, that in time it will become one of the great transportation mediums of the world and will continue to offer the fastest and most direct means of transportation for persons, mail, and light freight, known to civilization. Its development is limited only by the perfection of the mechanical devices used, with which we are constantly becoming more familiar, and by the extent of our knowledge of the atmosphere which is becoming more thoroughly understood each year.

3. It is equally difficult to determine the speed with which this development will take place. In fact, this will be determined largely by the opportunities afforded to employ the brains of the engineer and the scientist on the problems involved, which in turn will be controlled by the financial resources available for such work. It is thought by some well informed authorities that the next five or ten years will see this new industry through its initial stages, and established on a self-supporting basis, providing it is encouraged at this time. Adequate support cannot be expected from private enterprise alone, and if no outside aid is given, ten years will probably see this industry in America still struggling for a foothold, and far behind its European competitors who will receive substantial aid of many kinds.

4. History has shown repeatedly that no nation can afford to neglect the highest possible development of its transportation mediums regardless of the opportunities existing for immediate profit to the private enterprise concerned. This is particularly true of aerial transportation, which is not local in its nature, but which is essentially of a national and international character, due to the great distances covered, and to the speed with which it links together far distant points. This principle has been so clearly understood that an International agreement has been established between the Allies and their associates, by which international flight of aircraft has been provided for in a far-sighted manner, thus making immediately possible the flight of private craft from one country to another on a basis as clearly defined by law as that governing the movement of steamships, except, of course, that the practice of ages of ship travel is missing in the case of aircraft.

5. The development of aviation is progressing so rapidly at this time that it is difficult even for those in close touch with it to keep up with its progress. During the past two months the Atlantic has been crossed four times by aircraft: first, by a seaplane of the American Navy, second, by an airplane of Great Britain, and finally, by an airship of Great Britain which has twice demonstrated its ability to fly between England and America. All of this has been accomplished without the loss of a single life. Airships are now building in England which will be able to carry from five to ten tons of mail, in addition to the necessary fuel and crew, and cross the Atlantic from London to New York, in one-half the time made by the fastest steamships. Who can say such transportation facilities will not greatly serve civilization, and be of immeasurable value to our own country if properly developed and used.

6. Already lines of aerial transportation are being used in England and France in a small way for commercial purposes, but the distances in these countries are so short that relatively little advantage can be gained, so such ventures will develop slowly. A daily service from London to Paris has been in operation for some time, and promises to be quite serviceable as soon as it can be relieved of its war time military supervision. Other lines now in operation are from Paris to Lille and Brussels and from Paris to various points in Alsace Lorraine and German occupied territory. Among other plans English private interests are projecting airplane lines from Cairo to the Cape and Cairo to Bombay, and French interests are planning to run a line to Algeria and Morocco. These lines will carry mail, passengers, and express, and it is expected that they will materially shorten the time between European centers and their far distant

terminals. The United States Post Office Department has carried mail by airplane from New York to Washington for over a year with a record of nearly one hundred per cent. delivery at each end every day. It is now inaugurating a line from New York to Chicago which will shorten the mail time between these two points to about one-half. It is also projecting a two-day service from New York to San Francisco. England is already desirous of organizing with the United States a trans-Atlantic airship line for mail service which would give a five-day mail service from London to San Francisco. Such a service is entirely possible at this time, and its inauguration depends only upon adequate encouragement and financial support.

7. The risks involved in these ventures, due to unknown conditions of the atmosphere, imperfections of equipment, etc., are still so great as to make them impracticable from the point of view of private enterprise, undertaken for a profit. If left entirely to such private enterprise, aerial transportation will develop slowly and with many losses and backward steps, as did the steamship, the railroad, and the automobile, each of which, however, has ultimately become a vital factor in our civilization.

8. One of the striking features of our investigation in Europe was the unanimous belief that the use of aircraft in warfare and for national defense would continue to increase and that in the next war, whenever it might come, aircraft would be a far more vital factor even than it has been in this war. One of the greatest military authorities in Europe stated that in his opinion the first battle of the next great war would be in the air, and would very nearly decide which side would win, in that the side winning in the air would immediately have access to all of its enemy's sources of supply and production, and would quickly cripple them by air raids upon an enormous scale. The opinion was everywhere expressed that the development of aircraft for purposes of national defense must continue and that sufficient flying and production facilities and personnel must be maintained at all times to insure an adequate supply in case of need. Due to the complicated and delicate nature of such equipment, to its rapid depreciation in use, and to its constant obsolescence, the expense involved in such a program would be very great, in fact almost prohibitive in peace times.

9. The existence of an aerial transportation industry with a great commercial air fleet and of a strong production industry would greatly decrease the need for strictly military equipment and resources in that practically all of the aircraft and landing field facilities and personnel, and the manufacturing and maintenance facilities and personnel employed by such commercial activities, would be available as a reserve in time of war. It is evident, therefore, that the most economical way to develop a strong air service for national defense is to encourage by every means possible the use of aircraft for commercial purposes, and thereby build up a commercial fleet at relatively small expense to the government, which would effectively supplement its strictly military equipment, in time of need. America's experience during the war has proven conclusively that aircraft facilities and personnel, and particularly production facilities and technical personnel, cannot be obtained upon short notice, but only by long and continued experience and at great expense.

10. America's production industry reached large proportions during the war,

but since the signing of the armistice it has shrunken to a very small volume. Unless immediate attention is given to its conservation, it will practically disappear, and a considerable portion of the great sums expended in its development will have been spent fruitlessly. This industry does not require a large valume of business to keep it alive and healthy, but it does require a steady and dependable demand, otherwise private capital and enterprise will not long remain interested.

RECOMMENDATIONS

Upon the basis of these conclusions, we offer the following plan for stimulating the development of commercial aviation as an aid to national defense, and as a response to the demand that is already developing for improved commercial transportation through the use of aircraft.

A. The Civil Aviation Division of the National Air Service should establish with the advice of the Army and Navy, and the Division of Military and Naval Aeronautics, a series of flying routes throughout the United States and its possessions and to contiguous foreign countries, which will be of military and commercial value. It should also prepare and publish maps and descriptions of each of these routes, suitable for the use of fliers.

B. There should be provided at national expense certain flying fields in strategic locations, and suitable for military purposes, and encouragement should be given to the various States and Municipalities to provide flying fields upon all flying routes, at points found desirable, thus eliminating the necessity for private ownership of flying fields except for strictly private use. Hangars should be provided at each flying field by the governmental authority owning the field (that is, Federal, State or Municipal), or where such fields are used constantly by private interests, they should be permitted to provide their own hangars immediately adjacent to and opening upon such flying fields.

The operation and use of such flying fields should be controlled by federal law, so as to obtain uniformity throughout the nation and conformity with international regulations.

C. All flying routes and flying fields should be equipped at national expense with signalling and communication systems, including wireless telegraphy, wireless telephony, and searchlights, to thoroughly safeguard and guide aircraft in flight. The Government's attitude in this matter should be the same as that maintained toward shipping in its lighthouse and coast patrol service. The operation of signalling and communication equipment should be controlled by federal law for the reasons indicated under item "B."

D. A meteorological service should be developed to provide fliers and other aviation interests with accurate weather reports and other atmospheric data necessary to govern their activities intelligently. The value of this service to commercial aviation cannot be overestimated as it will go far toward establishing reliability and safety of service, just as weather reports are of immeasurable value to ocean and lake transportation.

E. Training facilities should be provided at various localities throughout the country, either at Government expense, or by private enterprise under Government regulation with guarantees from the Government of a sufficient number of students to cover expenses. Such guarantees could be given by the Government without undue expense if it used such schools for the preliminary training of its military personnel. Such a plan would encourage private enterprise to provide facilities for the training of the personnel needed for commercial requirements, which personnel in turn should become a permanent reserve for military requirements in time of need. There should be established at least one school for the teaching of aerodynamics and other branches of the science of aeronautics as recommended under the heading "Organization." Encouragement should be offered to universities throughout the country to establish departments of aeronautical science.

F. The Government should encourage the development of new design and aeronautical technique for commercial purposes along the lines recommended under the heading "Technical Development."

G. The Department of Aeronautics should maintain the closest possible relations with all civilized nations in determining and applying the rules and regulations which will govern the international use of aircraft, and there should be developed as rapidly as is consistent with proper consideration, a body of Federal law governing the use and airworthiness of aircraft for commercial purposes, which will safe-guard life and property, and promote the commercial usage of aerial transportation. In order that commercial aviation may be helped and not hindered by such legal restrictions, it is of vital importance that aerial transportation be recognized at once as an element of interstate commerce and be made subject to one body of *Federal* law applying uniformly throughout all of the United States. It will thereby avoid the complications of individual state control which have proven to be such a handicap to railroad and automobile operation.

H. Insurance of aircraft and its personnel against all kinds of hazards and risks involved should be encouraged in every way. The cost of such insurance should be kept as low as is consistent with the risks involved.

I. Encouragement should be given to the organization of private enterprises for carrying on aerial transportation. This encouragement might well be in the form of payment for the carrying of mail and expressage, and of guarantees as to the volume of such business. Compensation might be paid to such enterprises for keeping their facilities available for use in time of war. Guarantees of this kind coupled with opportunity to insure against loss by accident should make privately operated transportation lines a commercial possibility, but if it is found that private enterprise does not respond to such encouragement, then the Government should undertake certain transportation ventures on its own account and should continue to operate such lines until they are proven commercially successful. Ultimately they should be sold to private enterprises on such terms as would permit of successful operation, as it is not believed that commercial aviation will ever be successfully developed entirely under Government control.

J. The remaining aircraft production industry should be conserved and kept in a healthy condition by a well defined and continuing program of production for military purposes, over a period of years. This policy should be continued until the commercial demand is adequate to support an industry of sufficient proportions to form an effective nucleus upon which can be built a war-time production in case of need.

III. TECHNICAL DEVELOPMENT

With reference to technical development, your Mission in submitting its recommendations bases the following conclusions on a knowledge of conditions existing in the United States and upon extensive investigations conducted abroad:

(1) (a) The Mission visited plants making or experimenting in materials as follows:

FRANCE: Breguet, Farman, S. P. A. D., Bleriot, Hispana-Suiza, Morane-Saulnier, Renault, and Nieuport.

ITALY: Ansaldo, Macchi, Caproni, Pomilio, Isotta (plant closed by strike), and F. I. A. T.

ENGLAND: Handley-Page, B. A. T., Rolls Royce, Phonenix Dynamo, Bristol, Vickers-Vimy, Cosmos, Sopwith, Grahame-White, A. B. C., and Armstrong-Whitworth.

(b) The Mission has visited laboratory and experimental shops as follows: Institute Sperimentale Aeronautico, Rome; Eiffel Laboratories, Paris; R. A. Factory, Farnborough, England; Isle of Grain Naval Experimental Station, England; Pullman Dirigible Station, England; Aeroplane Station, Contocelli, Italy, and Dirigible Station, Craspiano, Italy.

(c) The Mission has interviewed the following governmental official and industrial officers upon the subject of the proper organization, scope and equipment of the Technical Division:

ENGLAND: General E. L. Ellington, Head of Department of Design, London, Royal Air Force; Sir Percy Herouard, Managing Director, Armstrong-Whitworth Co., 8 George St., Westminster, London; General Graves, R. A. F. Representative with British Peace Commission, Paris; General Brooke-Popham, Director of Research, London; Holt Thomas, London; Douglass Vickers, Vickers Ltd., London; Grahame-White, Grahame-White Aircraft Co., London; and Sir Samuel Waring, London.

FRANCE: Major d'Aiguillon, Interministerielle de l'Aviation Civile, Paris; Louis Breguet, Manufacturer, Breguet et Cie, Cie des Messageries Aeriennes, Paris; Caequot, Former Chief Technical Section, Department Military Aeronautics, Paris; Colonel Dorand, Department Military Aeronautics, Paris; General Duval, Director Military Aeronautics, Paris; Jacques Louis Dumesnil, Deputy, Former Under-Secretary French Aeronautics; Captain de l'Estrade, Technical Service, French Military Aeronautics; Pierre Etienne Flandin, Deputy, Former Chief Inter-Allied Organization of French Aeronautics, Paris; Messaguer, Head of Hispana-Suiza Co., Paris; Maurice de Saint Blanchard, Secy., Aero Club de France, and Daniel Vincent, Deputy Director, Former Under-Secretary of Aviation, Paris.

ITALY: Commander Caldara, Head of Aviation, Technical Section, Rome; Casati, Designer, Caproni Co., Milan; Lieutenant-Colonel Ferduzio, Designer of S. V. A., Rome Aeronautics, Rome; Colonel Crocco, Director of Institute Sperimentale; Colonel Guidoni, Italian Aeronautical Mission; and Admiral Orsini, Minister of Italian Aviation, Rome.

2. The form of technical organization and control recommended by your Mission differs materially from the controlling organizations in Italy, France or England. Inasmuch as, for some time at least, military, naval and departmental flying seems likely to lead in the development of the art, your Mission desires to lay

emphasis upon the necessity of having these departments strongly represented in the operations of the Technical Division so that they shall be materially helped and not hindered in their research, experiment and development. To the same end, we are of the opinion that lighter-than-air, which in England at the present time is independent, can be best served by making it a strong sub-division of the Technical Division. In both England and France, due to the closeness of the war, the Technical Division is at present dominated by military personnel, but the opinion is unanimous that, as time goes on, civil personnel will supersede military in this division. General Ellington, England, expressed this opinion flatly and General Brooke-Popham, Director of Research, England, holds the same belief. In the Royal Aircraft Factory, at Farnborough, civilian requirements are already overtaking military and naval. It has therefore been deemed wise to take the ultimate step at the outset in America, and a civilian head, of the type now earnestly sought in France and England, is recommended for America.

3. In equipment and personnel, England and France and Italy are maintaining their war strength in the Technical Division. At Farnborough, we found a complete experimental plant, employing about 3,000 men and women, and carrying on actively nearly every line of research, experiment and development in motors, planes and accessories. More than a score of planes, rigged with apparatus for aerodynamic experiment, were in the hangars and in the field. Physical and chemical laboratories seemed busy and fully-manned. Estimating the lighter-than-air and the naval experimental and research personnel, it seems probable that the plant and the personnel engaged in the division in England is nearly, if not quite, equal to the entire trade in America at the present time. Obviously, this branch of aeronautics lies at the very foundation of the future, both military and civil, and to fail to bring it up to the standard of the world cannot help but mean dependence and mediocrity, or worse, in aeronautics in America.

4. The inclusion of such topics as armament (Ordnance), wireless (Signal Corps), instruments (Admiralty), photography (Signal Corps), design and bombs (Ordnance), etc., has been found necessary in all countries. In reality, the design and supply of such appurtenances is left to the departments or bureaus specializing in them, but research and experiment and development, in methods of installation and use is essentially a function of the Air Service Technical Division, and must be carried on by this Division, both in the laboratory, on the factory floor, and especially in the air, in the tank and on the field.

5. In all the European countries visited, we found that access to and use of the Government owned facilities for development is established. The basis of such use varies, and can be adapted to the circumstances. In all countries, however, the principle is the same, namely, that private interests must obtain access to Government facilities, through the officers of the Division, so that new inventions, etc., shall pass the scrutiny and criticism of the Division heads before going into actual experimentation. In England, an attempt has been made to furnish facilities at cost, but to save overhead, a schedule of flat prices is being worked out.

6. In England and France, the question whether or not to design complete motors and machines no longer exists. France was forced to design airplanes in 1916, due to the failure of her private firms to meet the crisis created by the

Fokker; but the immediate result appears to have been a quick return to the safer measures for encouraging the private designers to design and build, under the direction and assistance of the State. In England, the complete design of airplanes ceased with the S. E. 5; and both government officials and industrial officers offered ample testimony that the making of complete designs was a mistake and would not be repeated, due to its effect upon the private design departments. Without exception the manufacturers appear to take the view that it would be idle to compete by private efforts, if one division of the Government was designing and another division buying, as the Government would inevitably favor its own designers, even though not quite so good. The result of such a policy, therefore, would be to limit the number of sources from which useful designs can be obtained, and also to lower the standard of personnel in the design departments of private firms.

7. In 1918, Sir Arthur Duckham, then Director of Aircraft Supply for England, said:

"As we all know, changes in design, unless they are actually for new types, may be absolutely against production; most of our delays in production in this country and in the countries other than ours, have been due to the effort to obtain too great perfection at too early a time."

Having this in mind, and having in mind also the disastrous effects upon production of similar causes in the United States, your Mission asked explicit questions concerning the plan used by the Technical Division in England to minimize the result of such changes. The method is outlined as follows:

"All changes made necessary by the fact that a machine or motor is dangerous to the flier or to the public are classed as Number I. These are imperative, and are ordered by the Director of Design, without delay. No machine is allowed to be accepted or flown without such changes having been made.

"Important changes involving improvement in performance, etc., are classed as Number II. Such changes are made by order of the Modification Board described below, and became effective only at such time as not to interfere unduly with production.

"Improvements and additions, not vital but often valuable, are classed as Number III. They are made when convenient, both to Government and to Contractor, and are not allowed to interfere with production or greatly increase price."

A Modification Board shall pass on changes and classify them. This board consists of five members, one from the Technical Division, one from Production, one from Operations, one from Finance and one from Supply. In the case of Number I changes, the Director merely reports that such and such changes have been ordered. All other changes are ordered by the Modification Board at regular meetings.

Your Mission is of the opinion that the establishment of some such uniform practice, covering not only such changes but also the method of paying for them, is essential to production; and should be a responsibility of the Technical Division.

RECOMMENDATIONS

(a) That all technical functions of the Government in respect to aeronautics be centralized in a single Technical Division which shall perform the work for the Army, Navy and Civil aviation; and which shall be headed by preferably a civilian of wide executive experience. Such a division should include as Assistants to the Director, experienced representatives of Army, Navy and other government departments interested in aviation, who shall be nominated by the departments and shall act as advisors upon the special needs of the Service they represent.

(b) That steps be taken forthwith to secure for the United States, the most advanced equipment for research, experimental and development work and for the testing of motors, planes, balloons, etc., for the testing of materials: for the examination and testing of aeronautical appliances, including armament and instruments; and that such an organization shall be established as shall assure at all times that the research, experimental and development activities of the Government shall be second to none.

(c) That the research, experimental and development facilities and equipment now used in aviation by the Army, Navy and other Government departments be inventoried immediately and put, as far as practicable, under the control of the Technical Division, retaining such of same as may seem suitable and bringing them under a central control to make a complete and efficient equipment, and discarding such of them as unneceassarily duplicate others or are out of date. In making this change, great care should be exercised to guard against measures which might tend to interfere with suggestions for improvements and advances in aviation, material and methods, coming from the operating aviation branches of the Army, Navy and Postal Departments. Experience has proved that the initiative in the advance of motors, planes and accessories often comes from practical experience in the flying field, rather than from the scientific department of aeronautics. The Technical Division will, in cooperation with the operating forces, study, work out and apply all such suggestions. Care should be taken also to avoid duplicating facilities already in existence, such as water tanks, armament testing grounds and many other items operated by existing departments. Arrangements should be made whereby the existing plants of this sort can be used, on a proper payment basis, by the Technical Division.

(d) That extreme care be taken in such a process of adjustment to provide ample means whereby the special technical needs of the (a) Army, (b) Navy and (c) civilian flying shall receive attention. Means should also be provided whereby military and naval experiments of a secret nature can be carried forward.

(e) That the organization of the Technical Division cover by means of adequate personnel and equipment, all branches of aeronautical research, experiment and development, including the application and aerial use of instruments, armaments and munitions, wireless telephone and telegraph, bombs and fittings, sights, fire fighting apparatus, parachutes, air bags and other safety devices, motor appliances for air service, propellers and photography.

(f) That all the technical facilities of the Technical Division for aviation, whether now existent or to be created, shall be available to private inventors and designers, upon proper and reasonable terms.

(g) That in view of the experience of England and France, it is dangerous to allow the Technical Division to operate under normal or war conditions a department of complete design in heavier-than-air machines or in motors, as such competition results immediately in stopping private departments of design. The Technical Division, therefore, should be a critic of, and supplementary to, private

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(d) That extreme care be taken in such a process of adjustment to provide ample means whereby the special technical needs of the (a) Army, (b) Navy and (c) civilian flying shall receive attention. Means should also be provided whereby military and naval experiments of a secret nature can be carried forward.

(e) That the organization of the Technical Division cover by means of adequate personnel and equipment, all branches of aeronautical research, experiment and development, including the application and aerial use of instruments, armaments and munitions, wireless telephone and telegraph, bombs and fittings, sights, fire fighting apparatus, parachutes, air bags and other safety devices, motor appliances for air service, propellers and photography.

(f) That all the technical facilities of the Technical Division for aviation, whether now existent or to be created, shall be available to private inventors and designers, upon proper and reasonable terms.

(g) That in view of the experience of England and France, it is dangerous to allow the Technical Division to operate under normal or war conditions a department of complete design in heavier-than-air machines or in motors, as such competition results immediately in stopping private departments of design. The Technical Division, therefore, should be a critic of, and supplementary to, private design, rather than aim at design on its own account. The policy of the Technical Division should be to maintain and encourage a considerable number of well-manned and well-equipped private design plants and to cooperate with these plants in all undertakings that meet with the approval of the Technical Division, and to place orders with these plants, at fair prices, for design and for experimental construction of motors, planes and appliances. Competition of the government with the industry should be avoided; the only allowable exception being cases where, either on account of expense or for other cause, the Technical Division cannot obtain needed material or design from existing sources.

(h) That careful thought shall be given to the establishment of competition in motor, plane, balloons and accessory design, and encouragement be offered in every reasonable way to the promotion of competitive events and the establishment of standard records.

(i) That the Technical Division shall publish regularly and under competent management all the technical facts and data developed by the Division that may be helpful to the industry, reserving at the same time to itself the right to preserve secrecy in all matters that are deemed to be in the nature of Naval or Military secrets.

(j) That such a Technical Division shall maintain at all times, as close touch as possible with the development abroad and shall maintain representatives in Europe charged with the duty of liaison between the American and European technical organizations.

(k) That a definite method of payment for independent design, experimental production, changes in design, alterations and adjustments be worked out by the Government as quickly as possible, to the end that the design and improvement of motors, planes, balloons and appliances may be stimulated and not stifled.

(l) That the Technical Division shall include an Inspection and Testing Department, which shall carry on all inspections and tests of experimental construction and revision, and which shall issue certificates of air-worthiness for all machines for private and commercial use, and shall, from time to time, inspect all machines and appliances, including landing fields, signals, etc., used by public. In cooperation with the Civilian Division, this department shall have power to limit and control all types of air machines used in commerce, and to test such machines before they become production models. This department should have power to examine the inspection methods of all private concerns building aircraft, and to pass upon the quality of such methods from time to time.

(m) That close cooperation be maintained at all times with the purely technical aeronautical bodies, and also with the industrial bodies engaged in aeronautics, so that standardization of materials and practices may be carried forward as rapidly as can be done without hindering the development of the art or entailing undue losses upon the trade.

Respectfully submitted,
(Signed) BENEDICT CROWELL,
The Assistant Secretary of War.
(Signed) HOWARD E. COFFIN,
Member of Council of National Defense.
(Signed) HENRY C. MUSTIN,[1]
Captain, U. S. Navy.

[1] NOTE: Subject to Memoranda 1 and 2, July 19, 1919.

(Signed) HALSEY DUNWOODY,
Colonel, Air Service, U. S. A.
Assistant Chief, Air Service, A. E. F.
(Signed JAMES A. BLAIR, JR.,
Lieutenant-Colonel, General Staff, U. S. A.
(Signed) GEORGE H. HOUSTON,
President, Wright-Martin Aeroplane Corp.
(Signed) C. M. KEYS,
Vice-President, Curtiss Aeroplane & Motor Corp.
(Signed) S. S. BRADLEY,
General Manager, Manufacturers' Aircraft Assn.

MEMORANDUM NO. 1.

Subject. Report of the Organization Committee, American Aviation Mission.

1. I concur with the report of the Organization Committee of the American Aviation Mission, to which I have affixed my signature, with the following reservations:

(a) Provided that the personnel employed in Naval Aviation operations shall be composed exclusively of officers and enlisted men of the Navy, Marine Corps, Naval Aviation Reserve, and where required for shore establishments, of civilians under the employ of the Navy.

(b) Provided that all advanced training of Naval Aviation personnel excepting advanced aviation engineering courses, shall be under the direct control and supervision of the Navy.

(c) Provided that when officers and enlisted men of the Navy, Marine Corps or Naval Aviation Reserve are detailed for duty with the proposed Air Department, they shall retain their naval or Marine Corps rank and ratings.

(d) Provided that administration and operation of all Naval Aviation forces shall be under the direct control of the Navy.

(e) It is recommended that the question of including in the proposed Air Department an offensive Air Force independent of the Army and Navy be left open, pending further investigation of this subject: and that the subject be investigated without delay by the Mission in conference with Army and Navy representatives, who have made a special study of military naval strategy.

(Signed) HENRY C. MUSTIN,
Captain, U. S. N.

MEMORANDUM NO. 2.

Subject: Report of the Development Committee, American Aviation Mission.

1. I concur with the report of the Development Committee to which I have affixed my signature, with the following reservation:

(f) Provided that nothing in the organization of the proposed Air Department shall restrict the Navy in the following activities:

(a) Maintenance of an organization adequate for the preparation of general specifications, general plans and characteristics of the aviation mechanisms, accessories, and equipment required for Naval purposes.

(b) Maintenance of an organization and facilities adequate for carrying on experimental aviation work of a class that is exclusively of a Naval character, and that does not involve duplication of efforts and facilities in the proposed Air Department that are common to other aviation branches.

(c) Maintenance of an organization and facilities for conducting the acceptance and tactical tests of complete aviation mechanisms and accessories.

(Signed) HENRY C. MUSTIN,
Captain, U. S. N.

CHAPTER VI

TECHNICAL DEVELOPMENT AIRPLANES, 1914 TO 1919

THE year 1919 in airplane work marks a transition period from the production of military and naval aircraft to the design of purely commercial planes.

In spite of all the difficulties and delays which the Army Air Service experienced, and in spite of all the criticisms it encountered, it may be said that at the signing of the armistice not only had production of standardized military planes reached a tremendous volume, with promise of greater volume in the immediate future, but that a number of most valuable models had been developed by aircraft manufacturers covering the entire field of military requirements.

The Naval Aircraft program, meeting less difficult requirements, and less ambitious in scope, had been more successful as regards production, and at the termination of the war the Navy also was in possession of a number of most valuable types, some of which were distinctly in advance of anything built abroad.

Military Machines at the Signing of the Armistice

In the ensuing paragraphs, brief mention is made of the most interesting American models at the signing of the armistice.

TRAINING MACHINES

The training machines employed by the Army were divided into two classes,— the "elementary training" plane, with 90 to 100 horse-power, and the "advanced training" plane, with 150 horse-power, although in most cases the low-powered machine was but very slightly redesigned to take the more powerful engine. The low-powered type such as the Curtiss J. N.-4-D with the Curtiss OX-5 engine did pioneering work for training. It also proved entirely satisfactory subsequently for private flying. The V. E.-7 a particularly interesting example of the more highly-powered training plane with a weight of 11.4 pounds per horse-power showed a maximum ground speed of 116 miles per hour. The Thomas-Morse S.-4-C constituted another interesting type of advanced training machine. This was a small single seater with an 80 horse-power LeRhone which gave a speed of 97 miles per hour.

SINGLE-SEATER FIGHTERS

No American single-seater fighters were produced during the war, and the Spad and S. E.-5 formed the bulk of equipment for this in the American Army. During the year 1919 these were replaced by the Thomas-Morse M. B.-3, the Ordnance and other single-seater fighters.

TWO-SEATER FIGHTERS

At the conclusion of the armistice, American designers had fully developed a number of brilliant models of the two-seater fighter type.

A survey of these models gives a very fair idea not only of the general possibilities of the best designs but serves to illustrate many important improvements in design.

Thus the Curtiss 18-B Biplane, known as the Hornet, offers many interesting features. The employment of a monocoque veneer fuselage gives a body of almost perfect stream-line form. The free air radiator is much smaller both in weight and cooling area than the average nose radiator for an engine of this power. To give the fuselage a clean rear portion, the designer has employed the useful dodge of placing the rudder and fin clean above the fuselage, while the body is equipped with a small end fairing piece. This is a device which other designers are likely to follow. There has always been a prejudice against the use of ailerons on the lower wing alone, on the grounds of insufficient controllability. In the Hornet the ailerons are carried on the lower wing only, yet give ample control. The ailerons are of the long narrow type, which wind tunnel experimentation had indicated as being most efficient. Rudder and elevators are operated by levers enclosed in the fuselage thereby doing away with all outside control cables. The hinges on all control surfaces are such as to do away entirely with the intervening gap. It is these points of apparent minor refinement which have the cumulative effect of excellency, and which constitute superiority of the post-war plane over that of an earlier date. A 400 horse-power K-12 engine, and a total load of 3,000 pounds, the Hornet gave a high speed of 160.5 miles per hour and a climb of 12,500 feet in ten minutes is attained.

In the Lepere two-seater Fighter, equipped with the Liberty Twelve, the American Air Service would have found — had the war continued — a most dependable fighting machine. Built at the Packard Motor Car Company's plant, completely equipped for military purposes, with a gross weight of 3,700 pounds, it achieved a speed of 136 miles per hour, and was beautifully balanced and maneuverable.

The Loening two-seater monoplane attracted very general attention because of the bold and original employment of rigid trussing for monoplane construction, and other interesting departures from standard practice, such as the new type of radiator, and the exposed engine.

AMERICAN PROGRESS

It is gratifying to observe how far superior these American products — Curtiss, Lepere, Loening, Phipps, Thomas — were to the D. H.-4 and other foreign machines corresponding in type.

NIGHT BOMBERS

The war developed one type of ship which could be immediately utilized for peace service, and this was the night bomber. Capable of carrying ten or more passengers, and equipped with multiple engines, they are capable of flying with part of the power plant out of commission. The Glenn L. Martin bomber was a particularly successful American example of this type, and has since passed, with but slight modifications, into the Air Mail Service.

ARMY TECHNICAL DEVELOPMENTS DURING THE WAR

While the main task of the Army Air Service during the war was to select the best European models, adapt them to American methods of manufacture and turn them out in the greatest possible number, nevertheless a great deal of technical development had to be carried on.

The bulk of this was concentrated at McCook Field, Dayton, Ohio, which, although its construction only began some months after the entry of the United States into the war, was by the end of 1917 a fully equipped experimental field, capable of handling any problem, whether in plane or engine design or construction.

One of the many achievements of McCook Field organization was the placing on a secure basis of the question of sand testing of airplanes. Full flight tests had also been conducted prior to the war in somewhat slipshod fashion without due care being given to the adjustment of instruments, to temperature corrections, to calibration curves, and to an exact comparison of results. The field placed this important branch of the art on a satisfactory basis.

With the cooperation of the Forest Products Laboratory, and a number of plywood manufacturers, considerable work was done in the development of veneer fuselages, such as those introduced into this country by the L. W. F. Engineering Co., which were systematically designed, built and sandtested. The final type arrived at could be built from veneer panels such as could be supplied by any plywood manufacturer, formed readily to any streamline shape, and have less weight for the same strength than a truss fuselage of the same size and strength.

In the engine field, much experimentation on the Liberty Twelve enabled the final touches to be placed on this wonderful product of American genius. Constant help was given to the various workers on the turbo-compression systems of which fuller mention is given later in these pages.

It may be pointed out here that while the greater part of our energies was concentrated on the Liberty Twelve, the Americanization and large production of the Hispano-Suiza by the Wright-Martin factory was a notable and extremely useful achievement.

NAVAL AIRCRAFT DURING THE WAR

The work of the Navy during the war was kept even more confidential than the work of the Army. Commander H. C. Richardson's paper before the Society of Automotive Engineers was perhaps the first announcement giving a classification of the Navy's planes and their different functions. Corresponding to the land single seater training planes, a certain number of Gnome engine sea-going scouts were used, such as the Curtiss and Thomas. Most of the training was done, however, with two seater machines such as the Curtiss N.-9, the R.-6, the Aeromarine and Boeing seaplanes. The N.-9, after the substitution of the Hispano for the Curtiss OXX 100 horse-power, was practically successful. The Curtiss F-boat, originally developed for sporting purposes, also underwent but slight modifications before being available for instruction purposes. The Gallaudet D.-4 was a useful bomber. The large submarine patrol and convoy machines underwent a wonderful development during the war. The N. C.-1, for instance, with its large range, enormous load, and fuel capacity was a wonderful product, immediately capable of commercial application. It is interesting to note that after the long debate as to the sea-going qualities of the float sea-plane and the flying boat, the flying boat came to be used almost exclusively.

Satisfactory as was the Navy's record in the engineering development of its planes, its record from a production standpoint was equally satisfactory. In production work the Curtiss Aeroplane and Motor Corporation, the Aeromarine Plane and Motor Company, the L. W. F. Engineering Company, and the Naval Aircraft Factory at Philadelphia, played, among others, a very important part.

It is a matter of some pride to the Navy that their aircraft work was to a large extent along lines of original American development and that real technical progress was achieved in many directions by the able body of Naval Constructors responsible for the work.

Thus the design of the hull in the N. C. flying boat in which the Navy cooperated closely with the Curtiss Co., marks a real achievement in design. As a result of careful basis work, the fine lines of the hull allowed a speed of 65 miles per hour on the water. While in the early flying boats it was considered necessary to have great width to make the boat plane at reasonably low speeds, and not over 100 pounds of displacement had been allowed per inch width, in the N. C. hull, the radical step was made getting planing by speed rather than by width. The N. C. boats start with 233 pounds load per inch run. The bare hull weighs only 2800 pounds, yet the displacement is 28,000 pounds or 1 pound of boat per 10 pounds of displacement. This lightness of construction was attained by a careful selection and distribution of materials.

The outrigger construction for supporting the tail surfaces is a distinct departure from both American and foreign practise. The outrigger construction permitted in the first place a shorter hull, and it is doubtful whether a hull extending the full length of the ship could ever have got off the water. The outrigger construction, consisting of three hollow spruce booms braced by steel cables, carried the tail surfaces clear of rough sea water, and permitted a machine gun to be fired straight aft from the stern compartment without interference.

One of the most serious problems in the construction of very large machines is to counteract the working of the A3-2 law on the weight of the wings, which stated in words, signifies that for geometrically similar ships the weight of the wing structure becomes a greater proportion of the total wing weight. If the N. C. wings had been built in exactly similar fashion to the wings of a small plane, their weight would have been so large as to affect seriously the magnitude of the useful load. But although the wings of the N. C. boats carry a load of 11.7 pounds per square foot in the air, and have a total area of 2380 square feet, their structural weight is only 1.2 pounds per square foot. This low figure was only achieved by a great amount of research and experiment so as to determine the best material to adapt and its disposition.

PEACE TIME DEVELOPMENTS

The sense of final achievement, the confident feeling of having equaled, and in some respects surpassed, the efforts of European manufacturers, did not help American manufacturers in finding the true policy, commercial and technical, for the work of peace time development. An immediate curtailment of production, and general depression ensued. This was followed by gradual resumption of development work, and the production of several promising commercial types, and a number of small commercial aircraft enterprises.

THE SMALL CHEAP SPORTING MACHINE

The very widely spread conviction that aeronautics held a large field for the cheap sporting airplane was justified during the year by the large sales of the rebuilt Canadian and American J. N.'s. equipped with the Curtiss OX motors. At the same time a number of even smaller planes, equipped with smaller power, were built and offered for sale. These deserve careful study. The possibility of building successful planes on a cheap commercial basis, with not much more power than was employed in the very early days of aviation, accompanied by proper licencing and control will offer a distinct advance. The Aircraft Engineering Corporation Ace is an example of this type. The L. W. F. Co. is bringing out a low priced sporting machine.

THREE-SEATER LAND PLANES

However simple it may be to pilot a plane, yet it is quite certain that just as in the automobile so in the practical and pleasure uses of the plane, there must on occasion be a skilled, professional man at the wheel or the joy stick. In the two-seater provision is made for this, but the passenger still travels in comparative loneliness. The three-seater Curtiss Oriole provides a rear cockpit for the pilot, and a front cockpit for two passengers sitting side by side, with no controls or instruments to inconvenience them, and a side door for convenient entry or exit. The design constitutes an apparently very useful type, which is certain to be the forerunner of a class.

Nothing illustrates so clearly the possibility of aerodynamic refinement as two designs of the Curtiss Company equipped with the same 90–100 horse-power OX motor. Thus the Curtiss Oriole weighing 2188 pounds attains a maximum speed of 85 miles an hour. The well-known Curtiss J. N.-4, with a maximum load of 1900 pounds, and two men only attains a speed of 73 miles per hour.

The Dayton Wright Airplane Co. has developed two striking models, both of the enclosed type. One, the K. T., is equipped with the Liberty engine, is designed for a speed of 125 miles per hour and carries a 6 hour fuel capacity. Both this model and the O. W.-1 are luxuriously finished, combining comfort and beauty with safety. The O. W. is Hispano-Suiza powered.

THE SPEEDIEST AIRPLANE FOR 1919

As far as published records go, the fastest American airplane for 1919 is the Thomas-Morse Single Seater Fighter M. B.-3, which has a high speed record of 164 miles per hour and a climb of 10,000 feet in 4 minutes 52 seconds, while carrying full military load. The photograph indicates that no very unconventional features are present in the design. Speed is gained by refinement in detail, hidden fittings, a good streamline body.

THREE-SEATER SEAPLANES

The same reasons that may lead to the popularity of three-seater land airplanes are likely to hold for the three-seater seaplane and 1919 has seen several flying boats of this character produced.

An interesting example of the three-seater flying boat is the Curtiss M. F. flying boat equipped with OXX 100 horse-power motor, for which a 150 horse-power K-6 may be substituted. A very pleasing and finished design, it is on more standard lines than the V. E.-10.

If further proof were necessary of the general utility of the three-seater flying boat, the Aeromarine Model 50, equipped with the Aeromarine 125–130 horse-power motor, which has a high speed of 80 miles per hour, could be used as an excellent example.

The V. E.-10 built by the Lewis & Vought Corporation is another interesting example of this type. While for pleasure purposes, and for general sea-worthiness the flying boat is superior to the hydro-airplane, the long hull which it has been customary to employ has militated against quick get-away. The success of the N. C.-4 was in a large measure due to the fact that a shorter hull had been coupled to outriggers for carrying the tail. In the V. E.-10 a similar construction has been adopted with satisfactory results. This construction gives the V. E.-10 a very strong resemblance to the N. C. boats.

TRANSPORTATION AND MAIL PLANES

While no commercial transportation line has so far been definitely established in this country, yet the interest in aerial transportation is constantly growing. The Lawson Company of Milwaukee have designed a twin-engine machine — two Liberty's — for the avowed purpose of a transportation line between New York and Chicago. The photographs indicate clearly the large seating capacity of the plane — 26 passengers are to be carried in all. The machine fully loaded weighs between 12,000 and 13,000 pounds, has a total wing area of 17,000 square feet, and is of sturdy, though unrefined construction.

Whether with a machine of this size, for so small a power, speeds of commercial value can be obtained is still uncertain, but there is no doubt that it is machines with enclosed bodies of this character, equipped with two or more engines, and having large passenger capacity which will finally be profitably used for transportation work.

While the Lawson scarcely can be said to present much that is new in its design, the Curtiss Eagle, which is the only other American machine built purely for transportation work, offers many new features. It is the first three-motored land machine to be produced in America. Three of the new Curtiss K-6 150 horse-power motors are used. With a wing span of 61 feet, a wing area of 770 square feet, and a gross weight of 7,450 pounds, the machine carries six passengers and two pilots at a maximum speed of 107 miles per hour. The fuselage design is particularly interesting as an example of commercial airplane construction. It is an enclosed limousine body, fitted up luxuriously with individual chairs, a spacious aisle, dome light, flat windows of triplex non-breakable glass, and curved windows of celluloid.

The Martin bomber, developed into a 12 passenger ship for the use of the Army, illustrates how remarkably the Martin war construction has been adapted to civil transport.

While a number of new types of planes have been ordered by the Aerial Mail, the service is too young to be identified as yet with anything but modified war equipment such as the D. H.-4. A very interesting piece of practical engineering is the rebuilding of the D. H.-4 by the L. W. F. Company to take first two Hispanos of 150 horsepower and subsequently two Liberty Sixes on either wing in lieu of the single Liberty 12. The rebuilt plane has had its wing area increased by a larger section in the upper wing and two center panels in the lower wing. The D. H.-4 was rebuilt for the express purpose of utilizing already available equipment, and yet having a twin-engine machine, minimizing possibility of failure. The twin D. H. while carrying a heavier mail load than the ordinary D. H.-4, was able to maintain its altitude on a single engine at an altitude of 1,200 feet. This is a very significant fact for airplane designers.

The first of the Post Office's fleet of big mail carriers have been built by the Glenn L. Martin Company, along the general lines of the bomber. Many carry six hours' fuel and 1,500 pounds of mail in addition to a crew of two. Trap doors are built in the fuselage to facilitate the discharge of the cargo.

TECHNICAL WORK IN 1919

Perhaps the most striking technical development of 1919 is the final successful employment of the turbo-compressor.

This was the outcome of a long series of experiments by Dr. S. A. Moss of the General Electric Company, following the experimentation and work on the Sturtevant motor. The device is simple in principle. The exhaust gases are utilized to drive a gas turbine revolving at the enormous speed of 20,000 revolutions per minute. This in turn drives on the same shaft a centrifugal air compressor which supplies compressed air to the carburetors. Since the falling off in power of the airplane engine at altitude is due to the decreasing density of the air, the turbo-compressor enables the power of the engine to be maintained to a very large extent.

The full advantage of the turbo-compressor cannot be attained however unless the characteristics of the propeller designed for low altitude operation, are altered to meet the needs of higher altitudes. The invention of the variable pitch propeller by Seth Hart of Los Angeles was particularly timely therefore. By a simple arrangement of gearing between the propeller blades and the hub, the pitch can be varied at the will of the pilot, so that the propeller can be coordinated with the engine and the airplane. European engineers are also working on the development of a variable pitch propeller and a two-propeller arrangement, the first of the ordinary pitch and the second of an extraordinary, to be used at high altitudes.

An interesting development at McCook Field was the construction of a wind tunnel operated by a 24 blade suction fan. The tunnel has a minimum throat diameter of 9 inches, at which point a speed of over 350 miles an hour is attainable. In this connection, special reference should be made to the wind tunnel and other laboratory facilities developed by the Curtiss Company at Garden City.

The importance of the air-cooled aeronautical motor is fully realized in this country. While no substantial development has been formally noted, the Dayton-Wright Company have done some vital fundamental work and it is understood that similar study is being carried on by the Wright Aeronautical and L. W. F. companies.

Reports from England show very valuable progress. A nine cylinder ABC engine developed 340 horse-power with a weight complete of 600 pounds, of 1¾ pounds per horse-power. As the air-cooled engine carries neither water nor radiator, this shows remarkable progress over the old type. A Cosmos Jupiter engine, also a nine-cylinder stationary air-cooled type, gave 450 horse-power for a weight of 662 pounds, an extraordinary figure.

One of the most interesting phases of aeronautical activity during the year, and one which is likely to have the greatest possible influence on the commercial growth of the industry is the construction and use of parachutes. The Army has developed completely successful parachutes which, strapped in a pack on the back of the aviator, acting at the same time as a cushion operated whether by a rip-cord attached to the plane or by the wearer himself, have enabled numerous perfectly safe descents to be made.

An experiment which may ultimately lead to very important results was the delivery of air mail to an ocean liner. C. J. Zimmerman piloting an Aeromarine flying boat, delivered mail to the White Star liner *Adriatic.* The plane was equipped with a specially devised weighted cable with shock absorbers, which when released caught and wrapped itself around a cable that ran from the masthead to the deck of the *Adriatic.*

CHAPTER VII

TECHNICAL DEVELOPMENT, BALLOONS AND AIRSHIPS, 1914–1919

THE technical development of aerostats — which are popularly called lighter-than-air craft — has made enormous strides since the beginning of the World War.

Nonrigid Airships.— The German submarine warfare was more than any other single factor responsible for the development of new airship types in the Allied countries. The ability of airships to regulate their flying speed and to extend vision below the surface of the seas, made of these craft an extremely valuable auxiliary to the Allied naval forces engaged in fighting the submarine menace.

The first type of airship developed with this end in view was introduced by the British in March, 1915; it was designated as S.S. (Sea Scout) and soon nicknamed Blimp. These were small nonrigid airships with a capacity of 60,000 cubic feet, at first, which was gradually increased to 100,000 cubic feet, and were chiefly remarkable for the original manner in which the problem of a lightweight car and power plant was solved. The car was merely an airplane fuselage, complete with its engine and tractor screw, gas and oil tanks, and accommodations for a crew of two or three men. This arrangement had the further advantage of permitting to utilize the fuselage of many obsolete machines. A notable feature of these airships was that the customary ballonet blower was dispensed with; instead a blower pipe, or "air scoop," was arranged to collect air from the slipstream of the propeller and to discharge it into the distributing duct leading to the ballonet. Later on, to save head resistance, the blower pipe was hinged to the envelope so that it could be folded up when not in use.

The Blimp type of airship proved highly successful in coastal antisubmarine defense and about fifty ships were built for the British Navy with successive improvements. Toward the end of 1916, the French produced a similar type of airship, which was fitted with twin engines and twin propellers, an arrangement which increased security of operation and was subsequently adopted by the British.

When the United States declared war on Germany, the Navy Department ordered sixteen airships of a type similar to the original

British Blimp, but incorporating a number of refinements. Nine of these B-class ships were built by The Goodyear Tire & Rubber Company, five by The B. F. Goodrich Company and two by the Connecticut Aircraft Company. About 170 pilots were trained on the B-class ships and 400,000 miles flown on coast patrol prior to the Armistice.

The extension of submarine warfare and the change in the tactics of undersea boats prompted Great Britain to develop in 1917 larger types of nonrigid airships, capable of lifting a greater load and having a longer endurance. These were used with great success for coast patrol and convoy work and for extended cruising.

At the same time the French Naval Air Service introduced a non-rigid which was chiefly remarkable for its armament; this consisted of a 37 milimeter aircraft gun, firing a 1-pound shell. These ships were the only ones built in any country during the war to carry artillery, though machine guns were used on both Allied and German airships.

In 1918 an excellent type of coast patrol airship was produced in the United States to the designs of the Navy Department. Owing to careful design, the ships attain a speed of 60 miles per hour with only 250 horse-power, furnished by two Hispano-Suiza or two Union engines — a higher efficiency ratio than has hitherto been obtained anywhere. Another factor which greatly contributed to this result was the use of the "finger patch" rigging, a type independently developed by The Goodyear Tire & Rubber Company, although it bears a certain resemblance to the Eta Patch. In this system, which permits to eliminate the heavy suspension girdle of German origin, the suspension wires are attached to patches of fabric strips, in the form of a hand, which are cemented and sown to the envelope. The finger patch rigging insures a very wide distribution of the load and thus reduces the number of suspension wires. Hence, the great reduction in head resistance.

These "C-class" airships have a length of 192 feet, a diameter of 41¾ feet, a capacity of 180,000 cubic feet, and a useful load of 4,760 pounds. They carry four 260-pound bombs, a radio set and a crew of six men. The endurance at 45 miles per hour is 47 hours, or 2,150 statute miles.

An interesting innovation is found on the British N.S. airships in the manner in which the fuel supply, amounting at times to three tons, is distributed. This is carried in 80-gallon tanks, made of fabric lined with a gasoline resisting dope, which are trussed to the inside of the envelope. The tanks are controlled from the car by means of wires and access to them is obtained from a tube which leads through the center of the ship to a gun platform fitted on the top.

Among the principal developments produced in Italy is an ingenious arrangement for compensating a contraction of gas in Forlanini airships. These have a double envelope, the inner one containing the gas, while the space between the inner and outer envelopes acts as a ballonet. Pressure in this space is derived from the air stream which strikes the nose of the airship in flight; this is admitted by means of a valve fitted in the bow, and is operated from the control car. An outlet valve of the spring-loaded type is fitted on the stern and automatically relieves the pressure in the air space whenever the latter reaches the designed limit.

Rigid Airships.— Real advance in rigid airship design and performance since 1914 has been, with few exceptions, limited to Germany, which entered the war with an efficient Zeppelin fleet and fifteen years' experience. The history of German Zeppelin development during the war is one of continuous increase in size and horsepower, resulting in greatly improved carrying efficiency (ratio of useful load to gross lift), speed and endurance, although a great deal of detail refinement work was also carried out. The evolution of the Zeppelin airship during the last twenty years is shown in the following table:

DEVELOPMENT OF THE ZEPPELIN AIRSHIP, 1900–1919

YEAR	NAME	DIMENSIONS (ft.)	GROSS LIFT (tons)	USEFUL LOAD (tons)	TOTAL h.p.	SPEED (m.p.h.)
1900	L.Z.I	420 x 38	12.8	1.0	32	15
1905	L.Z.II	420 x 38½	11.5	1.0	170	25
1907	L.Z.IV	446 x 42½	17.0	3.0	220	28
1910	*Deutschland	485 x 46	21.6	4.0	330	33
1912	L.1	518 x 48½	25.2	6.0	540	47
1913	L.2	518 x 54½	30.2	7.5	720	50
1915	L.11	564 x 61	35.4	15.7	880	55
1916	L.30	647 x 79	62.7	27.0	1320	60
1917	L.57	696 x 79	69.4	38.5	1500	62
1918	L.71	746 x 79	78.4	50.0	2100	75
1919	*Bodensee	395 x 57	22.4	10.0	1040	80

* Commercial airship.

The most striking departure noticeable on the Zeppelins produced since the war is the suppression of the external keel, for which an internal was substituted, and the discarding of the shaft drive for propellers, instead of which engines and propellers are mounted in streamline cars along the sides of the hull.

With the knowledge gathered from Zeppelins brought down in the Allied lines, Great Britain succeeded in producing in 1918 some very serviceable rigids, among which the R-34 type of transatlantic fame. The development of an original British rigid design just started when the Armistice intervened and ultimately caused the virtual scrapping of the British airship program. As a result, the largest British airship laid down — the R-38 — was sold to the United States Navy. This vessel, which is still in course of construction, has a capacity of 2,700,000 cubic feet, and is driven by six engines totaling 1,900 horse-power. The useful load will be in the neighborhood of 50 tons.

This purchase marks the first step of the United States toward the building up of a rigid airship fleet for naval use. An airship hangar 800 feet in length is being constructed with this end in view at Lakehurst, New Jersey, and a great amount of research work has been conducted by various government agencies for developing materials of construction suitable for rigids. The problems of duplicating the aluminum alloy of which Zeppelin girders are built and of developing a satisfactory fabric for the internal gas bags have in particular been investigated. With respect to the former, American ingenuity succeeded in producing an alloy which is slightly better than the German product; it has the strength of mild steel, although it weighs only half as much. As to the development of a suitable fabric for internal gas bags, this has not yet been achieved, but the Bureau of Construction and Repair of the Navy Department has succeeded in producing a compound, or "dope," which approximates the impermeability of goldbeaters' skin and is but slightly heavier.

Minor Developments.— In the field of nonrigid airships, the development of internally trussed, streamline fins was a most original and successful American innovation, alongside of which should be mentioned the Gammeter valve, produced by the Goodyear Company. The development of this valve represents a great achievement in that a gas tightness hitherto unachieved is secured thereby.

An important contribution to the science of aerostatics has undoubtedly been the discovery, in the United States, of a process whereby helium can be produced at comparatively low cost.

Helium has a lifting power of 92.6 per cent. as compared to hydrogen and is absolutely non-inflammable. Although its production cost has been reduced from $2,000 per cubic foot to about 10 cents per cubic foot,— a remarkable achievement — helium is still too expensive for commercial uses, and experiments are continued to further reduce its price. The gas contemplated by the Navy for all-round aircraft use will be a mixture containing 85 per cent. helium and 15 per cent. hydrogen.

A large production plant is in the course of construction at Fort Worth, Texas, in the vicinity of which large pools of natural gas, containing about 2 per cent. of helium, exist. Supplies of helium are as yet very limited.

The great changes which occur in the buoyancy of airships, mainly owing to a greater amount of radiant heat by day than by night, result in a considerable amount of gas and ballast being wasted in navigation. To overcome this drawback, experiments have been conducted in England with a view to condensing the steam formed in the engine exhaust and it has been possible to collect about 80 per cent. of the corresponding weight of the gasoline burned. On the other hand, the possibility of using hydrogen as an engine fuel has also been investigated: it was found that this can be done without danger, provided the gas is mixed with both fuel and air, and without impairing the maximum output of the engine.

The general shortage of materials during the war made it necessary to accommodate many airships in the open and to develop suitable mooring arrangements for them. Among the successful schemes devised may be mentioned the development, by the British, of a mooring mast to which nonrigid airships have been moored by the nose in winds up to 52 miles per hour with perfect security. Another ingenious system consisted in mooring airships in suitable alleys cleared in woods, where they would be protected from the wind by the trees. This has proven entirely practicable and airships have thus weathered winds up to 60 miles per hour.

Kite Balloon Development.— The kite balloon, which was invented by Major von Parseval and Captain Sigsfeld in 1893, was considerably developed during the war, first in France and then in Italy. The first improvement is due to Captain Caquot of the French Army, and consisted in substituting for the cylindrical envelope one of streamline shape, and in providing on the stern three inflated fins, which took the place of the sails and tail cups of the Parseval type. This arrangement insured much greater stability in high winds.

With the same object in view, the Italian Air Service produced in

1918 a kite balloon of similar features but which differs from the Caquot in that it has a spherical envelope. This so-called Avorio-Prassone balloon was extensively used on the Italian Front, where it rendered excellent service and proved easier to handle and capable of greater stability in high winds than the Caquot balloon.

CHAPTER VIII

MANUFACTURERS AIRCRAFT ASSOCIATION, INC.

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4 4

(The Springfield Aircraft Corporation of Springfield, Mass., the Engel Aircraft Corp. of Niles, Ohio, the Standard Aircraft Corp. of Plainfield, N. J., and the Standard Aero Corp. of Plainfield, N. J., have ceased the manufacture of aircraft and withdrawn from the Association.)

The Manufacturers Aircraft Association maintains executive offices at 501 Fifth Avenue, New York City.

THE Aircraft Year Book for 1919 carried the aircraft industry from the earliest times up to the signing of the Armistice, November 11th, 1918. In the year or more that has elapsed, the aircraft industry of the United States has successfully undergone the readjustment necessary to the development of a new means of transportation. In the four years immediately preceding, all the energies of the art had been applied to warfare. With the signing of the Armistice came this question:

Is aerial navigation to be a commercial factor, and if so, how soon?

The first great move in awakening the consciousness of America to a fuller appreciation of aeronautics was the preparation for an aeronautical exposition held in New York City, from March 1st to 15th, 1919.

AERONAUTICAL EXHIBITION OF 1919

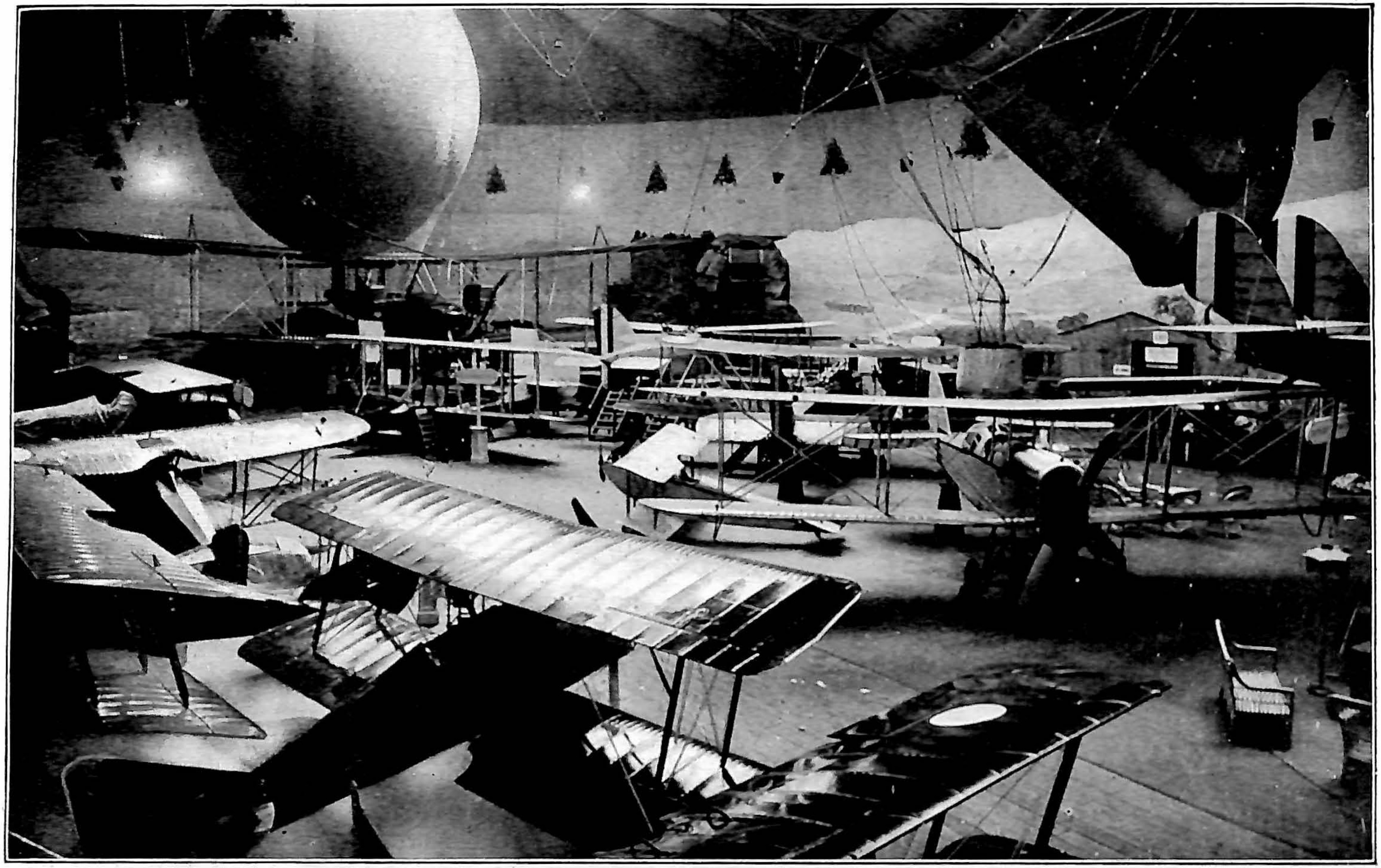
Owing to the importance of aircraft in warfare, the United States and the Allied governments had taken every precaution to withhold from the public the full story of the remarkable development in aviation. As a means of safeguarding military plans in the United States, President Wilson, on January 1st, 1918, issued a proclamation placing restrictions upon the private exhibition of airplanes, equipment, or aeronautical engines in the United States.

In preparing for the show in New York, the manufacturers therefore had first to request the President to revoke the proclamation of 1918, which was done in another proclamation under date of December 16th, 1918.

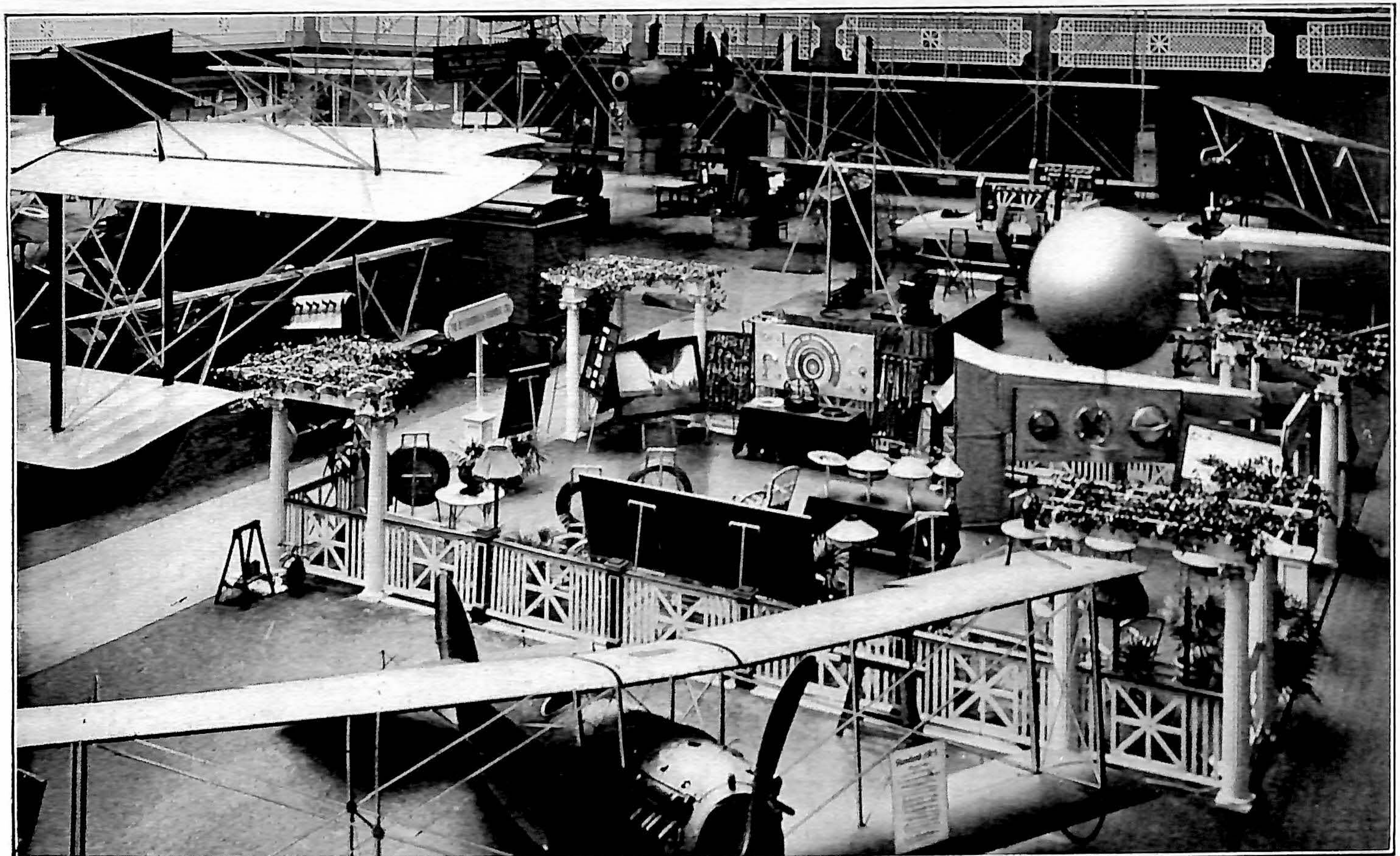
Official permission being thus granted, the Manufacturers Aircraft Association sought and obtained the cooperation of Army, Navy and Post Office Air Service officials. As all the manufacturing activities during the war had been under the direction of either the Army or the Navy, the next step was to obtain the release for exhibition, of the equipment then controlled by the military and naval authorities. To this end the Navy Department designated Commander G. C. Westervelt and Lieutenant-Commander A. C. Read, to cooperate with officials of the Association and with a similar commission from the Army Air Service, which consisted of the following: Majors Henry J. Miller and H. M. Clark, Captains L. E. Rubel, Roy N. Francis, and J. S. Maholl, and Lieutenant John Tuerk. The 1919 Show Committee consisted of: Inglis M. Uppercu, Chairman; F. H. Russell, A. H. Flint, G. M. Williams, Fay L. Faurote, H. B. Mingle, S. S. Bradley, and B. A. Guy, Show Manager.

Exhibits were obtained from the Army and Navy in such numbers as to fill both Madison Square Garden and the 69th Regiment Armory in New York. A total of 101 firms exhibited complete airplanes, inflated balloons or accessories. It was the Association's aim to provide an exposition which could fittingly commemorate the part which aircraft had taken in the war, and which could afford the public a substantial glimpse into future aerial commerce. By means of the remarkable decorative scheme the interior of Madison Square Garden was transformed into an ideal landing field in a mountainous country. At one end was a tavern and at the other was a representation of the sea. Mountains, forests, streams and pasture land were depicted on either side. The effect was at once beautiful and impressive.

It is safe to say, we believe, that no more historic exhibit was ever held in the United States than this Exposition. The first Wright biplane flown was shown in the Armory, while in a corner of the Garden there was an exact duplicate of the original Langley flying machine lent by the Smithsonian Institution. During the two weeks it continued, the Exposition was visited by thousands of people from all parts of the United States, including numerous high officials from Washington. It was unique, and can be permanently recorded as the



General View, Madison Square Garden, New York, where Manufacturers Aircraft Association held its first exposition, March 1–15, 1919.



General View, 69th Regiment Armory, New York, during the Manufacturers Aircraft Association's First Exposition, 1919.

first aeronautical exposition to be held after the cessation of hostilities in the World War.

The following is a summary of the principal exhibits:

MANUFACTURERS' EXHIBITS

AIRPLANES AND SEAPLANES

AEROMARINE PLANE & MOTOR COMPANY, Keyport, New Jersey.
Model "50" Flying Boat. Three-seater sport machine.

GIO. ANSALDO & CO., Genoa, Italy.
Exhibit S. V. A. Biplane. Pursuit machine.

BOEING AIRPLANE CO., Seattle, Washington.
Model C-L-4-S Seaplane. Two-seater Naval Training Machine.

CANTILEVER AERO COMPANY, New York.
Christmas "Bullet." One-seater monoplane.

CURTISS AEROPLANE & MOTOR CORPORATION, New York.
Model 18-B. Two-seater combat machine built for United States Navy.
Model JN-4 D-2. Two-seater training machine.
Model H.A. Two-seater combat seaplane built for United States Navy.
Model MF Flying Boat. Two-seater sport machine.

DAYTON-WRIGHT AIRPLANE COMPANY, Dayton, Ohio.
D H-4. Two-seater combat machine.
D H-K. ("Honeymoon Express.") Three-seater sport machine.
T-4. ("Messenger.") One-seater sport machine.

GALLAUDET AIRCRAFT CORPORATION, East Greenwich, Rhode Island.
Model D-4. Light bomber seaplane. Two-seater.
"Chummy Flyabout." Two-seater sport machine.

GLENN L. MARTIN COMPANY, Cleveland, Ohio.
Martin Bomber. Four-seater night bombing machine.

L. W. F. ENGINEERING CO., College Point, Long Island.
Model G-3. ("Shark.") Two-seater combat machine.
Model HS-2-L. Three-seater naval patrol seaplane.
Model VH-I. ("Seagull.") Two-seater sport machine.

PACKARD MOTOR CAR COMPANY, Detroit, Michigan.
Model 1-A. Two-seater sport machine.

STANDARD AIRCRAFT CORPORATION, Elizabeth, New Jersey.
Model E-1. Pursuit training machine.

THOMAS-MORSE AIRCRAFT CORPORATION, Ithaca, New York.
Model MB-3. Single-seater pursuit machine.
Model S-4 C. Single-seater pursuit training machine.
Model S-6. Tandem two-seater sport machine.
Model S-7. Two-seater side-by-side sport machine.

UNITED AIRCRAFT ENGINEERING CORPORATION, New York.
Canadian Curtiss. Two-seater training machine of Royal Flying Corps.

WRIGHT-MARTIN AIRCRAFT CORPORATION, New Brunswick, New Jersey.
Loening Monoplane. Two-seater combat machine.
Model V E-7 Vought ("Bluebird.") Two-seater advanced training machine.

AEROSTATS

BURGESS COMPANY, Marblehead, Massachusetts.
Car of Navy C-Class airship.

CONNECTICUT AIRCRAFT COMPANY, New Haven, Connecticut.
Free Balloon, solo type.
GOODYEAR TIRE & RUBBER COMPANY, Akron, Ohio.
Caquot model R kite balloon.
THE B. F. GOODRICH COMPANY, Akron, Ohio.
B-Class Naval Airship.

AIRCRAFT ENGINES

AEROMARINE PLANE & MOTOR COMPANY, Keyport, New Jersey.
Type L. 6 cylinder, 130 horse-power.
CURTISS AEROPLANE & MOTOR CORP., New York.
Type K-12, 12 cylinder, 375 horse-power.
Type K-6, 6 cylinder, 150 horse-power.
Type OX-5, 8 cylinder, 90–100 horse-power.
DUESENBERG MOTOR CORPORATION, Elizabeth, New Jersey.
Type Duesenberg H., 16 cylinder, 800 horse-power.
Type King-Bugatti, 16 cylinder, 410 horse-power.
HALL-SCOTT MOTOR CAR COMPANY, San Francisco, California.
Type A-8, 16 cylinder, 450 horse-power.
LAWRENCE AERO ENGINE CORPORATION, New York.
Type L-1-60, 3 cylinder, 80 horse-power.
LAWRENCE SPERRY AIRCRAFT CORPORATION, Farmingdale, Long Island.
Type W. B. B. Engine, 4 cylinders, 38 horse-power.
PACKARD MOTOR CAR COMPANY, Detroit, Michigan.
Type I-A-744, 8 cylinder, 160 horse-power.
Type I-A-1116, 12 cylinder, 240 horse-power.
Type I-A-2025, 12 cylinder, 440 horse-power.
B. F. STURTEVANT COMPANY, Boston, Massachusetts.
Sturtevant 5-A-4½, 8 cylinder, 210 horse-power.
Sturtevant 7, 12 cylinder, 300 horse-power.
THOMAS-MORSE AIRCRAFT CORPORATION, Ithaca, New York.
Thomas 8-90, 8 cylinder, 250 horse-power.
TIPS AERO ENGINE COMPANY, New York City.
18 cylinder rotary type.
WRIGHT-MARTIN AIRCRAFT CORPORATION, New Brunswick, New Jersey.
Hispano-Suiza-E, 8 cylinder, 163 horse-power.
Hispano-Suiza-H, 8 cylinder, 325 horse-power.

ARMY EXHIBITS

AIRPLANES

Albatros pursuit machine.
Caproni triplane night bomber.
Fokker pursuit machine.
Handley-Page night bomber.
J.N.-4 hospital airplane.
Nieuport pursuit machine.
S.E-5 pursuit machine.
Spad pursuit machine.

BALLOONS

French barrage balloon.
Propaganda balloon.
Kite balloon-winch.
Parachute.

MISCELLANEOUS

Photographic exhibit.
Gunnery, bombs, etc.

NAVY EXHIBITS

F-5-L Flying Boat. Navy patrol seaplane. This was a special display craft, one-half of which was exposed to show detail construction.
Loening M-2 seaplane (Loening "Kitten") ship-plane.

The Aeronautical Exposition provided the answer to the query previously asked. From March 15th on, the Manufacturers Aircraft Association has been actively engaged in the education of the American people to the truth of aeronautical possibilities.

May 2nd to 15th, there was held in Macon, Georgia, the South-eastern Aeronautical Congress, in which members of the Manufacturers Aircraft Association participated. This congress greatly accelerated the movement among American municipalities to establish landing fields and thus make cross-country flying possible. The Army, Navy and Post Office Air Services were represented. The most notable act of the Congress was the adoption of a set of resolutions which urged the formulation by the United States Government of a fixed aeronautical policy, the sending of aviation missions to Central and South America, recognition of the international features of aerial navigation and the principle of federal control within the United States, and the establishment throughout the nation of municipal landing fields.

On August 22nd, members of the Association, including the Glenn L. Martin Company, the Curtiss Aeroplane and Motor Corporation, and the Dayton Wright Airplane Company, participated in the culminating event — aerial mail day — of Cleveland aviation week, held under the auspices of the Cleveland Aviation Club and the Cleveland Chamber of Commerce. At a luncheon on aerial mail day, following a speech by Otto Praeger, Second Assistant Postmaster General, resolutions were adopted urging the extension of the aerial mail throughout the United States as rapidly as possible.

As this book goes to press, preparations are under way for an aeronautical exposition to be held January 8th to 15th, in the Coliseum in Chicago, March 6th to 13th, 1920, at the 71st Regiment Armory, New York City, and probably for a show in San Francisco.

The detailed story of aeronautical achievement since the signing of the Armistice is best told by the individual industrial accounts which follow:

AEROMARINE PLANE AND MOTOR COMPANY, KEYPORT, NEW JERSEY

MAIN OFFICES, AIRPLANE AND MOTOR FACTORIES, Keyport, New Jersey.

SALES AND ADVISORY ENGINEERING OFFICE, 1800 Times Building, New York City.

Officers

President	INGLIS M. UPPERCU
Vice-President	JOHN W. GERMAN
Secretary	E. DEB. NEWMAN
Treasurer	AUGUST FAUX
Manager	E. DEB. NEWMAN

Directors

INGLIS M. UPPERCU E. DEB. NEWMAN

JOHN W. GERMAN

Airplane Division

Advisory Engineer	CHARLES F. WILLARD
Engineer in Charge, Keyport, New Jersey	PAUL G. ZIMMERMANN

Motor Division

In Charge "L" Motor Division	CHARLES F. WILLARD
Chief Designing Engineer, "L" Motor Division	R. E. LAYMAN
In Charge "B" Motor Division	JOSEPH J. BOLAND

ARMISTICE DAY, 1918, found the Aeromarine Plane and Motor Company in production on a lot of fifty Aeromarine Model 40 flying boats of a three hundred machine Navy order. As these were to have been used for training purposes, the Navy saw fit to reduce the order to the quantity in production, and the lot was completed in the early part of 1919.

Extensive experimental work was carried on during the winter with the Model 40 flying boat, resulting in some slight changes, which made it an ideal sportsman's boat. This new model, known as the 40 "C," was put in production upon the completion of the Navy contract.

In the meantime experimental work progressed on a three passenger flying boat, equipped with the Aeromarine Models "L," "B" and Hispano-Suiza motors, resulting in placing on the market the 50 type flying boat, exhibited for the first time at the 1919 New York Aeronautical Exposition. As the passengers in this model are enclosed in a sound and weather-proof cabin, it became known as the

1. Aeromarine Plating Department, July, 1919. 2. Engineering Department, July, 1919. 3. Olsen Testing Machine in Aeromarine physical laboratory, July, 1919. 4. Layman Motor Department, Aeromarine Plant. 5. Wood mill, Aeromarine Plant.

"Limousine Boat," and created such favorable comment at the exposition that a number of orders were placed. A Model 50 was sold to the Aero Limited and used on the New York-Atlantic City Air Service Route.

After further extensive experimental work with the two passenger cabin, it was decided to try out a flying boat with the pilot, as well as the passengers, included in the cabin. This machine, while it was not placed on the market, was looked upon with much favor by the pilot and passengers on the test flights. It afforded complete protection against the elements and made possible conversation between pilot and passengers.

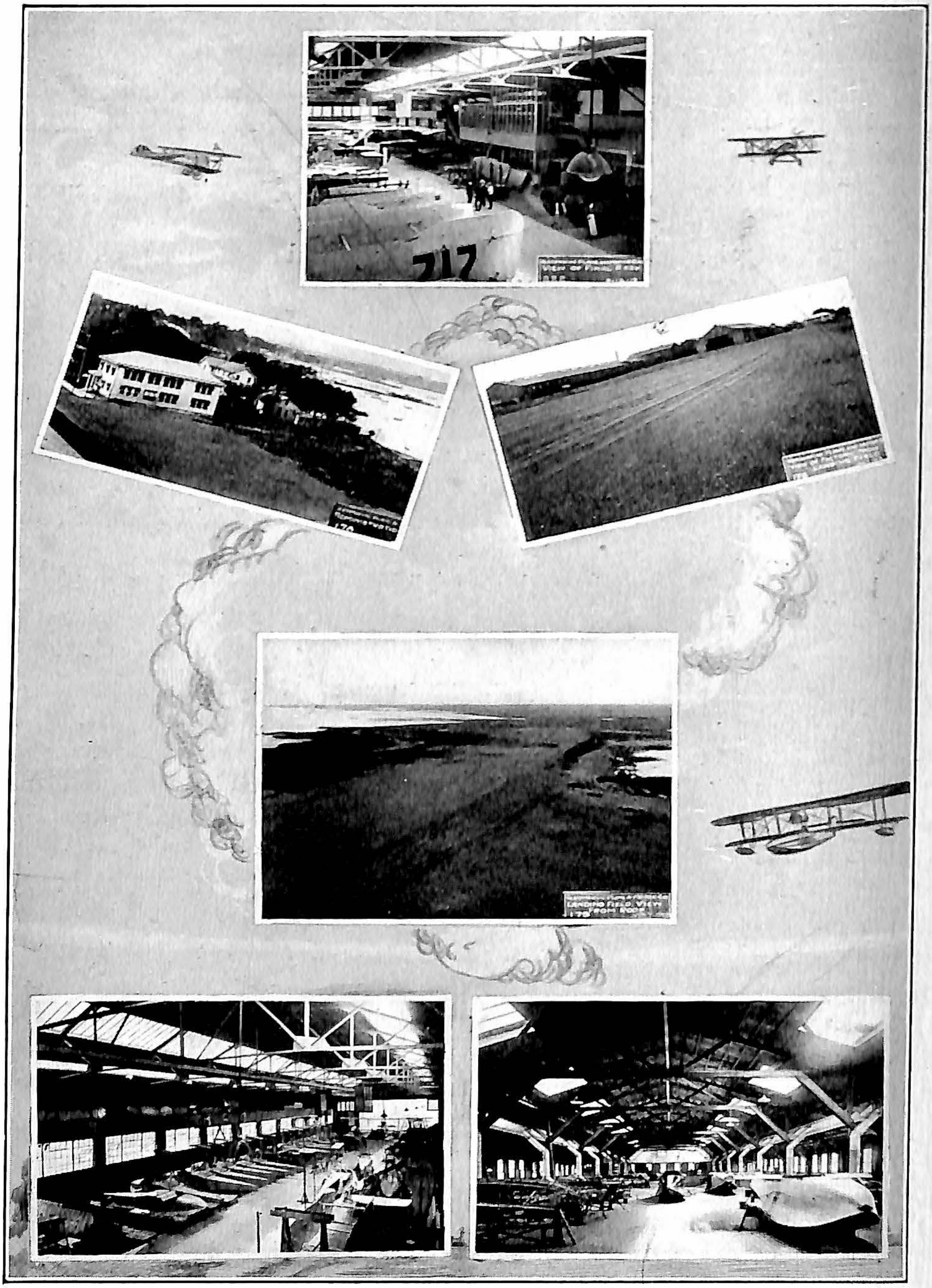
Realizing the demand for a machine with a multiplicity of motors powerful enough to carry a number of passengers, the construction of a twin motored, five passenger cabin flying boat was started. This machine, known as the Model 60, promises to be very successful as a passenger boat.

Although the Aeromarine Plane and Motor Company has confined its production efforts to flying boats, the land machine has not been overlooked, in an experimental way. During the year the Model M. L. Three-Place tractor airplane was designed and built.

During the 1919 Aeronautical Exposition the 27th (New York) Division returned from France on the *Leviathan;* and it was decided to greet the soldiers by air. C. J. Zimmermann, chief test pilot for the company, volunteered to carry out the commission with a Model 40 flying boat. Accordingly on March 4th a package of letters, consigned to the commander, was carried out and literally put on board the steamer by Pilot Zimmermann. It was necessary to bring the flying boat very close to the rear of the steamer to make certain the delivery.

Later, Otto Praeger, Second Assistant Postmaster General, ordered the experiment of delivering mail by airplane to a ship at sea. Accordingly Thomas A. Patten, Postmaster of New York City, with the cooperation of David Lindsay of the International Mercantile Marine and Inglis M. Uppercu, President of the Aeromarine Plane and Motor Company, arranged that the experiment be undertaken on the White Star Liner *Adriatic,* sailing from New York August 14th, 1919. The Aeromarine Model 40 "C" flying boat, especially equipped, was used.

Although the weather conditions were exceedingly unfavorable on the morning of the 14th, it was decided to carry out the pre-arranged



1. Aeromarine Final Assembly Room. 2. Aeromarine Administration Building. 3. Aeromarine Factory from Landing Field. 4. View of Aeromarine Landing Field from Roof. 5. Assembly Room, Aeromarine Factory. 6. Hull Constructing Room, Aeromarine Factory.

plans. Pilot Zimmermann with Richard Greisinger, as mechanic and operator of the mail dropping device (which had been worked out after days of careful experimenting at Keyport) started from 86th Street with the bag of mail and successfully dropped it on board the steamer at 2:10 o'clock that afternoon, one hour and forty-five minutes after the vessel had sailed.

From time to time damaged machines have been sent to the factory by insurance companies and individuals for repairs. Considerable work has been done on privately owned J. N.-4 land machines, which had either been through crashes or were in need of general overhauling.

Toward the end of the summer the air service selected various companies to rebuild D. H.-4 fighting planes into D. H.-4-B machines. The Aeromarine Plane and Motor Company was first given a contract to reconstruct seventy-five of these planes; and later the order was increased by fifty, making a total of one hundred and twenty-five. The first order was completed fully a month ahead of the contract time allowance of ninety days.

At the request of the Navy, bids were submitted for three machines designed and built according to specifications for ship airplanes. A contract for three machines was awarded, and they were built.

FLIGHT OF AEROMARINE MODEL 40 BOAT FROM NEW YORK TO HAVANA, CUBA, AND RETURN

As it was necessary to send a pilot and mechanic to Cuba to open a passenger service between the Island Republic and Key West, using a Model 50 "S" and a 40 "C" flying boat, it was decided to send the two men by air in a 40 "B" flying boat. This machine arrived in Key West after a flight of twenty hours and forty-five minutes and from there escorted the other two machines to Cuba on their maiden trips, thus completing the first trip from New York to Havana by airplane.

And on Wednesday, December 3rd, 1919, the Aeromarine Model 40 "L" flying boat piloted by Mr. Zimmermann with Richard Greisinger as mechanic, and Aero, the bull pup mascot, returned to the Aeromarine Plane and Motor factory, having completed the first trip by airplane from New York to Havana and return.

The Model 40 boat was flown to Havana, not so much to allow Pilot Zimmermann and Mechanic Greisinger to aid in starting the first air service between Key West and Havana, but to thoroughly

Airplane photograph of Aeromarine Factory at Keyport, New Jersey test in actual service two types of aeromarine motors, which later were to be put on the market. They are the Models "L-6D" and "B-8."

The "L-6D" is a direct drive, 6-cylinder aluminum block motor with a removable head, camshaft and valves being located in this head. It has shown remarkable efficiency in oil and gasoline consumption, both on the block and in flying tests. As a tried and proven piece of machinery, the "B-8" 8-cylinder, Vee engine has met with great success, it having been used in the 1918 trophy contest where it made an excellent record.

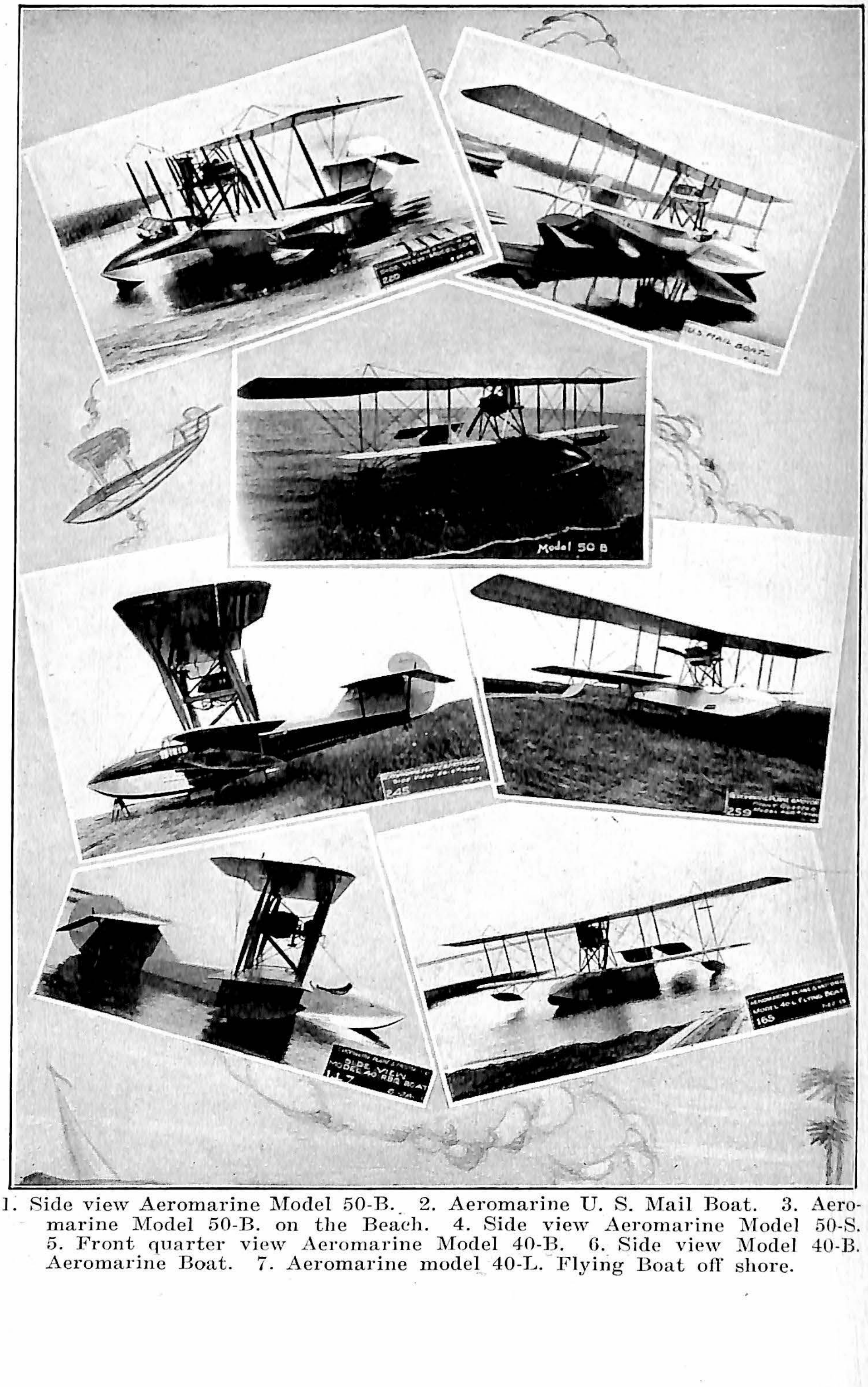
The Model 40 flying boat left Keyport, equipped with a "B-8" motor, on Monday, October 27th. The weather up to the time of starting was so foggy it was deemed advisable not to make an earlier start. The fog then lifted sufficiently to warrant beginning the flight.

The boat passed Deal Beach 25 minutes later, but ran into fog so thick it was necessary to fly entirely by compass. Later, it was decided to land in the ocean and wait for the weather to clear a bit. As an hour's wait did not improve conditions, Pilot Zimmermann again took the air and flew a course he thought would take him down the coast. After a few minutes' flying he again landed and found himself in front of a hangar at Atlantic City. The weather continued unfavorable so he laid over until next day.

The flight was resumed next morning. At Assategue the ship was refueled and guided to Manteo, North Carolina, where it was decided to spend the night. This city is only a few miles from Kill Devil Hill, the scene of the Wright brothers' early experiments and first success.

Leaving Manteo the next morning and passing Moorehead City, Southport, North Carolina, Beaufort, South Carolina, the voyagers made a landing, finally, four miles from St. Augustine, Florida, where a gallon of oil was obtained from a motor boat and the flight resumed to St. Augustine and thence on to Key West. After two days spent in changing motors the boat was ready for another flight and the two service boats were assembled.

Delays, due to improper customs papers, passports, etc., prevented sailing from Key West before November 15th, when the three flying boats set out. Darkness overtook the "fleet" halfway between Key West and Havana, but aided by a spot light carried by "Admiral" Zimmermann and guided by compass, the "fleet" sighted "El Morro" light, four miles to port of the course; and heading about



1. Side view Aeromarine Model 50-B. 2. Aeromarine U. S. Mail Boat. 3. Aeromarine Model 50-B. on the Beach. 4. Side view Aeromarine Model 50-S. 5. Front quarter view Aeromarine Model 40-B. 6. Side view Model 40-B. Aeromarine Boat. 7. Aeromarine model 40-L. Flying Boat off shore.

accordingly, made a safe landing in the harbor. Customs formalities finally permitted the three machines to ride at anchor under the protecting walls of El Morro castle where they created a sensation, these harbingers of the future in a city whose heart is always open to those who navigate the seas.

Pilot Zimmermann set out on the return flight in his flying boat the morning of November 19th. The return was much the same as the outward voyage, except bad weather and strong head winds were encountered, greatly delaying the flight and necessitating a stop-over in Key West, Savannah and Hog Island, Virginia, to await better weather. During the last two days of the trip, Zimmermann and Greisinger suffered considerably from cold, not being equipped for cold weather flying. This was the first round trip between New York and Havana.

Motor development, which has been under way for some years past, has progressed rapidly to the perfection of two general types of motors, the Model " L-6D " and the " B-8."

The " L-6D," a vertical 6-cylinder motor, developing 130 horsepower, has been looked upon favorably by the Navy for some time. One motor was delivered to the Bureau of Standards and tested for more than 90 hours, making a very creditable showing. Ten motors of this type, incorporating various suggested changes, were constructed at once.

The type " B-8 " motor, which was used for the Marine Trophy Contest, has been developed to a high point of perfection. A new and improved type of this motor with the cylinders at forty-five degrees instead of ninety has been built.

Various additions to plant equipment have been made, including a complete new set of production machinery for the " L " motor division and many special machines, among which is a crankshaft grinder.

A propeller department with equipment sufficient to produce propellers for the total production of airplanes and spare parts has been established and is in good working order.

Thus, during the last year, the Aeromarine Plane and Motor Company has built and exhibited the first cabin flying boat sold for commercial use. (Model 50.)

Perfected a two place sportsman's flying boat. (Model 40.)

Designed and built the first flying boat used for passenger service between New York and Atlantic City. (Model 50 " S.")

Designed and built the first flying boat used to carry mail to a ship at sea. (Model 40 " C.")

Designed and built the first flying boat to carry a commercial traveler over his territory. (Model 40 "C.")

Designed and built the first flying boat, including the motor, to complete the trip from New York to Havana, and return. (Model 40.)

Designed and built a five passenger twin-engine flying boat. (Model 60.)

Finished a navy contract for training flying boats. (Model 40.)

Designed and built three special fighting ship airplanes for the Navy. (Model A.S.)

Rebuilt one hundred and twenty-five D. H.-4 airplanes on an army contract.

Completed the experimental work on two separate types of airplane motors. (Models "L-6D" and "B-8.")

THE BOEING AIRPLANE COMPANY

PLANT — Georgetown Station, Seattle, Washington.

Officers and Directors

President	W. E. BOEING
Vice-President and General Manager	E. N. GOTT
Secretary and Assistant to the President	J. T. HARTSON

ON the afternoon of November 15th, 1916, a small group of sportsmen stood on the landing platform of a large hangar on the North shore of Lake Union, near the center of Seattle. Interest was intense in this little group, which was formed at the instance of W. E. Boeing, for the purpose of contributing to the development of aeronautics. This day was to witness the first flight of a machine representing their combined effort. A small seaplane had just left the hangar. With its motor idling, the machine stood off the landing platform, a beautiful picture against the blue water. Suddenly, with a roar from its motor, the machine gathered headway, and with the ease of a seagull, gracefully left the surface of the lake for the first time. A cheer went up from the little group. Only those who have firmly held to a definite principle over months of effort, can appreciate their enthusiasm, for this product of their ideals was the first American designed plane to combine symmetric and assymetric stability.

The new machine was original. It was a biplane combining 50 per cent. stagger, 174½ degrees dihedral, 2½ degrees decalage, and the use of balanced elevators entirely eliminating the horizontal stabilizer. This combination gave inherent stability, both lateral and longitudinal, and did not in any way detract from the controllability and ease of operation of the machine. Rather, the controllability was increased, for few seaplanes can perform the variety of stunts of which this type is easily capable.

But this machine did not represent the first effort of this group. In the summer of 1915, Mr. Boeing became greatly interested in aeronautics. In October he began flying instruction at the Glenn L. Martin school in California. On the completion of his course, early in 1916, a machine, Model T. A, was ordered from the Martin factory. This machine was delivered in Seattle early in the spring and active flying undertaken. Not satisfied, however, with the limitations of flying an already developed machine, Mr. Boeing gathered together a group of technical assistants and began the design of the first "Boeing" plane. The craft was along orthogonal lines corresponding with current practise, and was known as the B. & W. model. By installing the necessary machinery in the hangar which had been built to house the Martin plane, the construction of two of these models was commenced. The first flight, with Mr. Boeing as pilot, was made on June 29th, 1916.

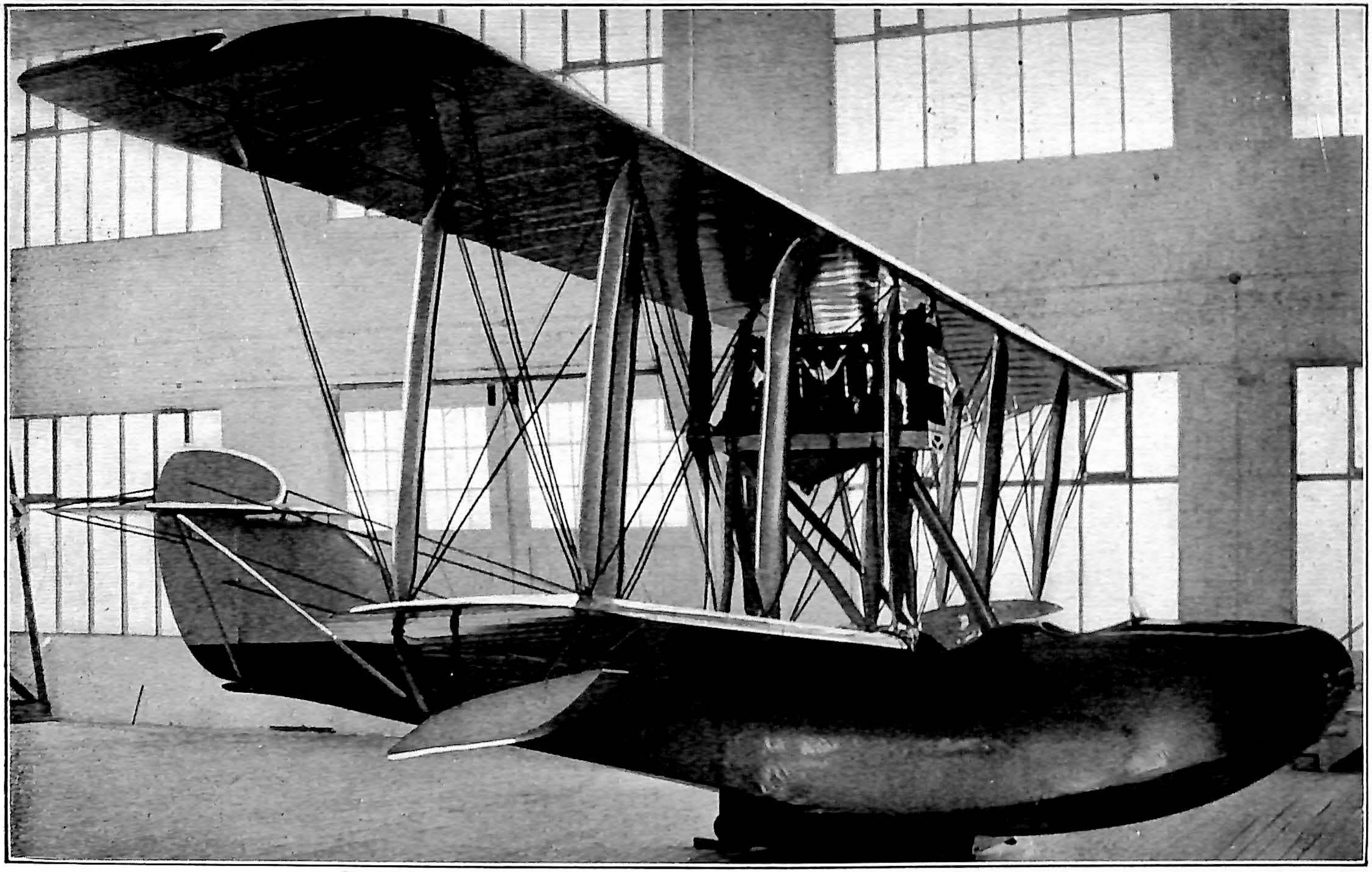
By this time it was found that the business necessary to the continuance of experimental work could more easily be carried on in the name of a corporation: Consequently, on July 15, 1916, the Pacific Aero Products Company was organized and the activities taken under that name. Later, on April 30, 1917, the name of the corporation was changed to the Boeing Airplane Company.

The original plant operated by the Pacific Aero Products was taken over in the spring of 1917 and consisted of one large two-story building, located on the Duwamish River, just south of the center of the city. The design and construction of the first distinctly "Boeing" plane, was carried out at the Lake Union hangar, and was followed by an extensive series of experiments on pontoon design, that ended with the successful development of a twin float landing gear which was used on the succeeding models.

Both the United States Army and Navy were quick to recognize the merits of the new Boeing plane. Experimental orders were soon placed for training machines of this type. The Type E. A. was developed for the Army and was a "Sociable Seater" training machine powered with the Curtiss O. X. X.-2, eight cylinder 100 horse-power motor. The Navy placed an experimental order for training machines very similar to the original type powered with the Hall-Scott A.-7-a, 100 horse-power motor. These machines were delivered to the Training Station at Pensacola, Florida, soon after the declaration of war, where exhaustive tests proved their adaptability to the training of Naval Aviators. As a result of these tests 50 machines were ordered for use at the San Diego Naval Air Station, and deliveries were made in the spring of 1918.

Continuing along the line of experiments on this type, the Navy requested a development using the single float, 178 degrees dihedral, and the Curtiss O. X. X.-5 motor. The type C.-1-F. was therefore completed and delivered to the Hampton Roads Naval Air Station for tests.

In order to handle quantity production during the war emergency, the original factory was greatly enlarged by the addition of several



Boeing B.-1 Commercial Flying Boat

buildings. Throughout construction one cardinal principle was maintained. The Boeing plant was to be an ideal aircraft factory and therefore must be self-contained. All operations necessary to the construction of modern aircraft could be performed within the plant and as a result a high standard of workmanship was maintained. To build up this standard has always been the ideal of the Boeing organization.

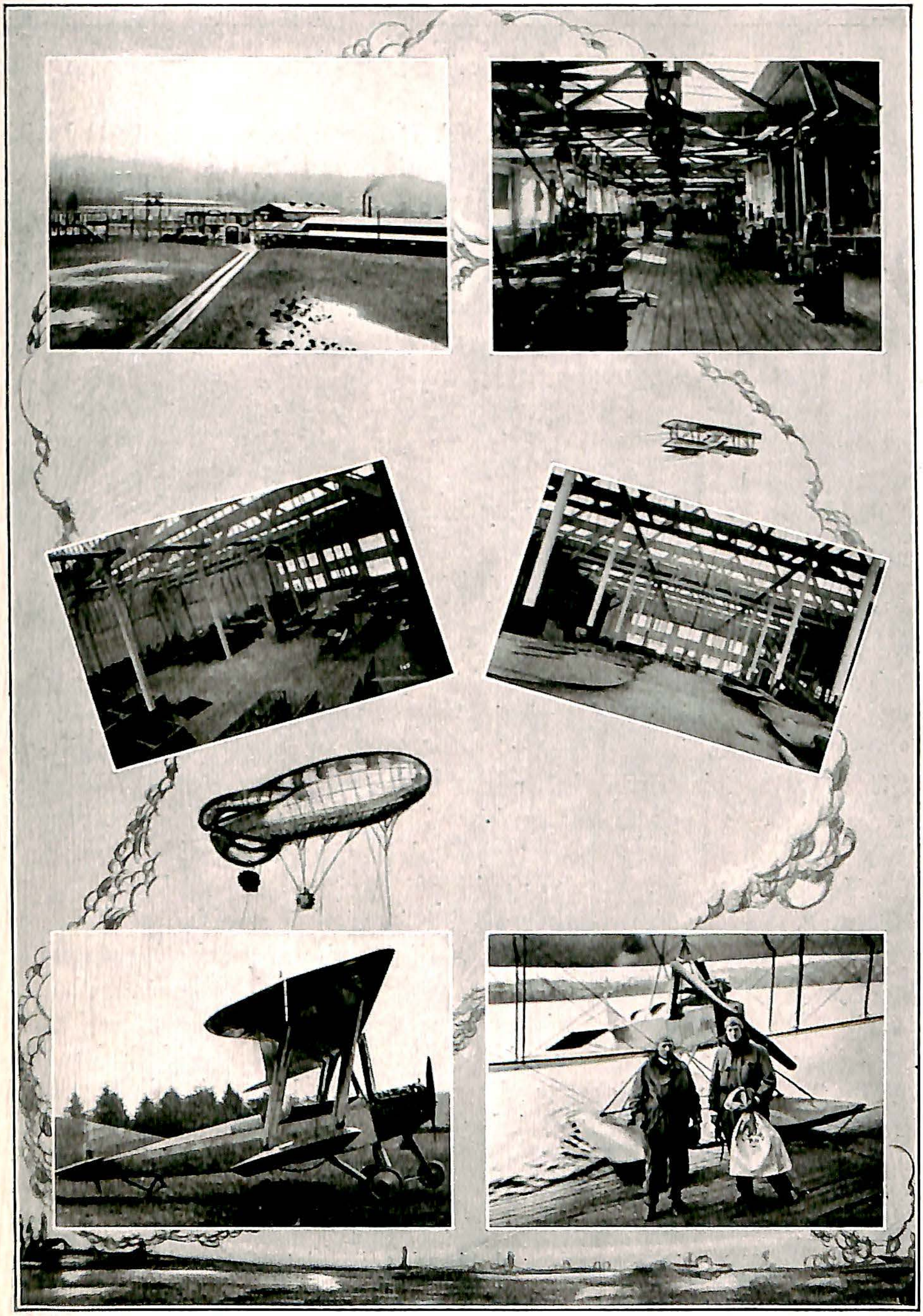
In the summer of 1918, the contract for training planes having been completed, the Navy requested that the efforts of the company be turned to the production of the successful standardized flying boat, known as Model H. S.-2-L. This craft was used extensively for submarine patrol and coastal observation on both sides of the Atlantic. The H. S.-2-L flying boats were much larger than the training planes and made necessary the construction of additional facilities.

Pursuing the practise followed in the previous buildings, a new assembly building was completed, embodying tile mill construction. This building is 200 feet long by 150 feet wide, and has a clear floor space 200 feet long by 100 feet wide with 30 feet headroom. The farsighted policy of providing a room of this size is shown in the present tendency toward the development of exceedingly large machines, and this room is of ample size in which to assemble the super-aircraft of the next few years.

With the signing of the Armistice and its accompanying cancelations, the company was permitted to finish only twenty-five of the H. S.-2-L type. These were delivered in the spring of 1919 and embodied several changes, made at the request of the Boeing technical staff, which greatly increased the efficiency and performance of the machine.

During the war emergency the personnel of the organization attained a high state of efficiency. The long interest shown by Mr. Boeing in fostering aeronautical development had placed him in a unique position. As President of the company he not only gave his active interest to the executive development but his influence in the design of the various models had been a practical help from the scientific standpoint.

Throughout the emergency the extensive executive and manufacturing experience of E. N. Gott, Vice-President and General Manager, has contributed materially to the success and final formulation of the organization. Coming from the Griffin Wheel Company, Mr. Gott



1. General View of Boeing Plant. 2. Boeing Machine Shop. 3. Boeing Assembly Department from mezzanine floor. 4. Boeing Assembly Room 200 x 100 with 30 feet of head room. 5. Boeing Model E. A. Social Seater Training Plane. 6. Arrival at Seattle of First Aerial Mail, March 3, 1919. W. E. Boeing, Pilot. Edward Hubbard, Assistant Pilot.

brought a wealth of practical experience the value of which cannot be overestimated.

Early in the spring of 1917, J. T. Hartson became connected with the company. Starting with the technical development, Mr. Hartson has progressed through all departments. This valuable experience is now being used to practical advantage in the executive position he now holds as Secretary of the company and assistant to the President.

The Superintendent of the Boeing manufacturing departments, C. A. Berlin, was an early and enthusiastic devotee of flying. Mr. Berlin was a member of the first Curtiss class in flying at San Diego in 1913, and subsequently gave exhibitions throughout the country, developing an excellent reputation as an exhibition pilot. His work in crystallizing the organization of the manufacturing departments cannot be overvalued, particularly in view of the increased production necessary during the war.

The early technical development was under the direction of J. C. Foley, who subsequently severed his connection with the company. During the war, John W. Miller, Professor of Aeronautics at the University of Washington, held the position of Chief Engineer, and materially assisted in the technical development during that period. The present technical staff consists of C. L. Egtvedt, chief engineer, L. S. Marsh, assistant engineer, and P. G. Johnson, production manager. The efforts of these men have been untiring and their progressive development along both technical and practical lines has kept them in close touch with the rapid advance of aeronautics.

Immediately on the signing of the Armistice, the future plans of the company took definite form. Realizing the natural advantages of the local district for the use of seaplanes and flying boats and considering the extensive experience represented by the organization in the design and construction of such types, it was decided that the future field of activities would center around the development of aircraft for use about the inland waters of Puget Sound and Alaska. The efforts of the engineering department were immediately directed to this end and several highly satisfactory types were developed.

Slight modifications were made in the "C" type, which had been so successful for naval training purposes, adapting it more fully to the needs of commercial users. It now represents the development of years of experience and combines extreme maneuverability and ease of control with great strength and sturdiness. This model is

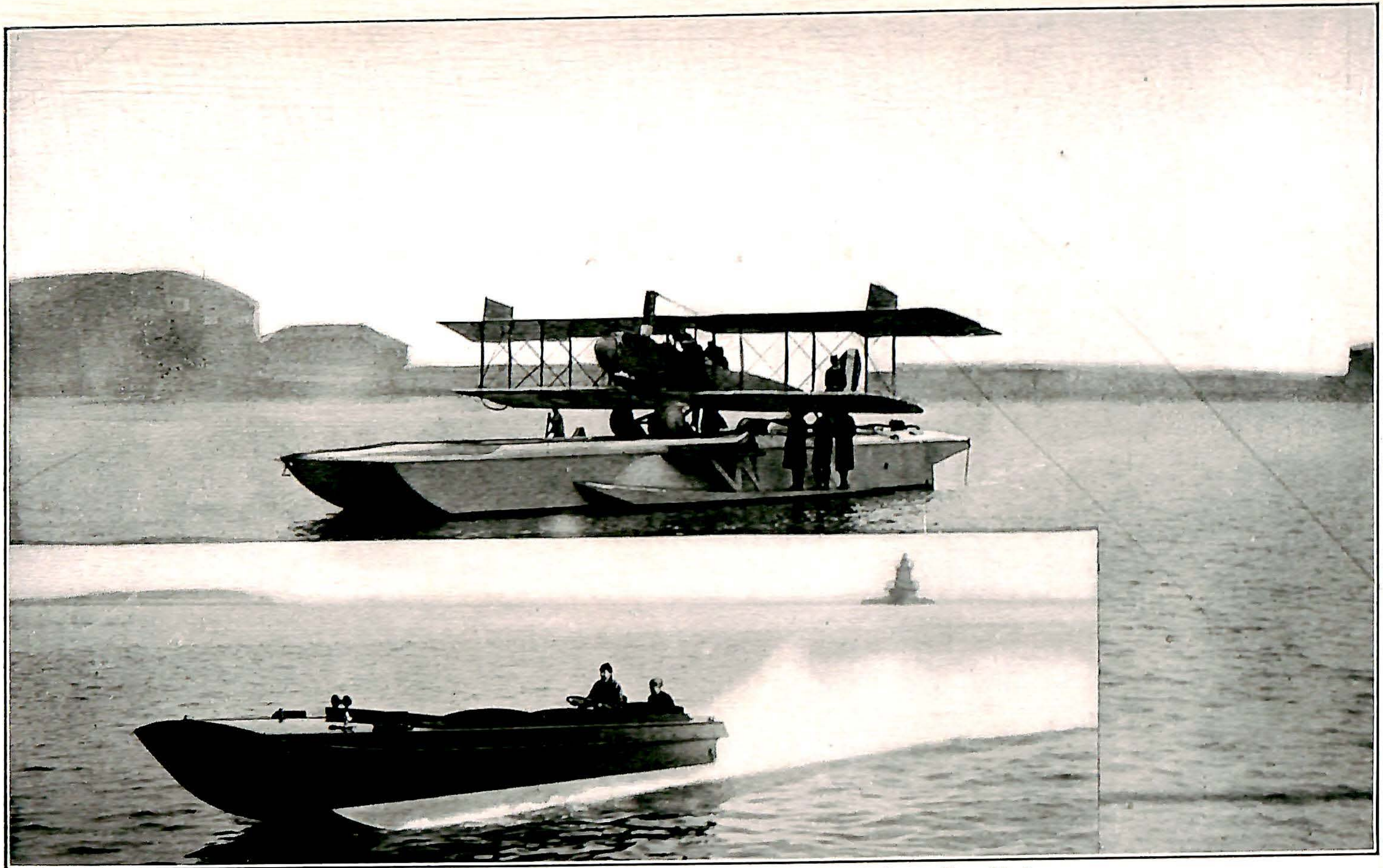
Boeing Model C.L.-4-S. Naval Training Seaplane now known as C. L.-4-S and is powered with the new Hall-Scott Liberty-4 motor.

Two decidedly new developments were made, improving the war practise in flying boat construction. These types are known as the B.-1 and B. B.-1. Both types have been designated for use under the extremely hard conditions that will be experienced during the early years of commercial aeronautics. The hulls in particular representing the latest development of strength and rigidity, being of laminated red cedar, laid at 45 degrees to each other and to the center line of the boat, with fabric and marine glue between the plies. This construction eliminates the use of fins or sponsons as was common in war practise, and greatly increases the hull strength, in addition to materially reducing its weight.

The B.-1 has a wing spread of 50 feet 3⅛ inches, is powered with the Hall-Scott Liberty-6, and develops 93 miles per hour at high speed. A low landing speed of 50 miles per hour, a climb of 3,600 feet in ten minutes, gasoline capacity for five hours' continuous high speed travel, and an allowance of 560 pounds for passengers or mail, make the machine eminently suited for commercial use.

The Model B. B.-1 is similar in design to the B.-1 but somewhat smaller, being powered with the Hall-Scott Liberty-4. It has a wing spread of 45 feet 6 inches, a high speed of 86 miles per hour, a landing speed of 34 miles per hour, gasoline capacity for three hours at high speed, will climb 3,400 feet in ten minutes, and has a passenger allowance of 500 pounds. These models have found great favor in the Northwest, the former for heavy commercial work, and the later as a sportsman's model.

It is of interest to note that in order to complete the field of aeronautical development, the Boeing Company became the sole licensees for the construction of the sea sled under the Hickman patents. Due to their high speed and great seaworthiness, these craft were used extensively by the Navy as rescue boats in connection with the Air Stations. Boats of this type were completed just before the Armistice was signed for use as torpedo carriers. Being of economical construction, and yet carrying a charge capable of sinking a capital ship, their offensive value was indeed great. A larger type was developed from the deck of which land airplanes were flown with great success. This type of boat was intended for use in connection with the larger types of bombing planes, the plan being to deliver the plane close to the German submarine bases of the North Sea, near which it could



Boeing Sea Sled and Converted Seaplane mounted on Sea Sled be launched into the air with full supply of gasoline and bombs. This eliminated the long flights necessary without the sea sled equipment.

Because of its high speed and seaworthiness, the sea sled is well suited to pleasure and commercial uses, and the Boeing Company is now developing the territory comprising the western section of the United States and Alaska, and the insular possessions in the Pacific.

The same interest and patriotism shown by the Boeing organization during the war is now being directed toward the development of commercial aviation in all its branches. The high standard of workmanship that made Boeing planes notably successful during that period will be maintained through future years.

The Boeing organization — schooled in the exacting requirements of war operation — will be available to the commercial user of aircraft, while the same undying faith in the future of aeronautics that led to the original formation of the company will keep it in the forefront of aeronautical development.

CURTISS AEROPLANE AND MOTOR CORP.
CURTISS ENGINEERING CORP.
THE BURGESS CO.

Curtiss Aeroplane and Motor Corporation

New York City

President	J. N. Willys
Vice-President	W. W. Mountain
Vice-President	C. M. Keys
Vice-President	W. B. Stratton
Vice-President	J. E. Kepperley
Secretary and Treasurer	R. W. Moore

Directors

J. N. Willys	G. H. Curtiss
C. H. Conner	W. B. Stratton
F. H. Russell	W. W. Mountain
J. E. Kepperley	C. M. Mertz

C. M. Keys

Curtiss Engineering Corporation

Garden City, New York

President	G. H. Curtiss
Vice-President (First)	W. W. Mountain
Vice-President	F. H. Russell
Vice-President	W. L. Gilmore
Treasurer	R. W. Moore
Secretary	J. P. Tarbox

Directors

G. H. Curtiss, *Chairman*

John N. Willys	A. H. Marks
W. W. Mountain	C. M. Keys

The Burgess Company

President and Secretary	F. H. Russell
Vice-President and Treasurer	Greeley S. Curtis

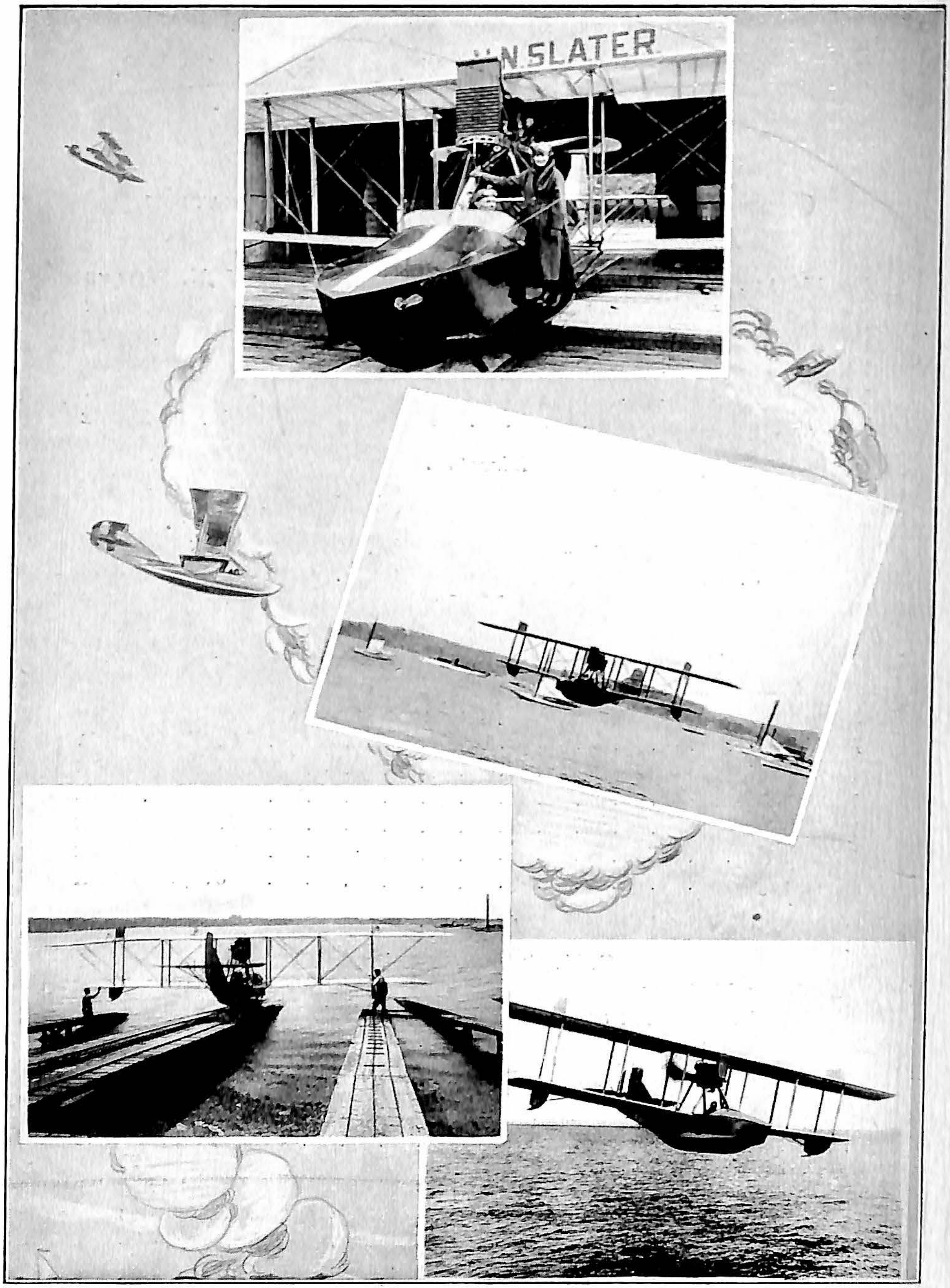
Directors

F. H. Russell	Greeley S. Curtis
W. B. Stratton	J. E. Kepperly

W. W. Moss

Factories: Hammondsport, Buffalo, Garden City, Marblehead

Flying Stations: Garden City, Buffalo, Atlantic City, Newport News, Miami



1. Dorothy Dalton ready for a flight in the Curtiss Seagull. 2. Curtiss Seagull over the bay at Port Washington, L. I. 3. Curtiss Seagull on the ways. 4. Curtiss Seagull in flight.

In the history of aircraft manlfacture November 11th, 1918, will be less important as the ending of the war than as the beginning of peace.

Particularly has this been true of the Curtiss organization with its experimental and production forces.

While better prepared than ever before to produce the accurate and progressive work demanded by military aviation, it has been extensively occupied during the last twelve months in meeting demands for commercial aeroplanes. The successful accomplishment by the Navy-Curtiss 4 flying boat, of the first transatlantic flight and the setting of new world's climb and altitude records by the Curtiss *Wasp,* link Curtiss design and production with two of the greatest scientific achievements of the year, both involving United States Navy aircraft.

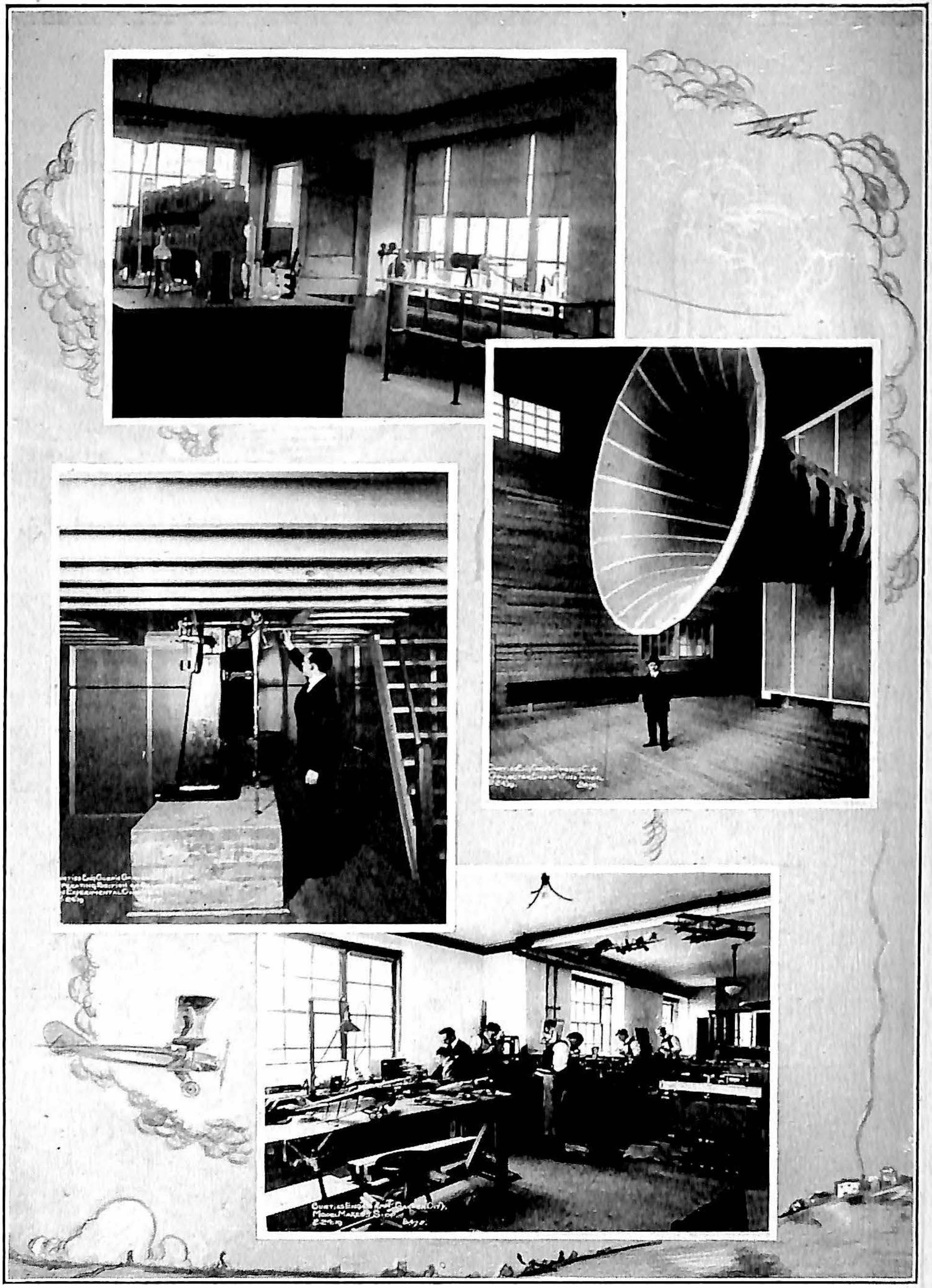
On the other hand, the industrial accomplishment, if entirely different, has been of at least as great a significance. Under the direction of Curtiss Executives the severe battle plane has been transformed into the upholstered aerial limousine. The machine gun has made way for the self starter. And Curtiss production has put the fuel cost of flying on a business basis, established an international system of dealers and distributors, and provided for public use five distinct commercial types of aircraft.

GOVERNMENT WORK IN 1919

At the conclusion of the war the nine Curtiss production plants of the Curtiss Aeroplane and Motor Corporation and the experimental plant of the Curtiss Engineering Corporation were busy with government orders.

It was evident that with contracts for four N. C. boats, a number of H.-16's, H. S.-3's, and M. F.'s with H. A. hydro-aeroplanes and 18-B and 18-T speed aeroplanes, the experimental plant would have government work on its floors for months to come.

The production plants, however, working on standard jobs, could finish their large contracts quickly. It was accordingly necessary to face the fact that with lessening government orders the Curtiss Aeroplane and Motor Corporation, the production branch of the organization, must retire from active work or reorganize and find and supply markets for commercial aircraft. The question of retirement was not considered. Reorganization for peace time aviation was begun.



1. A corner of the Chemical and Metallurgical laboratory, Curtiss Garden City Plant. 2. Collector end of seven-foot Curtiss wind tunnel, Garden City. 3. Balance of seven-foot wind tunnel, by which wind pressures on models are recorded. 4. The model shop, Curtiss Garden City, Research Department.

John N. Willys and Glenn H. Curtiss, the leaders in the Curtiss corporations, believed in the immediate practicability of the commercial airplane.

ORGANIZATION OF COMMERCIAL AVIATION

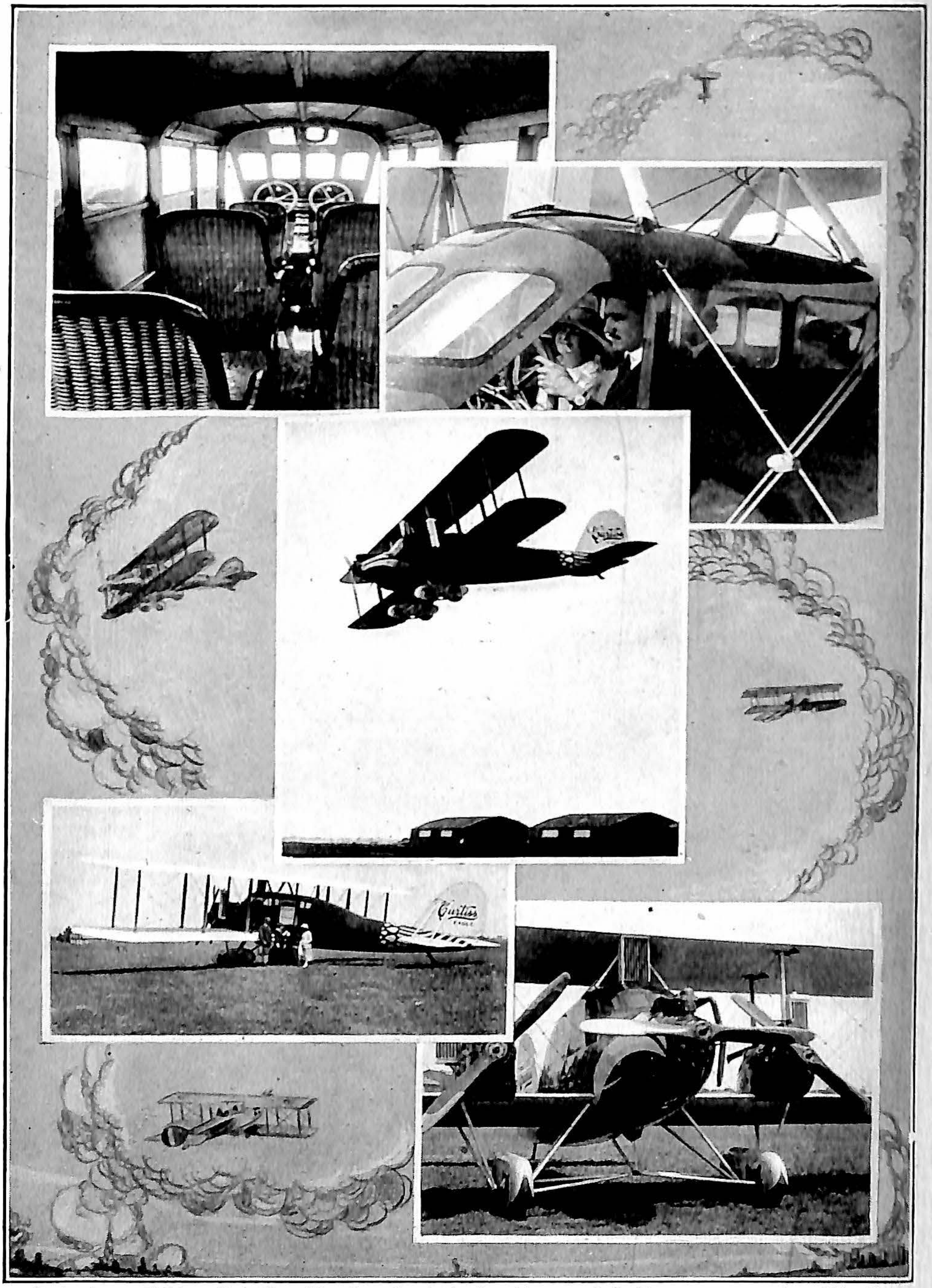
Mr. Curtiss, associated with aviation since 1904, flyer of the first aeroplane to make a publicly announced flight in the United States, and inventor of the hydro-aeroplane and the flying boat, had never regarded the airplane as a purely military or exhibition machine. As early as 1913 a four passenger flying boat of his design and construction had been used by Harold McCormick to commute between Lake Forest and Chicago. Curtiss aeroplanes had carried mail as early as 1911. In 1919 Mr. Curtiss turned with full confidence to a task in which he had always been interested and which now seemed capable of satisfactory completion: the designing of special types of aircraft for practical peace uses.

Mr. Willys brought to the problem of organization for the production and marketing of these machines a long and successful experience with the automobile industry.

With him W. W. Mountain, as first Vice-President and General Manager, assumed responsibility for peace time development. The business of making aeroplanes is still new. Few who make their first flight realize the importance of a skilful executive in the successful launching of a flyabout or aerial limousine. Mr. Mountain brought to the Curtiss organization tried and valuable executive experience. He has been a powerful directing influence in the establishment of the Curtiss Corporations upon a peace time business basis. Charles M. Manly, one of his assistants, was the designer of the motor for Langley's aerodrome, and an executive and consulting engineer identified with the Curtiss organization for many years.

EXTENSION OF CURTISS ACTIVITIES

Important development in the Curtiss Sales Department now began under the new Sales Manager, John P. Davies. Formerly Officer in Charge of Night Flying at Ellington Field, Texas, and later special American representative abroad for the study of night flying at the European fronts, Mr. Davies had considerable practical experience with flying and general aeronautical questions. Under his direction the Sales Department established Curtiss dealers and distributors throughout the United States, in Europe, Japan, and the Philippines.



1. Interior of the Curtiss Eagle, first intercity aerial liner powered with three Curtiss Six, 150 h.p. motors. 2. Bert Acosta at the wheel of the Curtiss eight-passenger Eagle. 3. Curtiss Eagle in flight. 4 and 5. General views of Curtiss Eagle, showing side entrance door, removable steps and power plant.

While this preliminary work was being completed the Department of Education and Sales Promotion, as part of the Sales organization, began a vigorous campaign under Fay L. Faurote in public education through aeroplane publicity, and in advertising designed to convince the business and pleasure worlds of the immediate practicability of the aeroplane for peace time service.

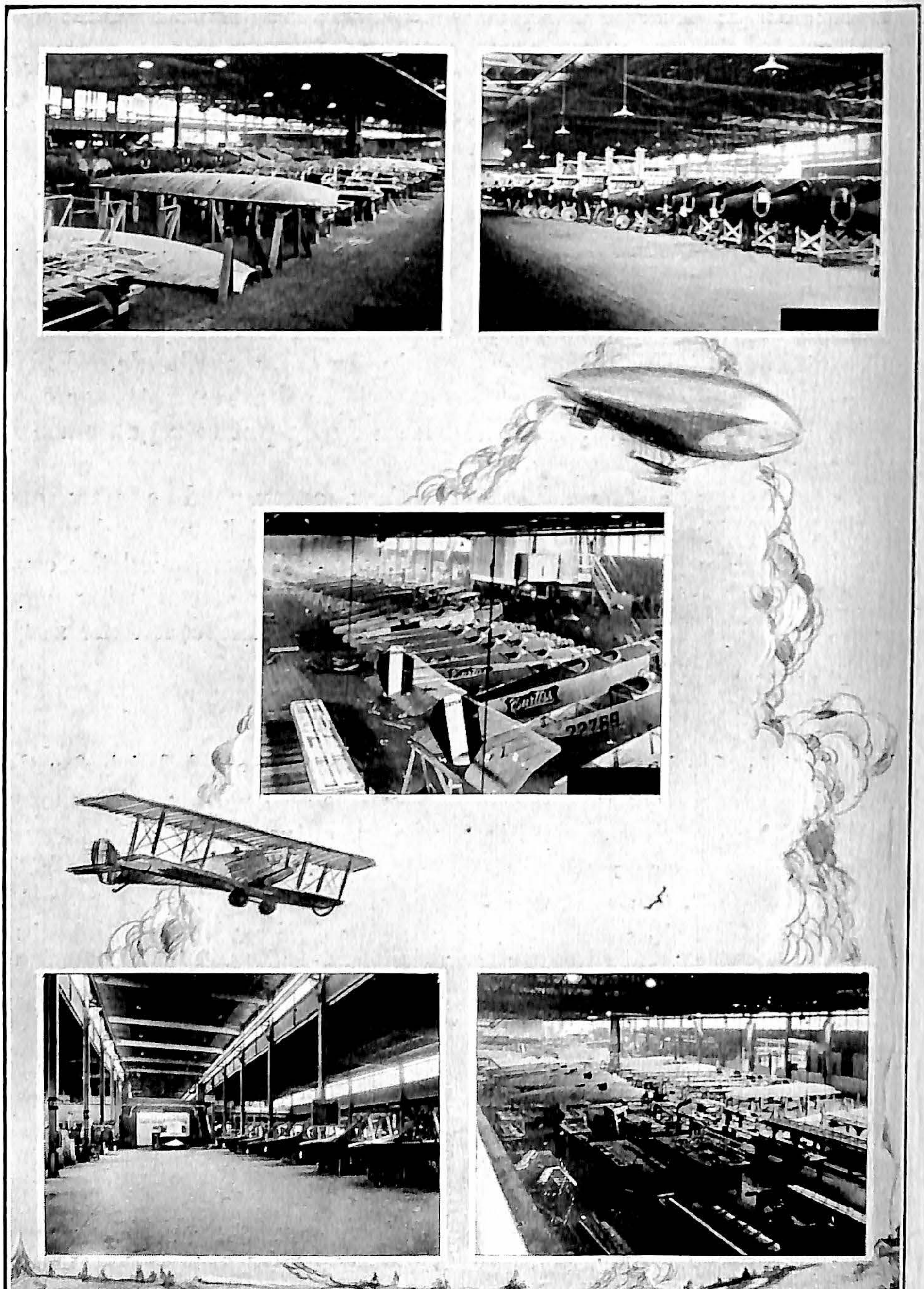
On April 4th, 1919, the first commercial Curtiss flying boat left the Garden City factory,— the three passenger flying boat *Seagull*. On April 12th, 1919, was made the first flight of the first Curtiss commercial aeroplane for 1919,— the three passenger *Oriole*. It is a matter of interest that these seem to have been the first post-war commercial designs for both marine and land flying put to regular use in any country.

In appearance and performance they announced a new era. "Make it safe," and "Make it comfortable" had been the demands of the business world. The new Curtiss designs paralleled the comfort of the automobile, reduced materially the cost of operation, gave new style and stability for everyday flying, and increased the available speed of their type.

NEW AERONAUTICAL TYPES

The *Oriole*, for instance, offered clean lines, enamel finish for the body, and a pleasing color harmony of orange and yellow. By means of a side door opening on the lower wing, entrance into the passenger compartment was made simple and easy. A touch of the self-starter button set the engine in motion. Cushioned compartments afforded comfortable seating, and specially designed windshields reduced motor noise and practically eliminated the wind pressure. Covering a ground space of only 36 feet for span and 23 feet for overall length, the new aeroplane had a speed of 96 miles per hour with the 150 horse-power K.-6 motor. This meant a fuel cost of from 3$\frac{1}{10}$ to 4 cents per mile of straight flying, or from a cent to a cent and a third for each passenger per mile. With transportation figured on a mileage basis the new aeroplane was thus able to offer service at a reasonable cost. At the same time it was, thanks to the construction of its body, a sturdy machine capable of resisting the roughest usage.

What the *Oriole* represented in the over-the-land flying, the Curtiss *Seagull* represented in practical marine aviation. Like the *Oriole*, it added to capacity without increasing power. It was equipped with a self starter. Entrance required merely the stepping from



1. Oriole Fuselages—Curtiss Buffalo Plant. 2. Curtiss Six Motors being installed in Curtiss Orioles. 3. Curtiss J.N.'s in process of rebuilding, Orioles in background. 4. Seagulls on floor of Curtiss Garden City Plant—Curtiss Scooter in Center. 5. Curtiss Panel and Fuselage Departments.

the "running board" of the lower wing into the comfortable compartment of the boat hull, where three seats were arranged for pilot and passengers. The result of a long evolution in flying boat building, the *Seagull* paralleled in small unit construction what the N. C.'s represented in larger units. Its hull, finished in mahogany planking, was sufficiently sturdy to ride rough water with safety. Employing Curtiss K.-6 motors it flew at a speed of 76 miles per hour.

TRANSFER OF GOVERNMENT AEROPLANES

With these two types ready for quantity production and the eight passenger Curtiss *Eagle* in process of construction for use as an aerial liner, Curtiss prospects for commercial flying were remarkably promising. Dealers and distributors were busy by early summer at Atlantic City, Boston, Los Angeles, San Diego, Chicago, and other cities, while the organization of new branch offices proceeded rapidly. Abroad a South American mission, composed of C. W. Webster, Lawrence Leon, and Orton Hoover, was active by July demonstrating the Curtiss *Oriole*, *Seagull*, and *Wasp*, and investigating South American aeroplane markets.

At this juncture the commercial aviation outlook was affected by an important action on the part of the Government.

Peace found the Army Air Service with thousands of training planes and motors. For many of these no legitimate governmental use could be found. It was decided to dispose of them.

With the question of marketing, however, came the question of preparation for sale. Many of the machines and motors had been used. The Government was not in a position to rebuild them. To sell them without guarantee among unknown buyers would be to reap a harvest of accidents and retard the development of flying. The furnishing of spare parts, too, represented an important problem.

It accordingly seemed advisable to sell the entire lot to some one responsible who would undertake to overhaul motors and rebuild engines and planes before disposing of them, and would guarantee a future supply of spares.

The Curtiss Aeroplane and Motor Corporation, as the company which had manufactured the major portion of the equipment to be sold, was a logical buyer and distributor of material, and with others, was given the opportunity of buying the government machines. After a careful inventory by Curtiss and Government engineers, an agreement was reached. The question of whether the

1. Dr. Brewster of Beaver City, Iowa, and his Curtiss J.N. 2. Curtiss J.N.'s for Spearmint deliveries. 3. Curtiss Model J.N.-4-D.-2. 4. Alfred Decker and Cohn Aerial Delivery service. 5. Curtiss HA Mail Plane. 6. Mary Roberts Rinehart in the cockpit of a Curtiss airplane. 7. Curtiss R.-4-L.M. Mail Plane. 8. Capt. Richard Depew, Head of Curtiss Flying School, Garden City, L. I. 9. C. S. Jones, Assistant Chief of Curtiss Flying Operations. 10. Curtiss Aerial Taxi Service.

number of aeroplanes could be disposed of caused great hesitation. It was felt by the Curtiss Companies, however, that the benefits bound to accrue to the industry through the proper preparation for the market of these planes and motors by some one responsible, and the establishment of aeronautical trade on a sound basis, outweighed the difficulties to be encountered.

FOUR AEROPLANES FOR PEACE TIME FLYING

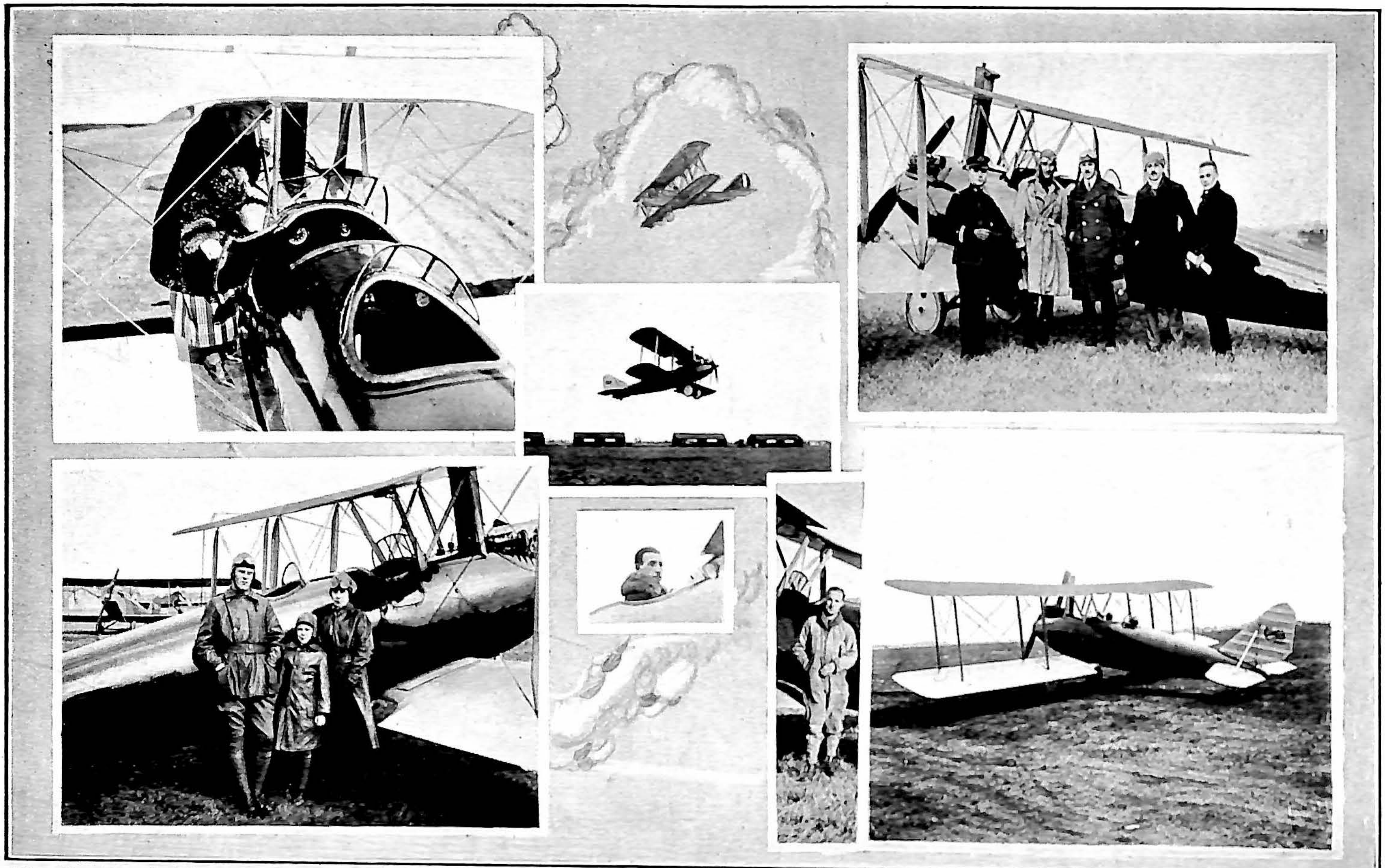
During the summer of 1919 the transfer of a number of planes was completed, but it was not until well into the fall that the government property as a whole may be said to have been put at the disposal of the Curtiss selling organization.

These army training planes, for the most past Curtiss J. N.'s, were by their design adapted to peace service. Built to withstand the hard knocks of training, they were calculated to meet the wear and tear of daily business or pleasure service. Their engines represented fuel economy. The cost price was considerably lower than that of any other high class machines put upon the aeronautical market. They offered the returning military aviator an opportunity to own and fly an aeroplane which he had grown to trust and appreciate during a period of stress.

With *Orioles, Seagulls,* Curtiss J. N.-4's, and J.-1's with Curtiss O. X.-5 motors available, the Sales Department now had four distinct aeronautical types to offer the public for commercial use.

ACTIVITY OF CURTISS PLANES

It is impossible here to trace in detail the activity of the Curtiss Aeroplane and Motor Corporation between March and December, 1919, embracing as it does the many records established by Curtiss dealers and distributors. On March 12th, 1919, Roland Rohlfs made for Lord and Taylor of New York City, the first commercial delivery of dry goods, transporting 150 pounds of merchandise from Roosevelt Field, Mineola, to Pelham Bay, New York, in 15 minutes. Under Lieutenant-Commander Scofield of the Third Naval District the practicability of the aerial ambulance was shown when a Curtiss flying boat transported a wounded officer from Far Rockaway to St. Luke's hospital, 113th Street and North River. Such demonstrations as the first aerial delivery of typewriters (Atlantic City, April 30th) by a Curtiss *Seagull,* the first regular clothing deliveries (Alfred Decker and Cohn, Chicago, June 3rd following) in Curtiss J. N.'s, the first



The Curtiss Oriole — 1. Oriole passenger compartments and side entrance door. 2. Upper center — Oriole in flight. 3. Oriole at Washington — Pilot Paul Collins and the Cuban representatives. 4. Mrs. S. E. J. Cox and her Curtiss Oriole. 5. Lower center — J. A. Morrell. 6. Pilot W. H. McMullen. 7. View showing seating of pilot and passenger, Curtiss Oriole.

flight of surgeon to patient in the same machine by Dr. F. A. Brewster of Beaver City, Iowa, May 24th, and the intercity flight of Mrs. S. E. J. Cox and her son in a Curtiss *Oriole* from Houston, Texas, to New York City, completed October 7th without plane or motor difficulty of any sort, are typical of what has been occurring.

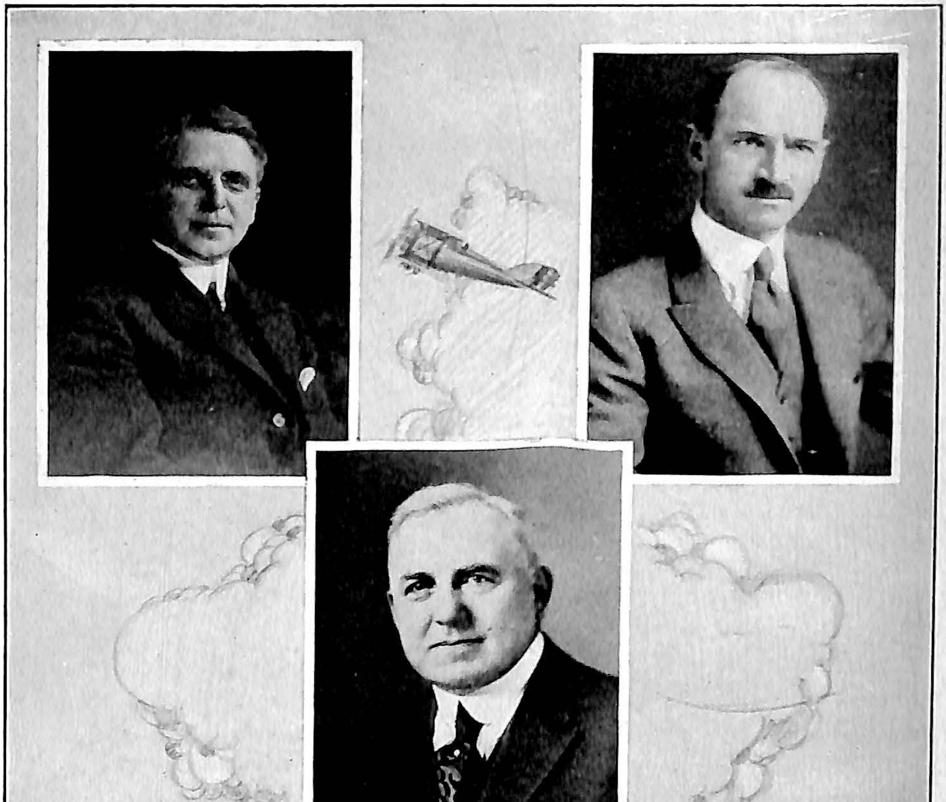
In the Aeronautical Convention tests at Atlantic City in May, 1919, the *Oriole* won first prizes for speed and reliability. Participating in the New York–Toronto reliability race, August 25th–29th, a Curtiss K-6 *Oriole,* piloted by Roland Rohlfs, took first prize for both reliability and speed among civilian types. Second, fourth, sixth, and eighth prizes were taken by Curtiss J. N.'s, O. X.-*Orioles,* and a Curtiss-motored J.-1 for reliability, and second and third prizes for speed by a Curtiss O. X.-*Oriole* and a Curtiss J. N.-4-D.

FIRST DAILY PASSENGER-CARRYING SERVICE

Between San Pedro and Catalina Island the Chaplin-Curtiss Aircraft Corporation initiated on July 15th the first daily aerial passenger carrying service. The Curtiss *Seagull* was the plane employed. During September the delivery of a complete moving picture outfit from Los Angeles to the ranch of W. R. Hearst was made from Los Angeles by the Chaplin-Curtiss Aircraft Corporation for the Los Angeles *Examiner.* The Wrigley Spearmint Company has used a number of Curtiss J. N.'s for advertising and sales purposes. Oil men in Texas and Oklahoma, ranchers in Montana and Iowa, theatrical circuits, movie players, news and photo services in New York have used Curtiss machines during the past year for inspection, administration, and publicity purposes. Well-known exhibition flyers such as Eddie Stinson, Ormer Locklear, and Ruth Law, have been using machines of the Curtiss J. N. type for exhibition and passenger carrying work, while others, such as Major S. E. Parker and Captain H. T. Wilcox, have used the Curtiss *Seagull.* Undoubtedly hundreds of thousands of people have made flights in such aeroplanes and flying boats during the last eight months. At Atlantic City alone, 2,500 ascended in two *Seagulls* at the Curtiss flying station.

NEW AERONAUTICAL MOTORS

In this commercial activity Curtiss planes have depended upon Curtiss motors. The O. X.-5, 90 horse-power engine had been used with the Curtiss J. N. by the majority of army flyers in their primary training. The new Curtiss K.-6, 150 horse-power motor, had been



1. John N. Willys. 2. Glenn H. Curtiss. 3. W. W. Mountain. 4. F. H. Russell.
5. R. W. Moore.

developed during 1918, together with the 400 horse-power Curtiss K.-12 motor. On March 6th, 1919, the adaptation of these motors to standardized production for commercial use was taken up by F. R. Porter as Chief Motor Engineer for the Curtiss Aeroplane and Motor Corporation. The work of the Curtiss K.-12 was done in connection with the Curtiss *Wasp* in speed and altitude flying. The 150 horse-power Curtiss K.-6 rendered continuous, successful service in both the *Oriole* and *Seagull*. Its run of 2,500 miles from Houston to New York in Mrs. S. E. J. Cox's *Oriole* without even the changing of a spark plug is unique. Other performances with which it was associated were the flight of R. W. Bubbard's *Oriole* through Oklahoma, Mississippi, and Tennessee of 1,200 miles of "absolutely satisfactory" flying, and the remarkable performance of a *Seagull* piloted by W. H. Blair for the Thompson Aircraft Company from New York to Detroit via the Hudson, Barge Canal, and Great Lakes,— 700 miles in all.

II

The establishment of a new industry — as commercial aeronautics was in January, 1919 — in the teeth of difficulties can not be a matter of hazard. The success of the Curtiss Aeroplane and Motor Corporation, the production arm, was possible only because of the efficient scientific service of the Curtiss Engineering Corporation. This experimental branch of the Curtiss organization drew up the designs for the Curtiss *Oriole*, *Seagull*, and *Eagle*. At the same time it was engaged in other work widely affecting peace time aviation and the progress of military and other governmental flying.

The Engineering Corporation took form under the personal direction of Mr. Curtiss. In 1918 he established laboratories and factory at Garden City, and carried on in them the building of the N. C.'s, the speed triplane and biplane, the Curtiss K.-6 and K.-12 motors, etc.

During the course of the war, the Burgess Company of Marblehead, Massachusetts, became associated with the Curtiss Aeroplane and Motor Corporation, and some time after the Curtiss Engineering Corporation had begun its activities, Frank H. Russell, President of the Burgess Company, joined Mr. Curtiss at Garden City as Vice-president and General Manager. During the war he was president of the Manufacturers Aircraft Association. On retiring as president he was elected secretary of the Association.

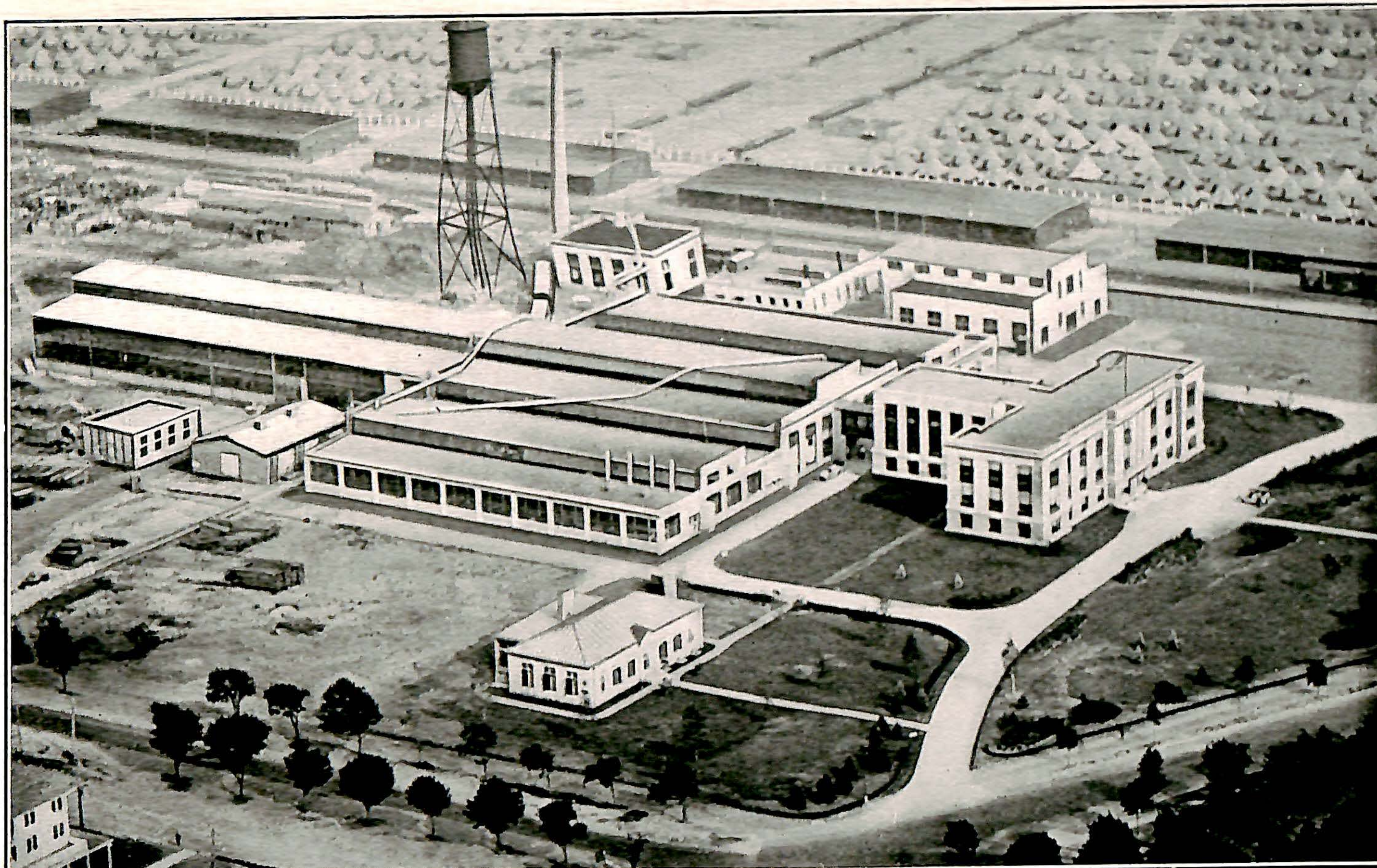
THE CURTISS WIND TUNNELS

The equipment of the Engineering Corporation for aeronautical research and experimental production had been not a little responsible for the remarkable work done on the N. C.'s, the speed machines, and the new motors. Perhaps the most important feature of this equipment was the wind tunnel building. Here three wind tunnels,—seven, four, and two feet respectively, have been in use. Most important of these is the seven foot tunnel, put in operation March 26th, 1919. Seventy feet in overall length, and from seven to seventeen feet in diameter, it is believed to be the largest wind tunnel in the world. Prior to its construction data was gathered concerning all notable wind tunnels both in the United States and abroad. Using this material as a point of departure, Curtiss designers made notable improvements in wind tunnel design over existing types. In particular the constancy of air flow was increased. The remarkably uniform velocity distribution in the air current of the new tunnel has insured an unprecedented accuracy in the measurement of wind forces.

Wind tunnels, which produce for small models conditions paralleling those of flight, and provide for the prediction of the performance of an airplane as a whole, or the efficiency of any part of it, are becoming of increasing scientific value. In the Curtiss laboratory 100 per cent. results have been obtained in foretelling the general behavior of Curtiss aircraft. The wind tunnel work has been under Dr. J. G. Coffin, Assistant Director of Research and formerly Associate Professor of Physics in the College of the City of New York. A graduate of the Massachusetts Institute of Technology, Dr. Coffin has for years given his attention to questions of Mathematics and Physics, and has made an intensive study of aerodynamical problems.

WIND TUNNEL PRACTISE AND RESULTS

Under his direction the Curtiss Model Shop has developed to a high point of efficiency. Here aeroplane models and models of aeroplane elements are made by skilled craftsmen for wind tunnel use. Varying in span from a foot to three feet, these miniature aeroplanes and flying boats, wrought in mahogany and aluminum, are accurate to thousandths of an inch. Built to the engineering designs for a contemplated machine, they are set up in the experimental chamber of the wind tunnel upon a spindle connected with a specially designed balance below. The speed of the air which is drawn past the model



Aeroplane View of Curtiss Engineering Corporation's Plant at Garden City, L. I., N. Y.

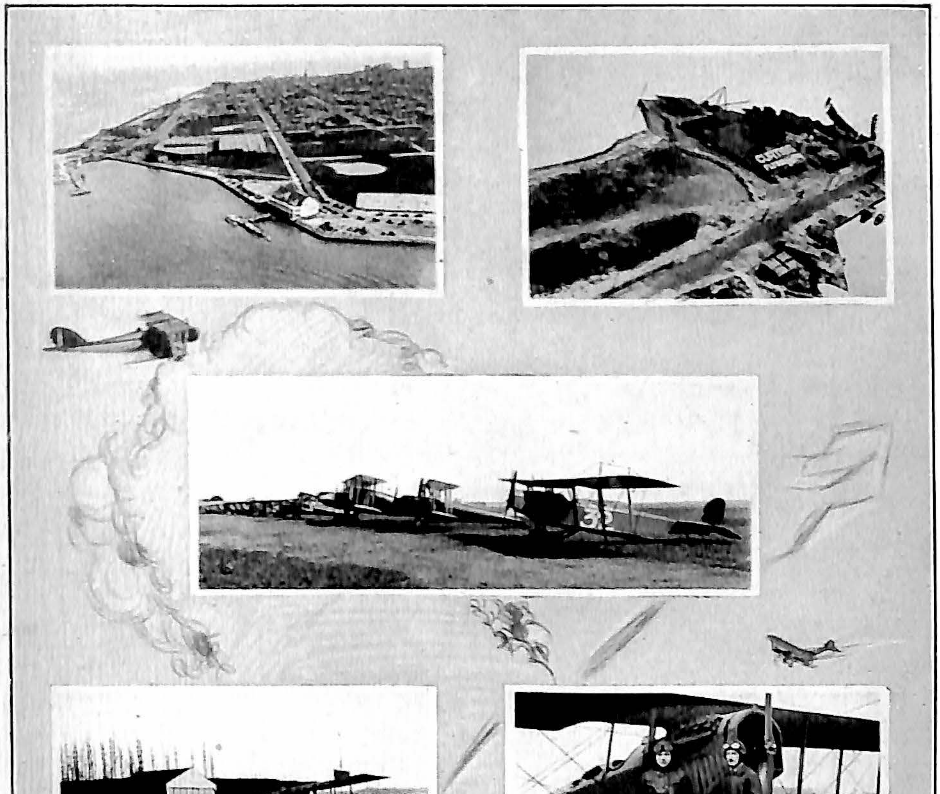
is determined by the action of a special propeller driven by a 400 horse-power motor. This motor is electrically controlled from the experimental chamber, and can furnish any speed desired, even to velocities approaching 100 miles per hour. These speeds are accurately measured by means of a new type of absolute pressure gauge.

The balance can record wind pressures in all desired directions to .0001 of a pound. Results are thus obtained which afford the basis for almost any knowledge touching the efficiency of aircraft. Shapes of wings can be tested for lifting capacity and for deadhead resistance. The efficiency of a fuselage shape can be determined. The pressures on the aeroplane in any position can be recorded. Stability, head resistance, action of rudder and elevator, behavior of streamline wires, air driven gasoline pumps, etc., become no longer matters of doubt, for they can be settled in the laboratory preliminary to any field work. As a result new Curtiss machines perform like seasoned types, showing that the aeroplane has been reduced to a problem like the railroad bridge, and solved in laboratory and factory preliminary to its first actual use.

TESTS FOR AEROPLANE MATERIALS

Another important part of scientific equipment used by the Curtiss Engineering Corporation was the Chemical and Metallurgical Research Laboratory. Here tests on wood, metal, "dope," cotton, etc., were scientifically carried out. Exact knowledge was made possible of the quality and hence the performance of every part of the aeroplane. This, checked against the stresses as figured from the wind tunnel data, insured a high factor of safety in Curtiss machines which made their construction as reliable as the scientifically erected bridge or tunnel to which the modern passenger daily trusts himself.

Nor has equipment for motor development been neglected. During the past year two new Curtiss motors, the Curtiss Six and the Curtiss Twelve, have been evolved. These represent a re-designing for commercial production purposes of the Curtiss K.-6 and K.-12 aeronautical engines. They have been developed under Chief Motor Engineer F. R. Porter, who was Chief Motor Engineer at McCook Field, Dayton, Ohio, during the war. Under Mr. Porter's direction the motor laboratory has been enlarged. A 400 horse-power Sprague dynamometer with its own power plant and a 50 horse-power Sprague dynamometer for testing pumps, cam shafts, etc., have been installed. A torque stand, an exhaust system for carrying off all exhaust gases



1. Curtiss Flying Station, Atlantic City. 2. Norfolk News, Va., Curtiss Station. 3. Curtiss Airplanes at Garden City Field. 4. Flying Boat coming to the ways at Curtiss Port Washington Station. 5. Curtiss Instructor and student at Garden City Flying School, Captain R. H. Depew and Miss Laura Bromwell. 6. Curtiss Buffalo Flying Field with Orioles and JN's before the Hangars.

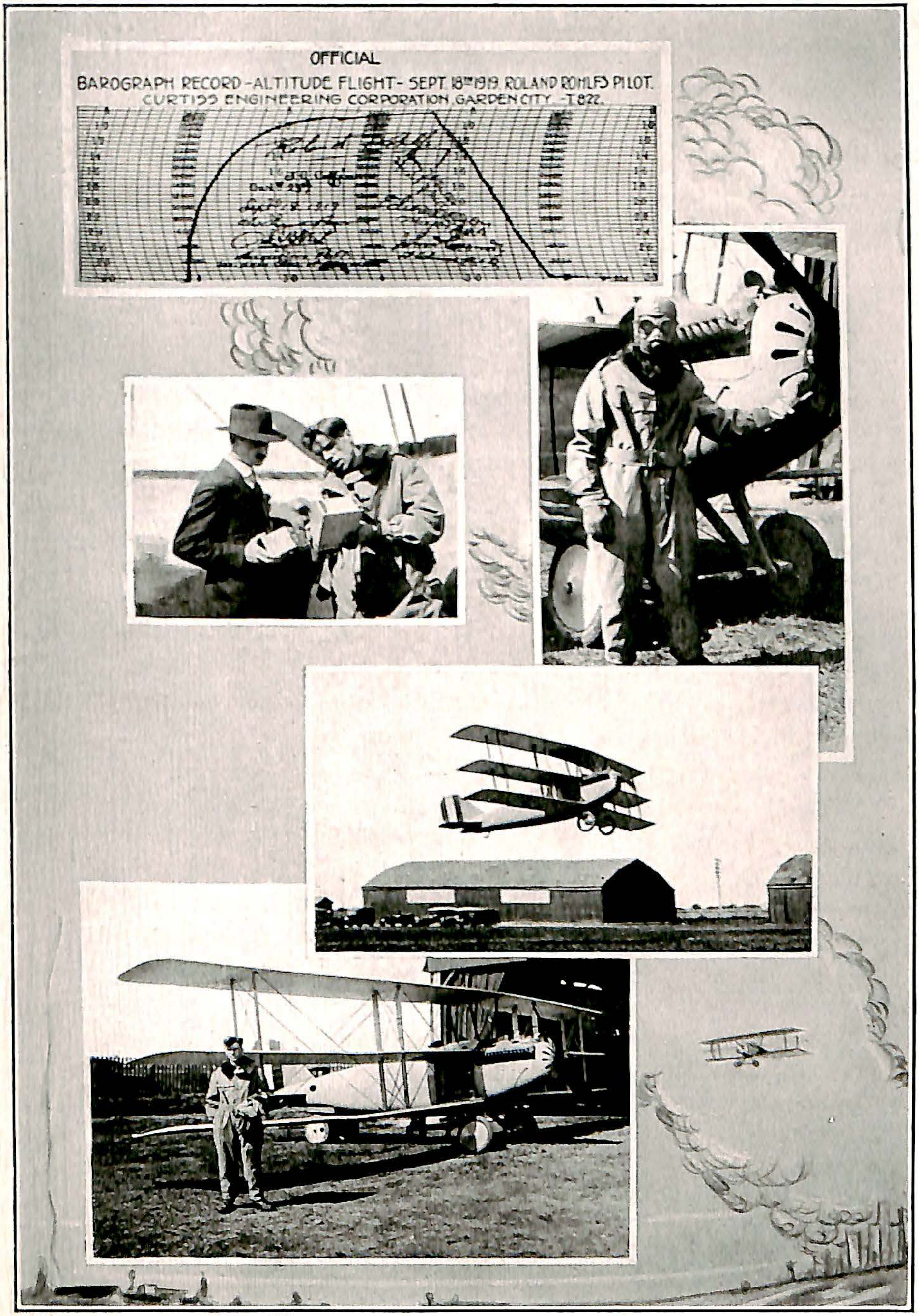
by underground conduits, a stock room and a machine shop are part of the equipment. All gasoline, oil, etc., employed in laboratory work is scientifically weighed and results to date show that absolutely accurate tests for power, consumption, etc., can be run.

FIRST FLIGHT ACROSS THE ATLANTIC

In January, 1919, the N. C.-2 has just made way on the floor of the N.-C. extension of the Garden City plant for the N. C.-3. This flying boat with its sister the N. C.-4 required the work of 800 Curtiss men and women until late in April. It is now well known that the United States Navy decided late in 1918 to employ these gigantic flying boat bombers in the cause of science. The first flight across the Atlantic, May 16th–31st, 1919, is a story that any schoolboy can tell. It is a tribute to the bravery and the skill of United States Navy fliers. It was also an indication of the possibilities of commercial aviation. Coming at the beginning of the first year of peace, it showed the scientific progress which the aeroplane had made during four and a half years of war. It also revealed the skill at the disposal of The Curtiss Companies in conjunction with the naval constructors. The N. C.'s were, indeed, an index to the character and accomplishment of Mr. Curtiss. Since his development of the seaplane in 1910–1911, Mr. Curtiss had led the world in hydro-aeroplanes and flying boats. It was significant that he should be asked to cooperate with government engineers in 1917 in the designing of the largest heavier-than-air craft built for the United States Aviation Service during the war, and the first aeroplane to cross the Atlantic.

CURTISS MAIL PLANES

The Navy-Curtiss flying boats represented only a part of the activity of the Curtiss Corporations. When the Aerial Mail Service was initiated in May, 1918, the first planes used were Curtiss J. N.'s Two of these made their anniversary flights on May 1st, 1919, indicating their high reliability under constant service. In the meanwhile, however, other mail carriers had been devised by the Curtiss engineers. One of these was the Curtiss R.-4-L. M. machine. With a mail compartment capable of carrying from 300 to 625 pounds of mail, this aeroplane maintained a speed of 123 miles an hour, and the six machines delivered between April and August have stood up well under service. During August two other mail machines were delivered. These, the Curtiss H. A. aeroplanes, with a speed of



1. Barograph record of Wasp altitude flight, Sept. 18, 1919. 2. Glenn H. Curtiss and Roland Rohlfs discussing the barograph of the world's altitude flight, Sept. 18, 1919. 3. Roland Rohlfs beside the Curtiss Wasp in his specially designed suit for altitude work. 4. The Curtiss Wasp taking off Sept. 18, for her altitude flight. 5. The Curtiss Wasp—holder of the world's climb and altitude records with Pilot Roland Rohlfs.

145 miles per hour, have made records in the Aerial Mail Service in the short time in which they have been in use.

The HA hydro-aeroplane was another type built during the year 1919. It had already been given trial flights in the early part of the year, showing a speed of 131 miles per hour with full load. the fastest rate of travel recorded for a seaplane. Three of these Curtiss designs were delivered to the United States Navy between April and July, 1919.

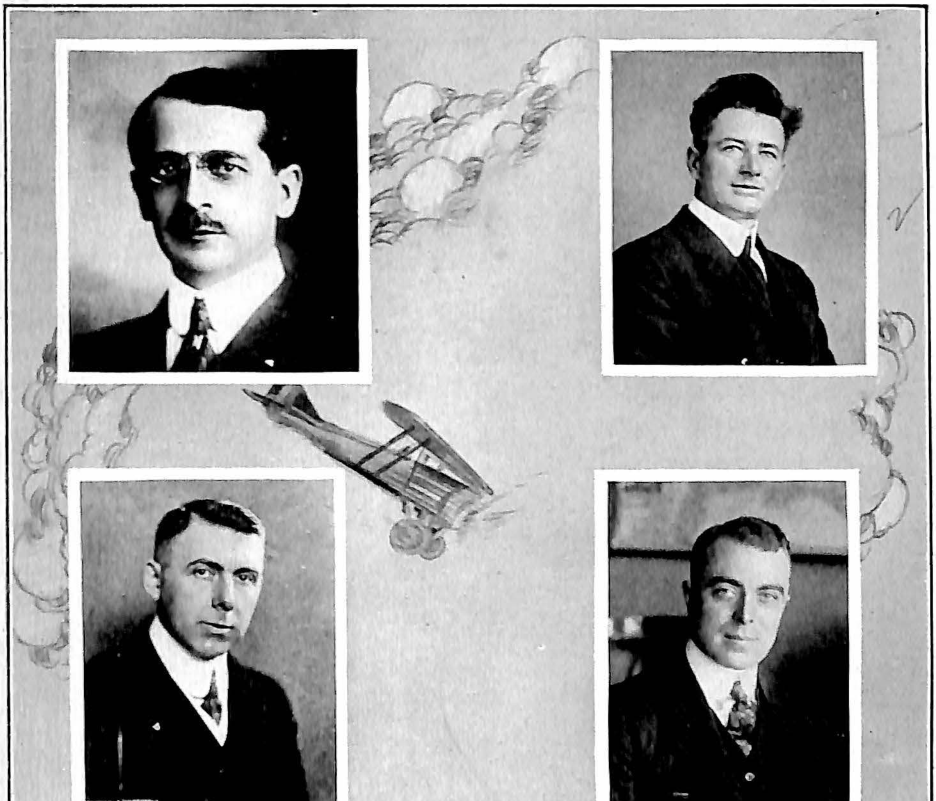
A number of aeroplanes and flying boats were also constructed for the Navy in quantity. A new navy type of flying boat, the H. S.-3 long distance bomber of 74 foot wing span — was delivered in quantity between May 17th and August 1st. Between the signing of the Armistice and the end of January, seventeen H.-16's — flying boats of 96 foot wing span — were also completed.

DEVELOPMENT OF THE WASP

With the exception of the N. C.'s, however, none of these types represented such progress in aeronautical design for the purely scientific and military purposes as the Curtiss *Wasp* and the Curtiss *Hornet.*

Curtiss executives have always considered speed to be the prime characteristic of the aeroplane. As speed rates shot to 75, 90, 100, and even 140 miles an hour they were still convinced, as they are today, that the limits of aircraft with regard to velocity had by no means been reached. During the war they had initiated work upon a speed plane both in triplane and biplane form. The former had been tried out July 5th, 1918, with success, but refinements designed to increase an already remarkable performance delayed tests on the final machine until the spring of 1919. In flights made at this time by Roland Rohlfs a speed was achieved of 162 miles per hour with two men and a full military load. A climb of 12,000 feet in ten minutes with full load and 16,000 feet in ten minutes with part load was obtained.

Even at this time it was known that the *Wasp* had altitude possibilities. Pilot Rohlfs climbed in March, 1919, to a height of 26,000 feet, and descended only because of a failure on the part of his oxygen apparatus. It was decided, accordingly, to try for a world's altitude record, and a special model was designed whose increased wing surface raised the design ceiling from 30,000 to 35,000 feet.



1. C. M. Manly. 2. W. L. Gilmore. 3. Fay L. Faurote. 4. J. P. Davies.
5. F. R. Porter. 6. Dr. J. G. Coffin.

A NEW WORLD'S ALTITUDE RECORD

Three altitude flights were made by Pilot Rohlfs with this machine. All three were made with standard fuels and without special plane or motor accessories. The first, July 30th, 1919, set a new American altitude record of 30,400 feet. In absence of verification of Lieut. Casale's mark of 33,100 feet claimed on June 14th, at Villacoublay, France, this seemed also to be a world's height mark. Rohlfs followed this flight, which he considered unsatisfactory, with a second though unofficial flight on September 14th. On this occasion he ascended to an elevation of 34,200 feet. On September 18th, he made his third attempt. In the presence of government, Aero Club, and Curtiss officials he left Roosevelt field to reach an elevation of 34,910 feet, or 90 feet less than the design ceiling of the machine.

"Did it this time, all right," was his first words on reaching the ground.

As Lieut. Casale's altitude was read from a barograph uncorrected for temperature, in accordance with European practise, the reading from Rohlfs' barograph of 34,910 feet, as calibrated by the U. S. Bureau of Standards, is the only one which can be compared with it and is 1810 feet better.

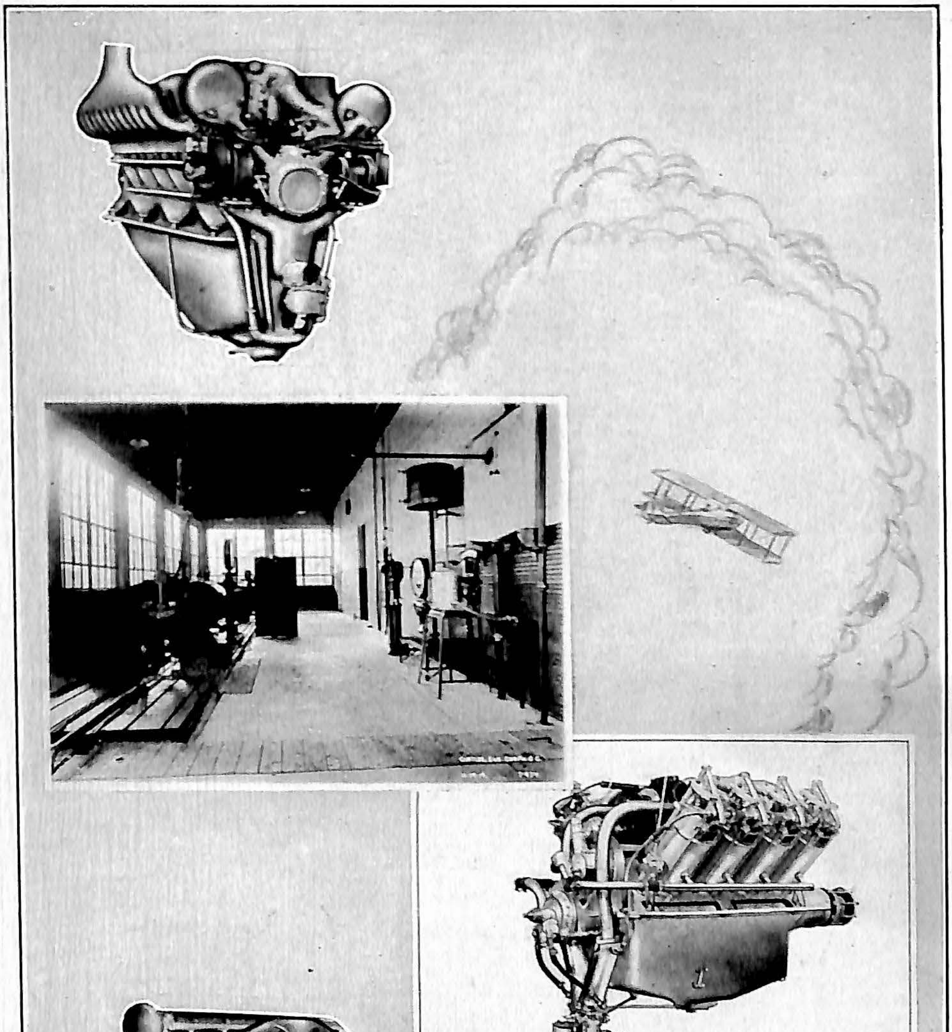
With all corrections made in Rohlf's barograph, an official minimum altitude of 32,450 was granted by the Bureau of Standards.

Whether European or American practise is followed Rohlfs thus holds the world's altitude record.

On the following day the *Wasp* made a test flight for climb, and was officially granted a record of 20,000 feet in ten minutes.

Like the Navy-Curtiss flying boats, the seven aeroplanes of the *Wasp* type which the factory produced this year for the American and the Bolivian Governments were a demonstration of what scientific equipment and skilled workers could accomplish.

The *Wasp* was a study in scientific aeronautical construction. The Curtiss-ply fuselage enabled the body of the machine to be molded into a streamline shape. Special wing construction made the planes of the *Wasp* reliable under the strong pressures resulting from her tremendous velocity. The Curtiss K.-12 400 horse-power motor, built in a form remarkably compact, and by a reduction gear raising the propeller shaft above the crankshaft, enabled the streamlining of the nose to be effectively carried out. Streamline wires, streamline shock absorbers, and streamline arrangement of the radia-



1. Curtiss K.-12 400 h.p. Vee type motor. 2. Curtiss Motor Laboratory at Garden City. 3. Curtiss O.X-5′ 90 h.p. Vee type motor. 4. Curtiss K.-6 150 h.p. Vertical motor.

tors on the sides instead of the front of the fuselage, and enclosure of all control wires, cut down head resistance to a remarkable degree.

W. L. Gilmore, chief aeronautical engineer, is in charge of research, design, and experimental production. Mr. Gilmore has been identified with Mr. Curtiss in the development of many Curtiss aeroplanes, and is prominent as a marine engine and boat designer.

While working as an experimental unit under the direction of the Curtiss Aeroplane and Motor Corporation on the problems of peace-time aviation, the Curtiss Engineering Corporation plans to continue the more strictly scientific development of aeroplanes, hydroaeroplanes, flying boats and aeronautical motors.

III

The designing of an aerial liner which could be used as the transportation unit in regular passenger carrying lines had been one of the first projects to which Curtiss executives had given their attention early in 1919.

Their conception of the practical aeroplane for commercial passenger carrying was finally manifested in the plans for an eight passenger machine with an enclosed passenger cabin and a power plant of three Curtiss Six motors. Leaving the factory on July 24th, it soon proved that its contribution to commercial aviation would be highly important. Without sacrificing anything of the comfort and security which its builders had in mind, it developed a speed of 99 miles per hour, proved an ability to maintain altitude on two motors and showed a cruising radius from 350 to 475 miles.

AN AERIAL LIMOUSINE

On September 27th, 1919, the Curtiss intercity passenger carrier made its first public flight, carrying a number of editors and writers prominent in the scientific and aeronautical worlds. The demonstration was unanimously agreed to have showed the practicability of the machine for passenger service. "Steadier than any Pullman," was the verdict of Evan J. David, editor of *Flying*. Entering the capacious side door the first seven passengers found themselves in a comfortable cabin, equipped with individual wicker seats, and looking through clear windows on the outside world. A touch of the self-starter button "turned over" each of the three motors. With three propellers revolving, the *Eagle* taxied across the field, faced the wind, and in a few seconds was riding smoothly upon it.

"The ladies in our party," says Laurence La Tourette Driggs, President of the American Flying Club, "were particularly enchanted to discover that they did not have to remove their hats, and that the pressure of the wind did not even disturb their hair!" Passengers conversed with one another, walked about from seat to seat, and watched the world go by beneath convinced that commercial aviation, with the highest speed and the smoothest roadbed in the world, had arrived in a tangible and thoroughly practical and delightful form.

PRACTICAL DEMONSTRATION AT WASHINGTON

The flights of September 27th were followed by a number of others. So reliable was the *Eagle* that it was decided to fly it, together with three Curtiss *Orioles*, to the national capital via Philadelphia. Here it would be possible to make demonstrations with both machines which would bring to the attention of Congress and other representatives of the United States as well as of foreign governments, the year's progress in practical aviation.

On October 24th, accordingly, the *Eagle*, piloted by Bert Acosta, left for Washington with three Curtiss *Orioles* and two Curtiss J. N.'s. Stopping at Philadelphia, she made a number of demonstration flights.

On October 29th she resumed her journey and, arriving at Washington, was busy for ten days in the greatest practical demonstration of flying ever known to have been made. Eighty-two flights were completed, four hundred and ninety-six passengers were carried, in the *Eagle* alone. Not an accident in the air or on the ground marred the performance. Under the skilful piloting of Bert Acosta the machine thoroughly proved her steady flying value. She flew under varying and often unfavorable weather conditions. Such prominent Washington residents as Second Assistant Postmaster General Praeger, in charge of the Aerial Mail Service, Benedict Crowell, Assistant Secretary of War, Mrs. Newton D. Baker, Air Commodore L. E. O. Charlton, British Air Attaché, Major General C. T. Menoher, Director of the Air Service, Senators C. S. Page, H. S. New, I. L. Lenroot, and dozens of other Congressmen, members of embassies and legations, officers and secretaries in the aviation services of the Army and Navy, etc., flew in the *Eagle* and the *Orioles* — a total of 855. Washington, which had seen every military plane to date, was amazed by the new achievement which the Curtiss peace time planes recorded for its benefit.

This is the story of Curtiss planes during the year 1919. They have made for both scientific and commercial development. They represent a great beginning in a new activity, a new industry.

Great as the success of practical aviation has been this year when measured by public expectation, its immediate future is far greater. Curtiss factories at Garden City and Buffalo are supplemented by Curtiss Flying Stations at Buffalo, Atlantic City, New Jersey, Newport News, Virginia, and Miami, Florida. New Curtiss dealers and distributors are being established. Existing Curtiss distributors are already establishing sub-distributors. The work of the year has also included the establishment of a large number of landing fields — not only fields for the use of every one of the twenty-five Curtiss companies, but municipal fields as well, which these companies have been instrumental in establishing. The coming twelve months will undoubtedly see an even more rapid development of commercial flying than has been witnessed during the last eight.

THE BURGESS COMPANY

AMONG the most important preparations of the American Navy against German submarines was the construction of a number of airships of new design. These C machines are acknowledged to have been an important contribution to naval aeronautics. At the signing of the Armistice in November, 1918, the Burgess Company of Marblehead, Massachusetts, was busy completing a number of cars for these balloons.

The war work of the Burgess Company had been varied. Among other work it had constructed about 400 N-9 training seaplanes with 100 sets of spares. The last of these machines and ten of the airship cars, were completed in Plant No. 1; the production plant, No. 2, burned down on November 7th, 1918.

The C airship cars constructed by the company were of forty foot overall length, had a depth of five feet, and were fifteen feet in overall width. They accommodated a crew of five men, carried four 260 pound bombs, radio equipment, electric lights, etc. They afforded more comfortable housing for the crew than earlier airship cars, and their truss construction, supplemented with fairing for streamline shape, represented a refinement on earlier construction. Two eight-cylinder, 150 horse-power Hispano-Suiza or two six-cylinder, 150 horse-power Union motors were mounted in each car. The speeds of over sixty miles an hour attained by the C class airships may be attributed partly to the low head resistance of the car, designed by navy constructors and produced, with some suggestions as to design details, by the Burgess plants. The airships were designed for convoy and coast patrol service and have done excellent work. The C.-5, in its flight of 1,175 statute miles from Montauk Point, Long Island, to St. Johns, Newfoundland, June 14th–15th, set an American airship endurance and distance record.

On December 15th, 1919, Mr. W. Starling Burgess retired from the Burgess Company. Frank H. Russell, President of the Burgess Company, became Vice-President and General Manager of the Curtiss Engineering Company of Garden City, Long Island.

The company having finished all war contracts, has now closed its plant awaiting a definite government policy with regard to experimental aviation.

DAYTON WRIGHT AIRPLANE COMPANY

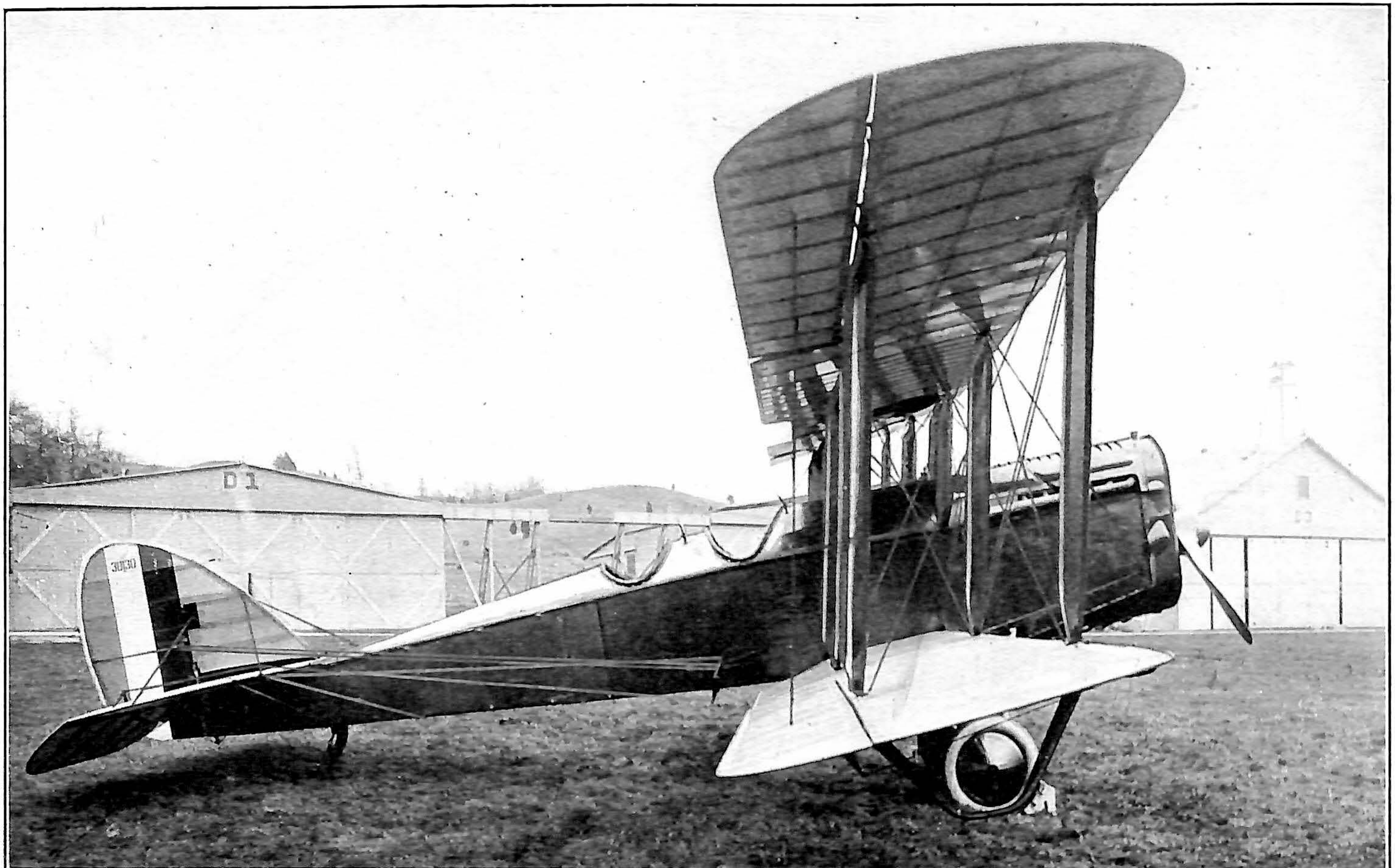
EXECUTIVE OFFICES, Dayton, Ohio

OFFICERS

Chairman of the Board	H. E. TALBOTT
President	H. E. TALBOTT, JR.
Vice-President and Consulting Engineer	C. F. KETTERING
Consulting Engineer	ORVILLE WRIGHT
General Manager	G. M. WILLIAMS
Treasurer	C. J. SHERER
Aeronautical Engineer	HOWARD M. RINEHART
Chief Engineer	L. C. LUNEKE
Works Manager	J. P. HENRY

At the cessation of hostilities and later cancelations of government contracts, the Dayton Wright Company decided upon a policy whereby nearly all of the current year would be utilized in the development of such aircraft models as would adapt themselves to commercial and pleasure purposes.

The military plane, while admirably suited to the purpose for which it was designed did not lend itself entirely to commercial purposes. Dayton Wright engineers, however, during the pursuit of government contracts gained invaluable experience from a fundamental standpoint in the production of aircraft. Consequently every effort has been made to improve the standard Dayton Wright design and to embody in such design the qualities of comfort and safety, at the same time retaining the speed and mobility which were characteristic of military planes.



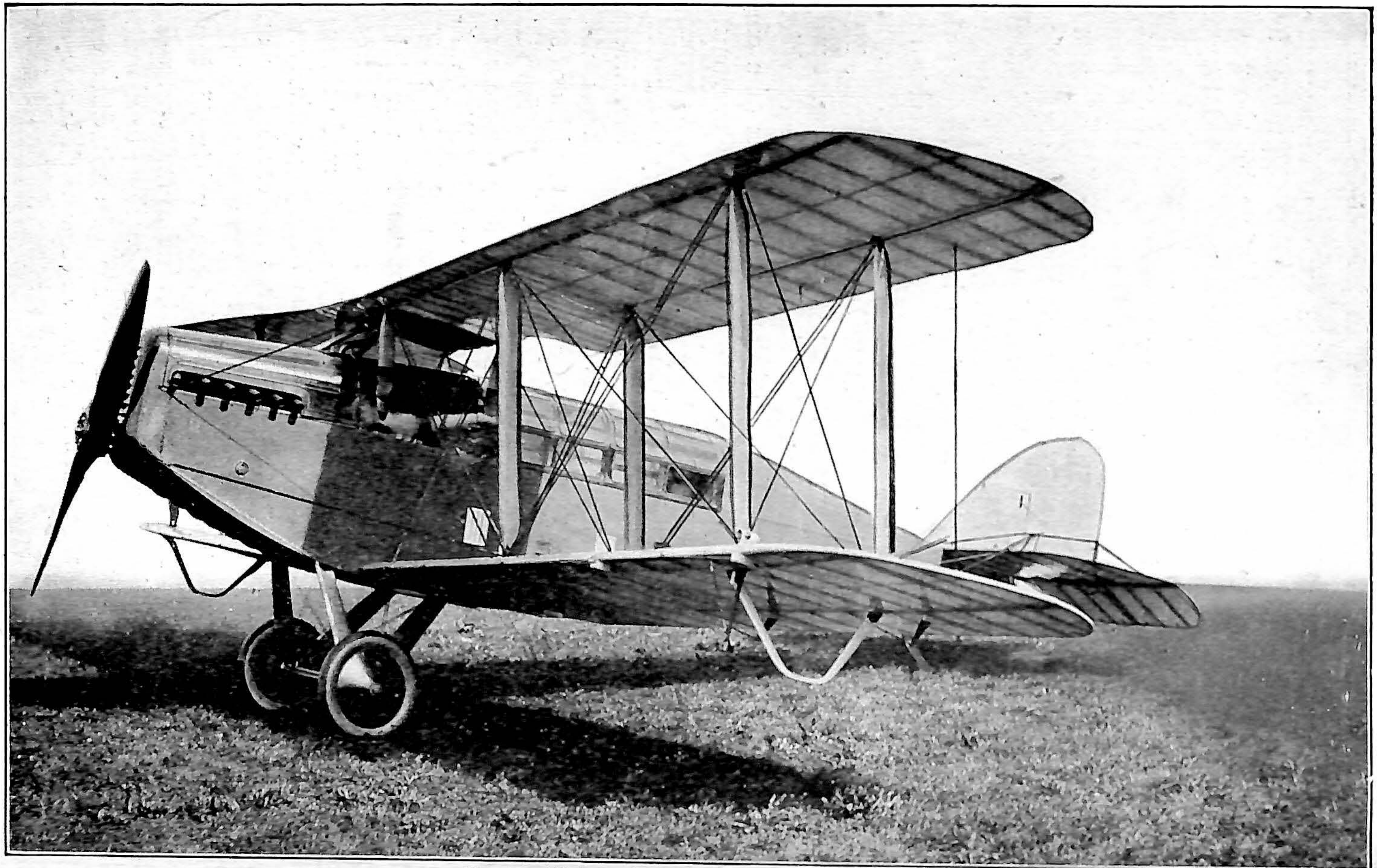
Dayton Wright 9-Hour Cruiser

The inadequacy of landing fields in this country made necessary the design of planes with a greater touring range. The use of unsightly "flying togs" so necessary in open planes with the necessity of exposure to all sorts of inclement weather prompted Dayton Wright engineers to develop the closed airplane. The result has been satisfactory and it is the intention of the company to place upon the market for the 1920 season two models of this type.

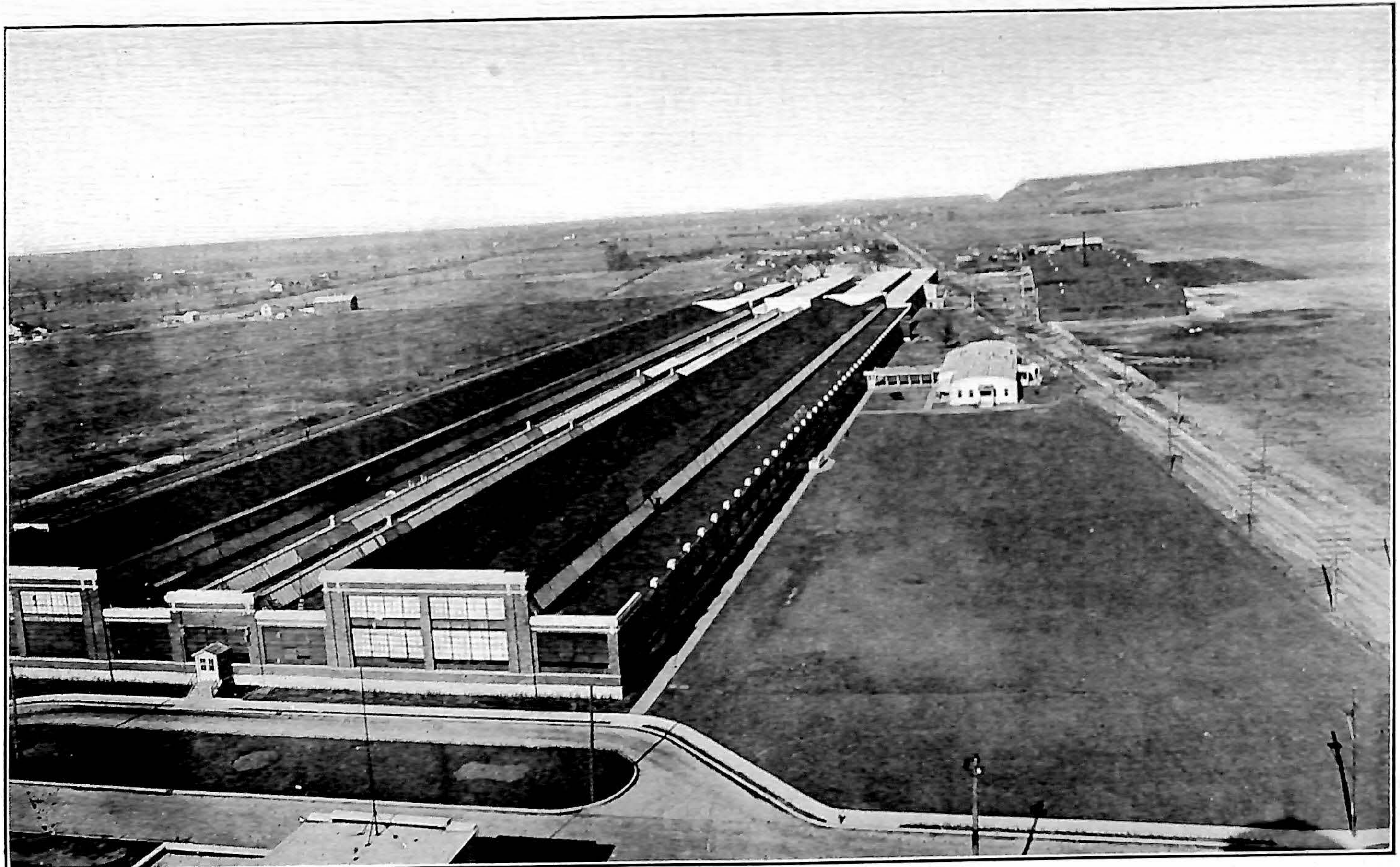
The Cabin Cruiser model K. T. is equipped with a Liberty motor and is designed for a speed of 125 miles per hour. It carries fuel capacity for six hours' continuous flight and lends itself particularly to long cross-country trips, where the factor of time saving is essential. Features of comfort and luxury have been embodied in the craft by arrangements for baggage carrying, typewriter table and thermos bottle containers. The enclosure of the pilot in the same compartment with the two passengers is an interesting feature, inasmuch as the stability of the plane affords the pilot an opportunity to converse freely with the passengers. The elimination of objectionable noise caused by the exhaust of the motor permits of a conversation in a normal tone of voice. Inasmuch as the Government has placed an embargo on the export of Liberty motors, the company has completed an arrangement with the Packard Motor Car Company, whereby the Packard-12 will be substituted for the Liberty motor in cases where the plane is to be sold abroad.

The Aerial Coupe, model O. W.-1, is designed with the idea of substituting in the air the luxuriously appointed limousine of the road. No expense has been spared in the development of refinement and detail. At the same time features of speed and practicability which characterize automotive developments have been embodied. The plane may be equipped with either the Hispano-Suiza model E or the Packard 8. A rather radical departure from orthodox construction is noticeable in this plane. The entrance is made through a full size door in the side of the cabin, thus bisecting entirely the upper longeron and the usual longeron stresses are carried up and over the door frame.

While not designed primarily for long distance cruising, it has a radius of action of five hours at a speed of 87 miles an hour, which permits of its use in trips from 350 to 400 miles. The low landing speed of 35 miles an hour facilitates the use of such emergency landing places as would not otherwise be available with larger and heavier machines.



Dayton Wright Model K. T. Cabin Cruiser



View of main plant, Dayton Wright Airplane Company.

Another interesting development of the company is the Nine Hour Cruiser. This plane has many of the characteristics of the D. H.-4. It is of the ordinary open type and is designed to carry a pilot with one passenger. This plane was designed primarily for government purposes and is equipped with a Liberty motor. Important changes which have been embodied in this craft from the original De Haviland design is the placing of the gasoline tank ahead of the pilot instead of between the pilot and the passenger, the new position of the tank being directly over the landing gear. The increased radius of action of nine hours in comparison with the usual De Haviland of four and a half hours adapts this plane particularly to long distance flights. In this plane, the trip from New York to Chicago may be undertaken without the necessity of stopping for fuel.

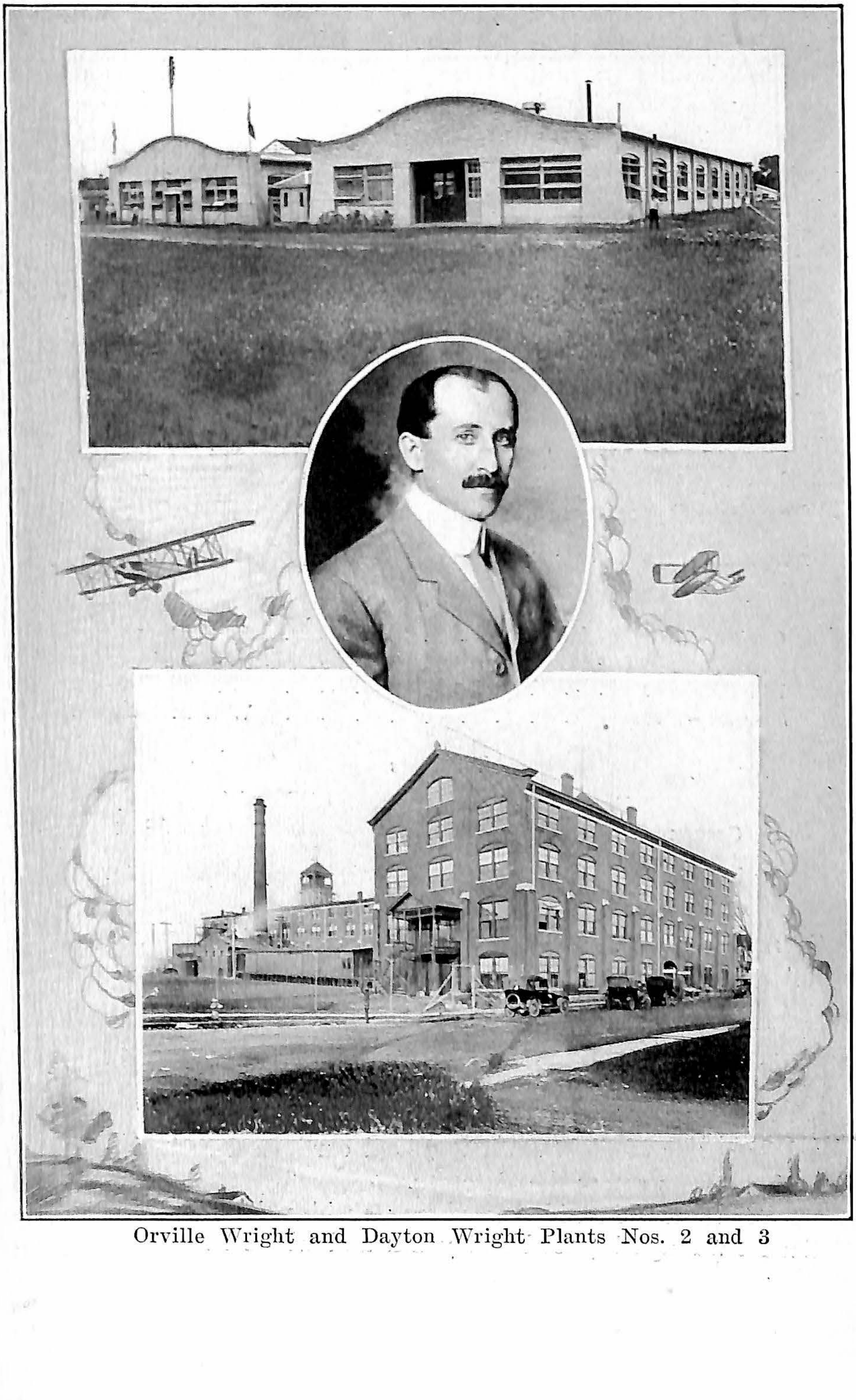
The commercial development of the company has been in keeping with their policy on furthering aviation on a sound and practicable basis. The conservative engineering policies pursued by the Dayton Wright Company during the past year have had the continued supervision of Orville Wright and C. F. Kettering.

During the past year, in addition to the previously described development work, the Government has placed with the Dayton Wright Company orders for a number of planes of special military types. Among these is the model D. H.-4-R. This model is a modification of the regular D. H.-4, with the following changes:

Pilot's and Gunner's armament removed.
Complete dual engine control.
Complete dual instrument board.
Complete dual stick control.
Gunner's stool changed to Pilot's type.
Gunner's cowling and after deck made round instead of regular D. H.-4 type.

In addition, the company has also manufactured for the Government a small number of planes known as the model D. W. H.-4. This type most closely resembles the Dayton Wright Nine Hour Cruiser. Both of the above types were completed in a short period of time, and it is understood were used by the Government as advanced training planes.

The Dayton Wright Company feel that it is not only voicing the opinion of aircraft manufacturers, but of the increasing number of people who are interested in aeronautics, in advocating the extended establishment of suitable landings placed throughout the



Orville Wright and Dayton Wright Plants Nos. 2 and 3 country. The question of expense in the development of such fields actually is quite small in relation to the importance which it bears toward national aeronautical progress. The matter of large amounts of money expended in the construction of such fields is somewhat of a fallacy. What pilots most desire, is a chain of fields throughout the country, selected with a view as to natural smoothness, with proper facilities for taking on oil and gas, and housing of planes over night, when necessary. The use of good judgment in the selection of such fields is essential inasmuch as it quite frequently occurs that a smooth landing field will exist in a location which is entirely surrounded by trees, telegraph wires, buildings or such other obstructions as detract from otherwise satisfactory characteristics of the field.

GALLAUDET AIRCRAFT CORPORATION

GENERAL OFFICES, No. 30 East 42nd Street, New York City

FACTORY AND ENGINEERING DEPARTMENT, East Greenwich, Rhode Island

Chairman, Board of Directors	E. F. GALLAUDET
President and General Manager	J. K. ROBINSON, JR.
Vice-President	J. G. CRAWFORD
Secretary-Treasurer	WM. B. LEBHERZ

Directors

E. F. GALLAUDET, *Chairman of Board*

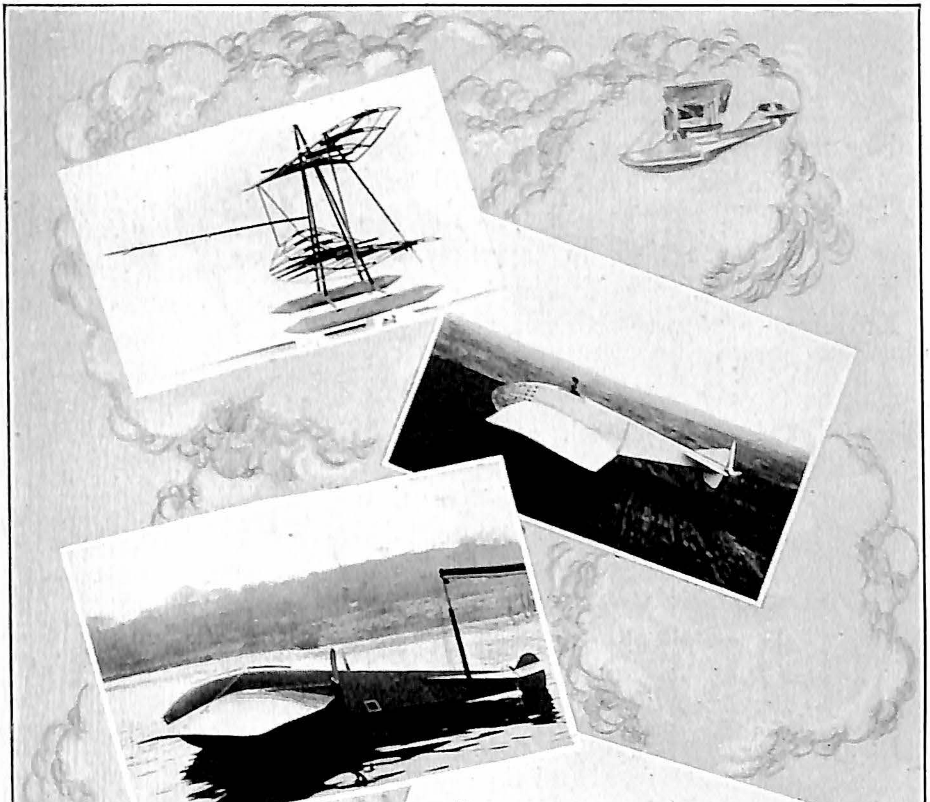
GEORGE M. PYNCHON	F. F. BREWSTER
ALFRED MCEWEN	PAUL MCEWEN
W. A. HARRIMAN	J. K. ROBINSON, JR.

SOME thirty odd years ago a sturdy youngster lay at full length on the grassy slope of a park in the nation's capital, his gaze fixed upon the dome of the summer sky.

The drone of insects, the chirp of the park sparrows, the lazily drifting clouds passed unnoticed, for young Gallaudet's whole attention was concentrated upon a bird that soared far aloft.

He watched it sweep in graceful circles to right and left and followed its course of flight until it glided earthward and disappeared beyond the trees across the Potomac.

Thus the germ of an idea was born; an idea that lived with E. F. Gallaudet through boyhood and youth and which in manhood grew



1. Gallaudet method of "Wing Warping," July 1, 1898. 2. Gallaudet Bullet, 1912. 3. Gallaudet Flying Boat, 1914. 4. Gallaudet Tractor, 1915. 5. Gallaudet Model D.-1, 1916.

and grew until in the more mature years it filled his soul with a fixed purpose — aviation.

Graduating from Yale with degree of A.B. in 1893, and from Johns Hopkins with degree PH.D. in 1896, he still clung to his study of aeronautics. A few years later he went to Yale University as instructor in physics. It was while filling this position that he devoted his spare time to experimenting with the warping wing principle, attaining considerable success.

But his efforts were frowned upon by the authorities at Yale and he was notified that he would have to discontinue the experiments or resign, as (to use their phraseology) he was making an ass of himself and a laughing stock of the faculty with his "flying jimcracks."

Faltering for the moment he discontinued his efforts and allowed others who had entered the field to out-distance him in the evolution of this particular principle.

The spirit of aerial flight being strong within him he soon bravely cast aside the pedagogic fetters and entered the aeronautic arena as a pioneer. Resigning his position at Yale, he in company with his brother Denison, began the practical construction of airplanes.

In 1911 E. F. Gallaudet obtained an American Pilot's license with the Wright Brothers and the same year went to France to study continental methods in construction and actual flying, obtaining the French Pilot's license with the Nieuport monoplane in November, 1911.

Returning to this country, Mr. Gallaudet and his brother, in 1912, built the A-1 or the Bullet as it was popularly termed; a monoplane equipped with a 100 horse-power Gnome motor and having a wing spread of 32 feet, total wing surface 210 square feet and measuring 21 feet from nose to tail tip.

This ship was exhibited at the first Aero Show held in the Grand Central Palace, New York City, in May, 1912, and was flown that spring. In July of the same year, while flying the Bullet, Mr. Gallaudet was injured in a smash. It is believed that this machine was making 130 miles an hour at the time.

Later models brought out by Mr. Gallaudet are as follows: Monoplane Flying Boat "B," 1913–14, powered with a 110 horse-power Maximotor, measuring 27 feet from nose to tail tip and having a wing spread of 36 feet. Gallaudet Tractor, C.-1, 1915, with 50 horsepower Gnome motor. Wing spread of 38 feet, total wing surface 400

Gallaudet Executives — 1. E. F. Gallaudet. 2. J. K. Robinson, Jr. 3. Wm. B. Lebherz. 4. J. G. Crawford.

square feet, length from nose to tail tip 25 feet. Gallaudet Tractor, C.-2, 1915, with 100 horse-power Gnome motor. Wing spread of 34 feet, total wing surface 350 feet. Length 25 feet. Gallaudet D.-1 Twin-motored Seaplane 1915–16. D.-2 Twin-motored Seaplane, 1917, and D.-4 Liberty-motored Seaplane, 1918.

Possibly the most interesting of Mr. Gallaudet's innovations in aeronautical development is his geared propelling mechanism. To illustrate this we quote from the speech of Lieutenant Commander C. A. Read, who made the Trans-atlantic flight in the N. C.-4.

At the welcome home banquet given by the American Flying Club at the Hotel Commodore, New York City, July 2nd, 1919, Commander Read said:

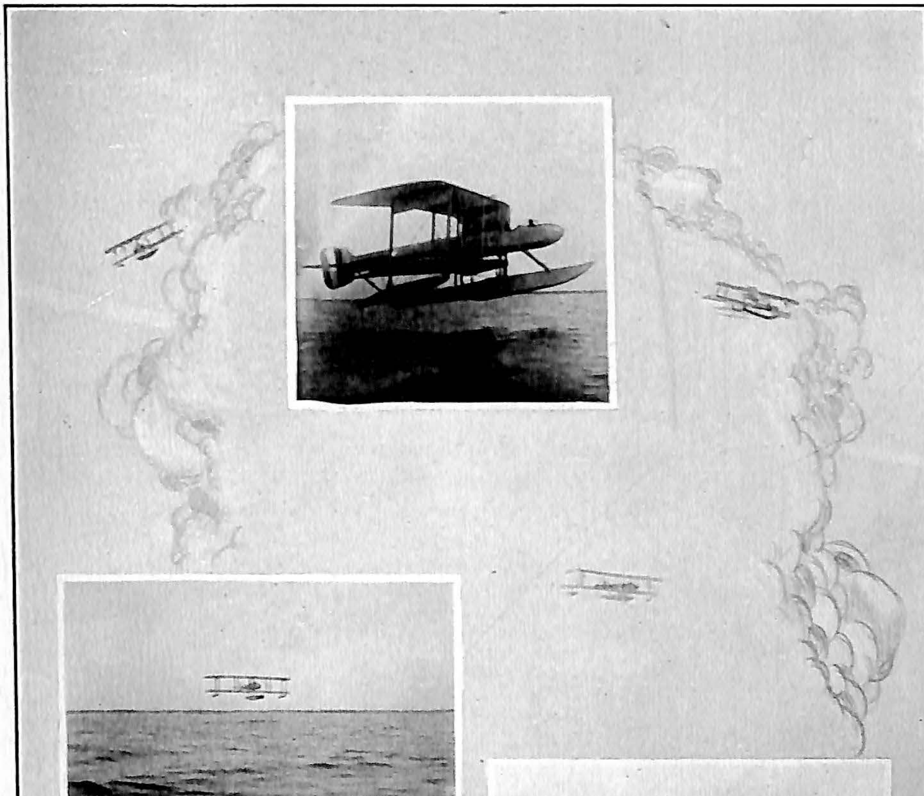
> . . . we have a lot ahead of us. It has been demonstrated that the geared motor is the thing for seaplanes particularly . . . The motor is most efficient when it is going the fastest and a propeller is most efficient when it is going slowly. And in that connection, one of the future developments of importance — which Mr. Gallaudet has already shown us — is the hitching up of more than one motor to a single propeller.

The Gallaudet Engineering Company intended for consulting engineering work was organized in 1908 and re-organized into the Gallaudet Company and again in turn into the Gallaudet Aircraft Corporation in 1917 with Mr. J. K. Robinson, Jr., as President and General Manager.

Incorporated under the laws of the State of New York, January 19th, 1917, the factory was completed and ready for occupancy in May of the same year, at which time operations were started with orders on hand for four big land machines for the United States Army and two still larger water machines for the United States Navy.

The first of the army machines was finished in October and made successful flights in November. The second one flew at Langley Field in February, 1918, loaded thirty-two pounds per horsepower, making speed of seventy-five miles per hour. The others were turned over to the Army in June, 1918.

The Navy machines were modified to a light model of the same type. The first of these fast, light bombers for the Navy Department was flown in July and the second one in October, 1918. These machines with Liberty motor have shown wonderful performances, making a speed of 126 miles per hour, climb in two minutes, 2100 feet. Fuel consumption at cruising speed of 78 miles per hour, 16 gallons per hour.



1. Gallaudet Seaplane rising. 2. Gallaudet Seaplane in flight. 3. Gallaudet Seaplane landing. 4. Gallaudet Light Bomber.

In January, 1918, this corporation accepted a contract from the United States Navy for H. S.-2 Flying Boats and the production of these boats reached its high point in September of the same year.

The present activities of this corporation are devoted to the fulfillment of several new Army and Navy contracts and the promotion of Aerial Transport in general.

It also operates as a subsidiary, the Gallaudet Aviation School, Inc., which during the early stages of the recent hostilities trained a large number of young men for the Aviation Corps, several of whom made enviable records at the front.

J. K. Robinson, Jr., who is a member of the Board of Directors of the Manufacturers' Aircraft Association and to whose guiding hand, untiring efforts and vigorous personality a large share of the success of the Gallaudet Aircraft Corporation is due, has been interested in aviation since the first heavier-than-air machine made its flight.

Born in Akron, Ohio, he received his primary education in Chicago, Illinois, and later attended Twyford at Twyford, England, finishing his education at St. Paul's School, Garden City, Long Island. His first business experience was with the Diamond Match Company of Chicago. For a period of years he was first, secretary and then President and general manager of the Carrara Paint Company of Barberton, Ohio.

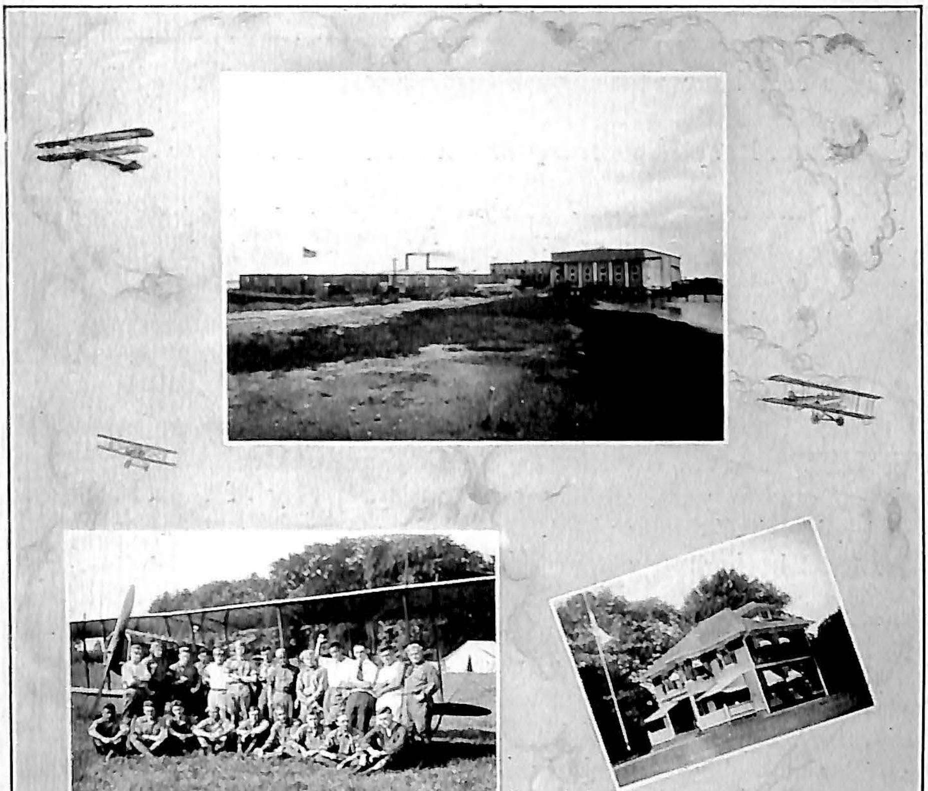
In 1905 he was elected president and general manager of the Ox Fibre Brush Company of New York City, and Frederick, Maryland, and is still serving in that capacity.

He was attracted to aviation originally through his deep interests in sports. This began as early as 1898 when the "Winton One" which he drove, was considered the last word in motor cars.

He is also a yachting enthusiast, having owned several crafts, the last of which, the *Elithro 11,* served in Navy Aviation as S-P-15 for the duration of the war.

Mr. Robinson brought with him to the Gallaudet Aircraft Corporation, from one of his most successful enterprises, J. G. Crawford, as Vice-President and Works Manager, and Wm. B. Lebherz as Secretary and Treasurer.

Mr. Lebherz was born at Frederick, Maryland, and was educated there. In 1905 he joined the staff of the Ox Fibre Brush Company of New York City and Frederick, Maryland, and in this concern he advanced to the positions of Office Manager, Sales Manager, Factory



1. View of Gallaudet plant. 2. Gallaudet Aviation School, 1917. Extreme right, standing Frank B. Rhodes, Chief Instructor; Philip Rader, fifth from left, standing; Jack McGee, Instructor, eighth from left, standing; Fred Eden, Instructor, second from left, standing. 3. Gallaudet Executive Offices. 4. View of Gallaudet Assembly Room.

Manager and later was elected Secretary of the Corporation. In 1909 he managed the Royal Brush and Broom Company of Toledo, Ohio. Later he spent several years in the Palmetto Fibre Industry in Florida.

As an expert accountant and an ardent student of finance and business methods, Mr. Lebherz was given opportunity in the Gallaudet Aircraft Corporation to display his splendid qualifications in the installation of an accounting and business system that was highly commended by United States Government officials who were in touch with the situation during the war.

John G. Crawford, vice president and factory manager, is a native of Ireland. He was educated in Scotland and in Ireland and became assistant engineer and chief engineer respectively of the old city of Dublin electric lighting plant.

In 1893 he became connected with the Thompson-Houston Electric Company of Lynn, Massachusetts, and later, went with the General Electric Company of Schenectady, New York.

In subsequent years he was connected with the Westinghouse Electric and Manufacturing Company at East Pittsburgh, Pennsylvania, the Siemens and Halske Electric Company of Chicago, and later with the Jeffrey Manufacturing Company at Columbus, Ohio, as superintendent, which position he resigned to accept that of works manager with the Ox Fibre Brush Company at Frederick, Maryland.

During the late war when airplane production was at its height, Mr. Crawford's ability as works manager proved one of the outstanding features of the Gallaudet Aircraft Corporation's activities, which activities are best described by the following extract from the corporation historian's note book:

> . . . nothing could stop them! Day shift — night shift — the fires never cooled. A thousand patriotic men and women working at top speed to fulfil to the utmost the demands made by the Government at Washington. Seaplanes — Bombers — Flying Boats! The slogan was "One a day" and every twenty-four hours saw a completed machine take the ways, tune up and fly to its destination somewhere on the Atlantic coast or securely boxed for shipment Overseas. Those were the happy days! Every one in fine fettle. New buildings springing up like mushrooms, carloads of spruce, linen, steel, dope, varnish, and wire arriving with clock-like regularity to be converted into fighting machines for Uncle Sam.
>
> Each new German atrocity served but to spur the workers on to greater effort and the end of the shift found them limp and exhausted but happy in the thought that they had extracted one more nail from the Hindenburg Statue.

THE L. W. F. ENGINEERING COMPANY, INC.

COLLEGE POINT, LONG ISLAND, NEW YORK

Officers

President . . . . J. M. FITZGERALD
Vice-President and General Manager . . . . A. H. FLINT
Secretary and Treasurer . . . . W. N. BENNETT

WHEN one thinks of the United States Aerial Mail — and since the war the air mail has been one of the main activities for the flying machine — naturally one thinks of the L. W. F. Engineering Company at College Point, Long Island, New York. For the L. W. F. Company has been particularly active in providing airplanes suitable for the transportation of the mails, and has developed one of the first all-American aerial freighters.

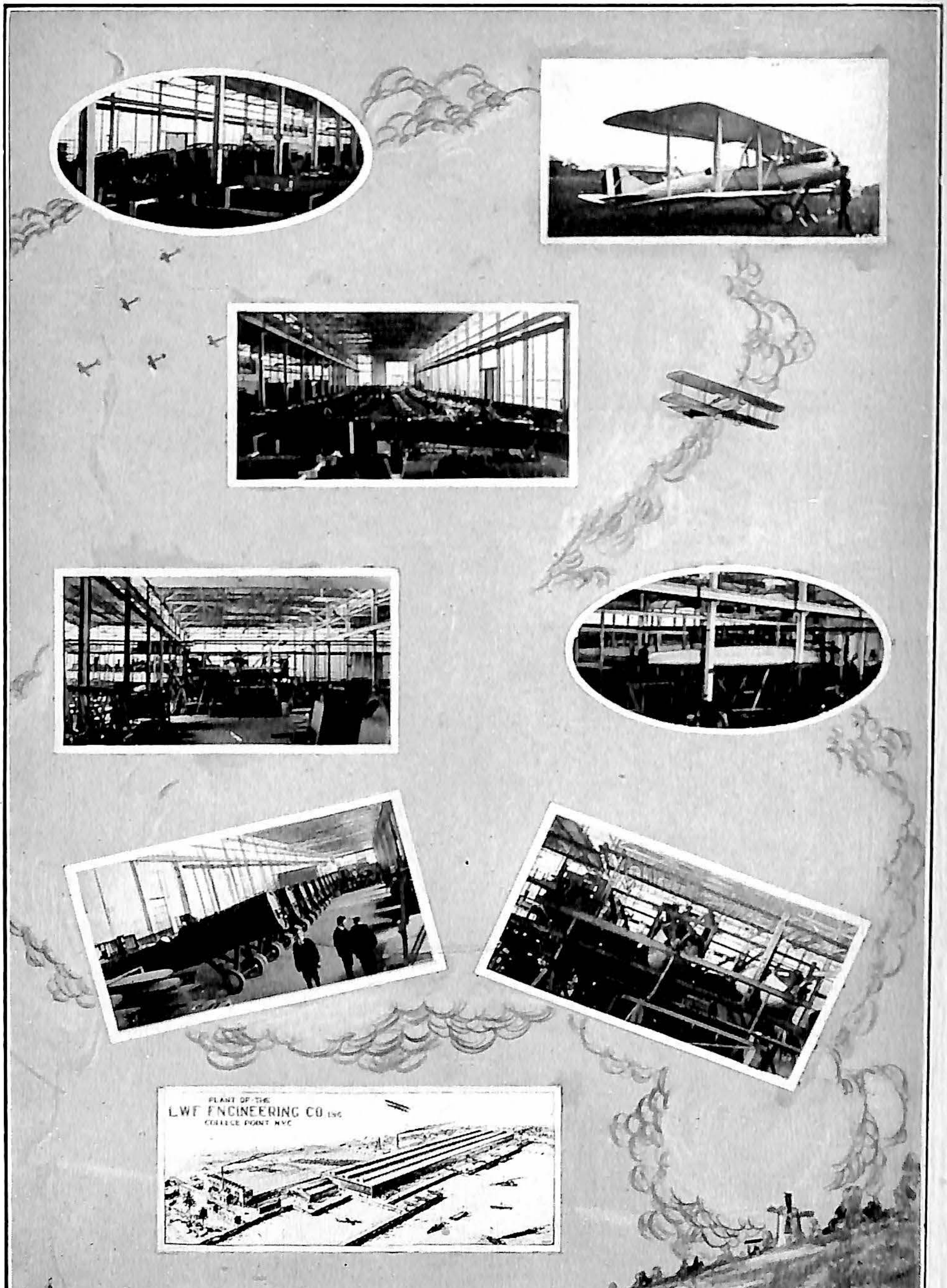
Otto Praeger, Second Assistant Postmaster General, as chief of the aerial mail service, desired to increase the scope of his department when hostilities ceased. The New York-Washington aerial mail route was operating successfully. The New York-Chicago service has been begun with equal success. Plans for a more extensive service has been approved but there were no planes.

The war machines which Mr. Praeger had received from the Army and Navy "to play with" as one official expressed it, were not adequate for flying the mails on long hops. They had neither the staying power nor the capacity for fuel and cargo necessary for a public utility which must maintain sure service and a daily schedule under all conditions.

The peculiar needs of the mail service required an airplane that could make long or short hauls with a paying cargo, make daily scheduled flights in all kinds of weather, over all sorts of country, and do this, not occasionally, but every day in the year. There are no holidays for the planes in the mail service.

Mr. Praeger was compelled to use what he could get. His first ships were battle planes built for speed and climbing ability, powerful enough for their size, but constructed to carry two persons only and the comparatively light armament of a fighting machine.

These planes had many advantages from a military viewpoint. From that of the postal service they had but one. They offered the only opportunity for flying the mails. It was a case of taking or leaving them and in the latter event, carrying the mail by rail.



1. L. W. F., D.H.-4's being remodeled for Army. 2. L. W. F. Model M. 3. L. W. F. Assembly Room. 4. L. W. F. Triple Motored mail plane under construction. 5. View showing rear of mail plane fuselages. 6. L. W. F. D.H.-4's ready for wing assembly. 7. Installing motors in triple engined mail plane. 8. Plant of L. W. F. Engineering Co., College Point, New York.

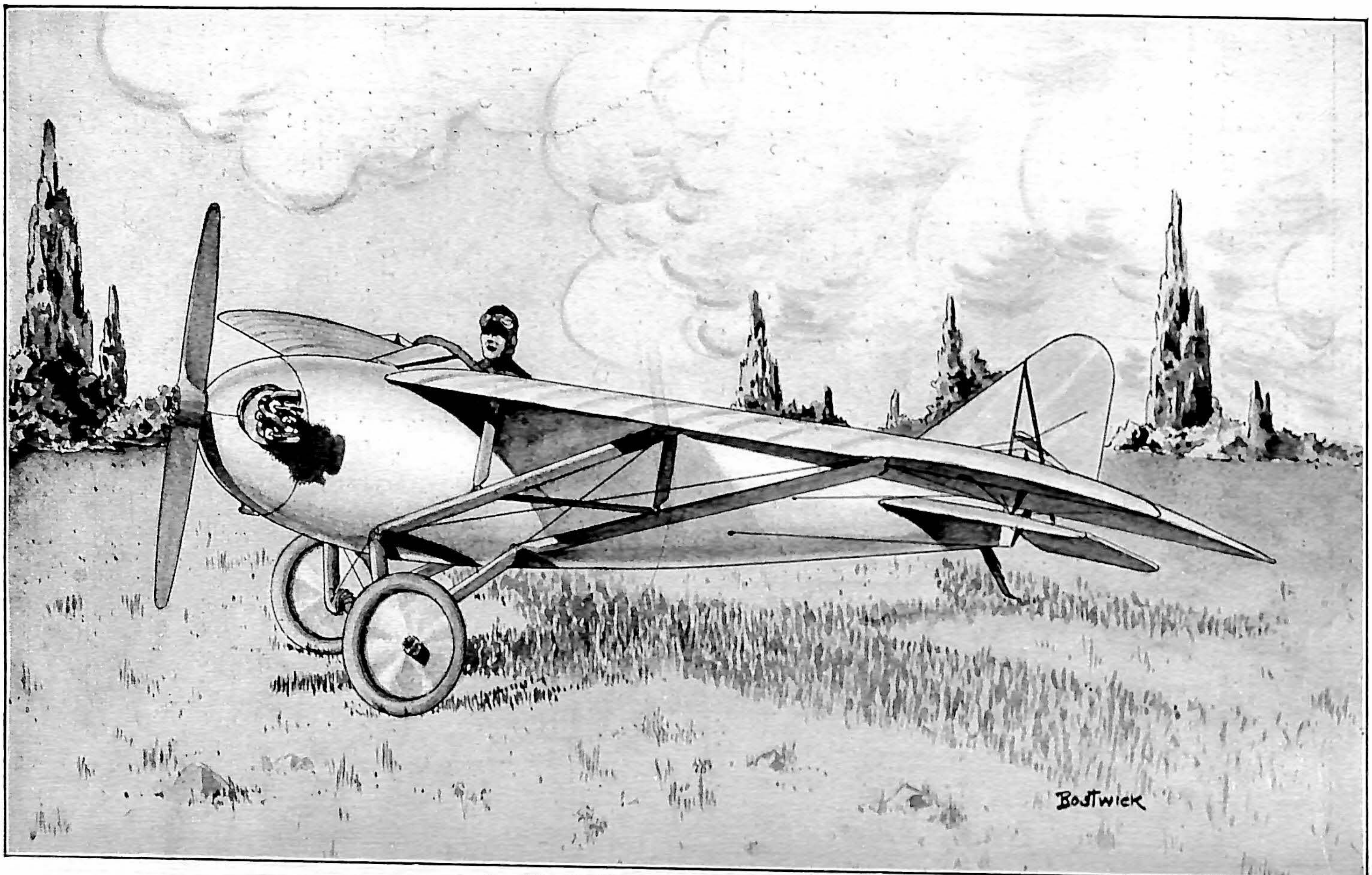
Early in 1918 the service had several of these planes on hand. They were DeHaviland-4's, single motored, two seater biplanes. The L. W. F. Company which already bore a reputation for quick delivery and accuracy of workmanship, was entrusted with the task of remodeling these craft.

Perhaps there was another reason for assigning the work to the L. W. F. It may be that when Mr. Praeger and Mr. Flint conferred on the requirements of a mail plane, the chief of the air mail realized that the engineering staff of the L. W. F. Company could proffer suggestions and design improvements to the ultimate good of the aerial mail. Most of these engineers had been retained and were working on the problems of developing a strictly commercial airplane from the military type of flying machine. Then there was Joseph L. Cato, also a member of the L. W. F. engineering staff who was developing a single seater monoplane with a view to creating a popular sporting machine having slow landing speed, quick get-away and ease of control, together with the maximum of inherent stability.

Organized in December, 1915, the L. W. F. Company is widely known as the organization which makes the laminated wood fuselage. This type of fuselage is the monocoque. Monocoque means "one shell," a layer of muslin fitted over a streamline mold is the first process in making the monocoque type. Three layers of one-sixteenth inch spruce are then laid on as many layers of tape wound about this from nose to tail, wound spirally between the middle, inner and outer layers. The inner laminations are spiraled in opposite directions, while the outer lamination runs straight fore and aft. The three laminations and the two layers of tape are laid in hot glue. The outside is then covered with linen, doped on and enameled, making the complete shell approximately one-fourth of an inch thick.

It was the L. W. F. model F airplane that flew the Liberty motor on its first flight. The test was made August 21st, 1917. When the Liberty motor was produced there were no planes in the country suitable for the immediate installation of the motor. The L. W. F. Company agreed to supply a suitable craft in ten days, and delivery was made on time. The test flight was a success. The motor was a success and the combination proved one of the fastest flying machines in existence.

There were other triumphs for the company, however. Its plant, which had been erected at College Point, Long Island, in the summer



L. W. F. "Butterfly" Sport Plane

of 1916, was known as an airplane factory, not as a foundry or machine shop turned into an airplane plant overnight.

The plant has been developed to make airplanes. Every department created especially for the skilled work on planes. To-day the floor space covers five city blocks.

So, Mr. Praeger thought himself justified in interesting the L. W. F. Company in mail planes. To rebuild the DeHaviland-4's into commercial machines required numerous changes in construction. Fifty of these planes were thus made over. From reports on the performance of the D. H.-4 as a battle plane structural changes were made to decrease the tendency to nose over on landing. The machines were rebalanced and strengthened throughout and a fire extinguishing system installed, protecting both pilot and cargo.

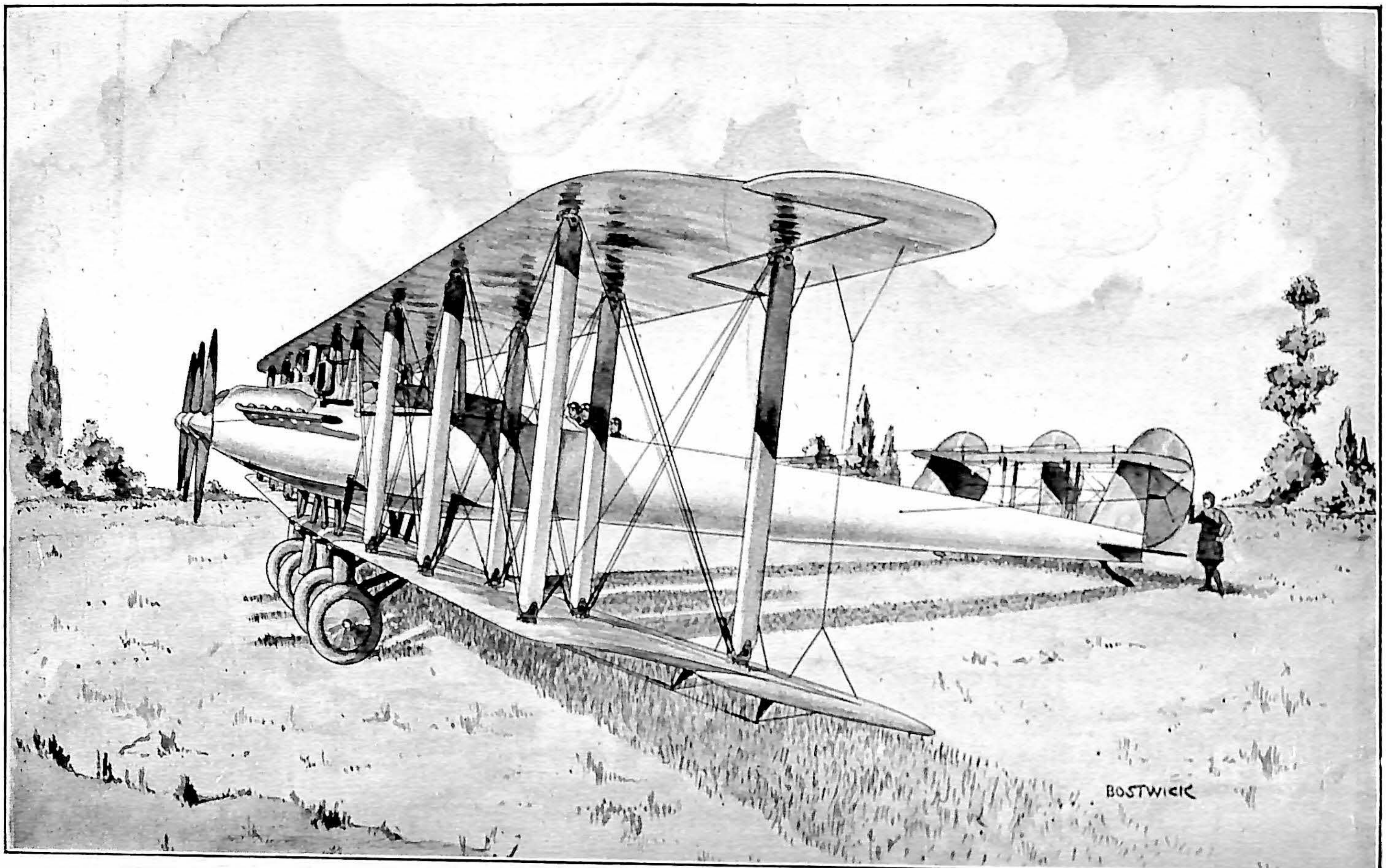
There has been no accident with these fifty remodeled planes since they entered the postal service. A mail compartment holding more than 400 pounds of mail was installed in front of the pilot who was transferred from the front cockpit to the rear. Additional fuel capacity increased the cruising time to four hours.

A military criticism of the DeHaviland-4 was based on the position of its gasoline tank, which was between the two cockpits and therefore, in the event of a fall, aided in crushing the flyer against the motor. The Army Air Service employed the L. W. F. Company to remodel 128 of the DeHavilands, placing the gasoline tank in front of the occupants and rebalancing the entire plane accordingly.

During the summer of 1918 Mr. Cato's monoplane, known as Model L and christened "The Butterfly," was given several experimental tests which proved successful and marked the initial attempt to bring the airplane within reach of the sportsman or business man who could not afford the cost of maintainance of the larger types of planes. The Cato monoplane is designed to sell at moderate price.

The Cato machine is only 28 feet, 11½ inches from tip to tip. It weighs only 736 pounds fully loaded. Empty it weighs only 495 pounds. It has already attained a height of 12,500 feet, the 60 horse-power Cato Model C motor driving it at a rate of 70 miles an hour. It can remain aloft at the low speed of 25 miles an hour for six hours, landing at a speed of only 20 miles an hour. The machine has been brought to a dead stop within forty-five feet of the place where its wheels first touched the ground.

The L. W. F. engineers while recognizing the necessity for devel-



L. W. F. Aerial Freighter

oping a sporting machine realized that, for the present, the big cargo-carrying machines are equally important, that on the practical cargo-carrying plane depends the extent to which the Government, excepting the military, will be able to utilize the airplane.

It was with considerable faith, therefore, that the L. W. F. Company accepted a contract to build commercial land tractor biplanes, to be used by the aerial mail service on long hauls, such as the one-stop mail flight between New York and Omaha. The machines are characterized as among the first aerial freighters and are designed to carry mail, express or light cargoes.

These L. W. F. aerial freighters will carry from 3,000 to 6,000 pounds cargo. At the time of their construction at the plant of the L. W. F. Company they were the largest all-American land airplanes, and their development marked a new step in aerial transportation.

On the long distance flights, such as the New York-Omaha route, with the one stop at Chicago, they carry 3,000 pounds of mail each. On shorter flights, such as from New York to Buffalo, when the quantity of necessary fuel is considerably reduced, the big ships carry their maximum load.

The actual design of this type of machine removes it finally from the war model. First of all, it is a three-motored tractor biplane.

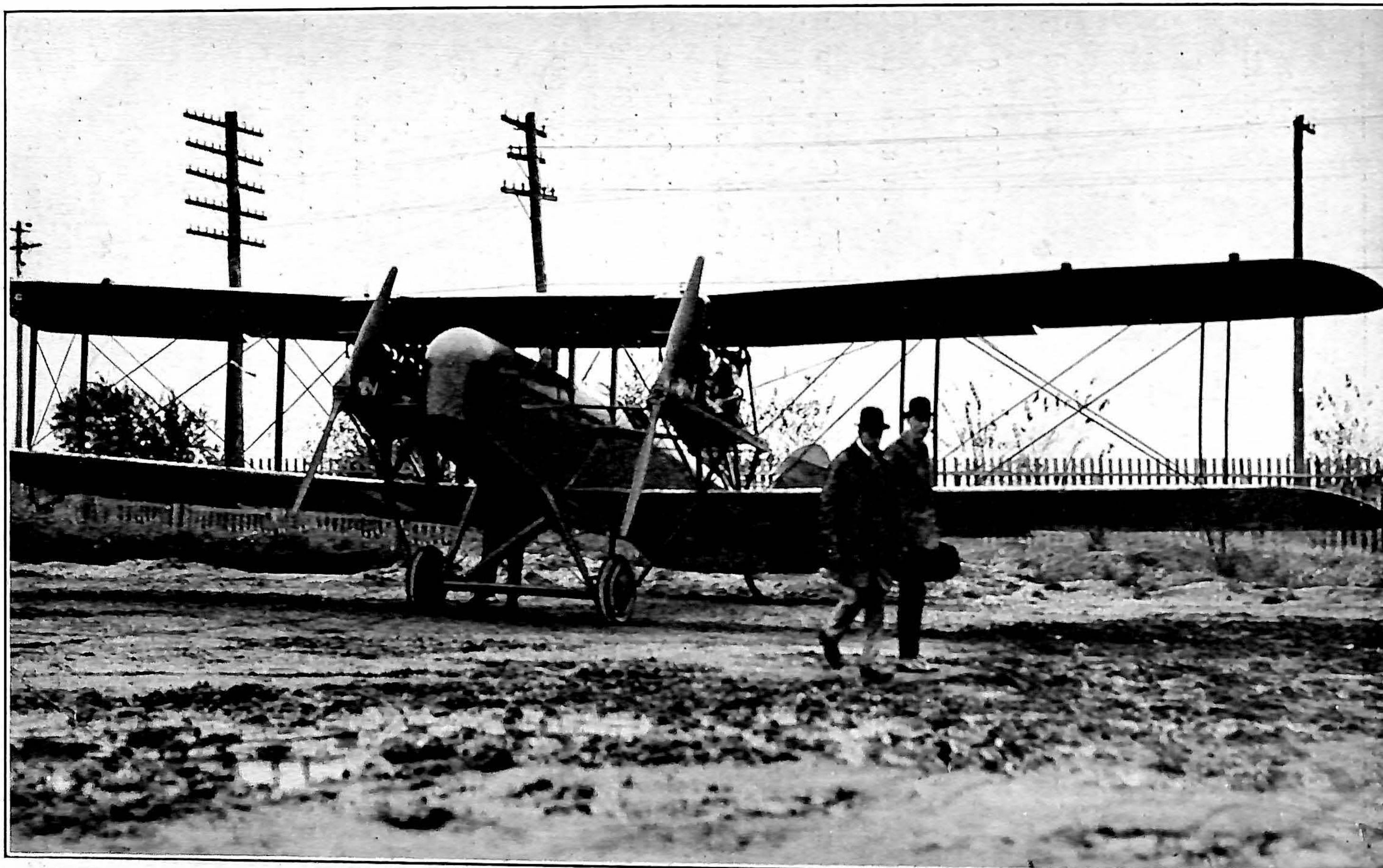
Two great fuselages, each 53 feet, 9½ inches long and constructed of laminated wood, by the L. W. F. patented process, carry part of the fuel supply and 1,000 pounds or more of mail.

The crew of four, including two pilots, a radio operator and mechanic are located in the nacelle, or tail-less body, which constitutes the central carriage of the machine.

A twelve-cylinder high compression 400 horse-power Liberty motor is set in the nose of each of the two fuselages and also in the nacelle, supplying in all 1,200 horse-power.

Both wings span 105 feet from tip to tip, furnishing a total main wing area of 2,200 square feet. They are separated by an 11-foot gap. The nacelle, in which comfortable resting and relief quarters for the crew have been installed, is used for cargo and fuel when shorter hauls permit less than four in the crew. The big machine stands 17½ feet high. It weighs, fully loaded, 20,000 pounds; empty, 12,000. The actual useful load is 7,500 pounds.

With its maximum load these machines will travel on high speed at 109 miles an hour, and throttled down to low speed, at 56 miles



L. W. F. Two-Motored D. H. Mail Plane

an hour. They will climb about 10,000 feet in 18 minutes, while their ceiling is 17,500 feet. The endurance, or flying radius is 10 hours.

These machines are equipped with the radio plant which enables the pilot to make his way through rain, storm or fog, and to determine the exact location of the landing field when he desires to descend, though the earth is obliterated by fog.

During the last year the L. W. F. Company has redesigned several DeHaviland planes, installing two motors instead of one. Cargo capacity was increased from 400 to 800 pounds, landing gear changed to bear the additional weight and three rudders instead of one.

Captain Jack Foot, chief test pilot for the L. W. F. Company, was most successful in Washington when he demonstrated the first of these rebuilt twin Hall-Scott motored machines in November, 1919. So satisfactory were the tests and exhibition flights that the machine was at once accepted by the Aerial Mail Service.

The immediate success of this twin-motored DeHaviland is shown by the following despatch from the Washington correspondent of the New York *Times:*

WASHINGTON, DECEMBER 2.—What is regarded as a record was established today by a twin-motored De Haviland-4 airplane, devised and manufactured for the Post Office Department, and which today covered the distance between the air mail field at Washington and that at Belmont Park, New York, in one hour and thirty-four minutes with a mail load of nearly 30,000 letters weighing 630 pounds. The distance covered was 218 miles and the rate of speed was 138 miles an hour. Postal officials asserted their belief that this achievement broke all load-carrying airplane records.

The best previous record in the air mail service was on September 19th, when a single motor De Haviland carried 300 pounds of mail from Washington to New York at a speed of 123 miles an hour, and the third best record was established on October 1st when a Curtiss plane carried 348 pounds from New York to Washington at a speed of 118 miles an hour.

The twin-motored De Haviland used to-day was piloted by Samuel Eaton, Jr., of Philadelphia, and left College Park, on the edge of Washington, at 12 o'clock. It arrived at Belmont Park at 1:34 o'clock this afternoon. The time of flight included two circles around the field for altitude before setting out on the course, and it was the first trip made by the plane in a regular mail-carrying flight. This plane is believed to be the only twin-motored plane built in the United States which not only maintains the altitude under full load with one engine but actually climbs on one engine. Post authorities gave it as their opinion that it is "the greatest forward step made in the development of a small weight-carrying plane."

"It eliminates the fire hazard," said Otto Praeger, the Second Assistant Postmaster General, "by having the engine in the wings and away from the gasoline supplies, and also minimizes danger to the pilot for the same reason."

With its record for turning out airplanes of new and practical design, or remodeling other machines according to the demands of the service, the L. W. F. Company is prepared to fill all orders in the quickest possible period of time. Improved facilities at its factory and exhaustive study on the part of the L. W. F. engineers have made possible the rapid development of aerial freighters, the machines on which officials of the company are depending to fill the transportation needs of the future when the saving of time becomes the chief essential in American trade and commerce.

THE GLENN L. MARTIN COMPANY

CLEVELAND, OHIO, 16800 ST. CLAIR AVENUE

Officers and Directors

President and General Manager	GLENN L. MARTIN
Vice-President	CARL N. OSBORNE
Secretary	W. D. TURNER
Treasurer	S. LIVINGSTON MATHER

M. B. JOHNSON

W. G. MATHER — ALVA BRADLEY

CHARLES E. THOMPSON — C. W. BRIGHAM

THE signing of the Armistice November 11th, 1918, signified to the Glenn L. Martin Company the beginning of an era of prosperity as well as an era of peace, for the twelve months following the cessation of hostilities have brought this company wonderful success.

Mr. Martin and his organization had been successful designers and builders of aircraft for eight years previous to our entrance into the great war and the two years of experience in the building of military aircraft, culminating in the 800 horse-power, twin-engined Martin Bomber simply served to ripen their experience and emphasize their ability to produce airplanes of the highest quality.

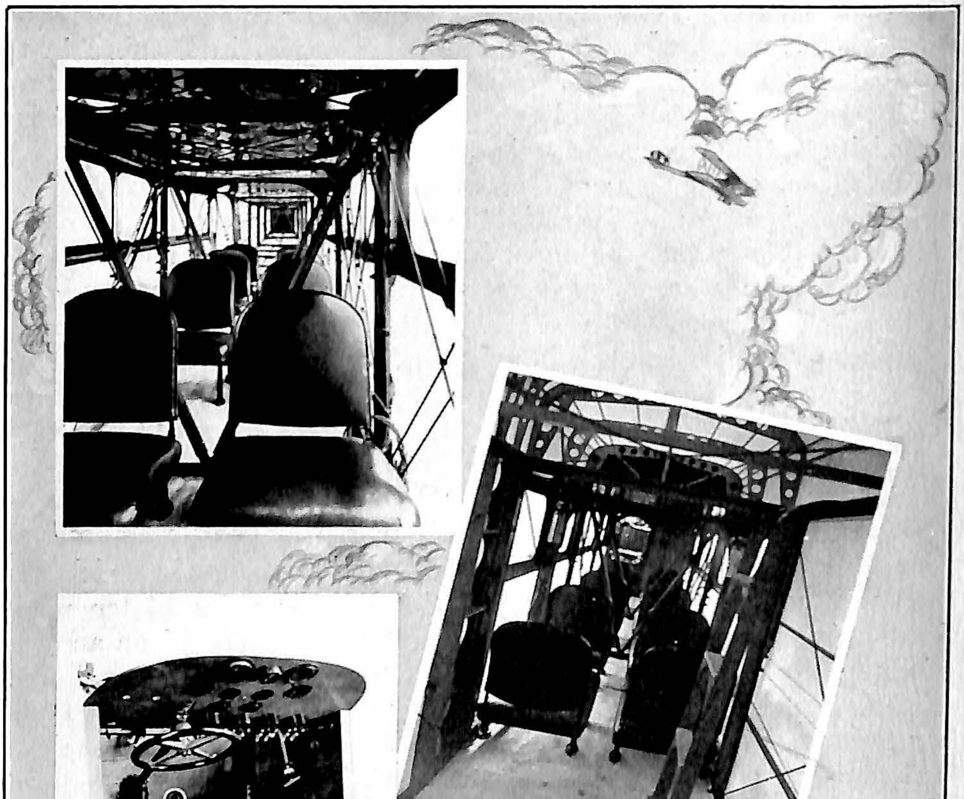
Not in any sense an organization born of the war, the signing of the armistice gave them an opportunity of entering once more the field of commercial aviation and their success is demonstrated by the fact that a year of peace finds the Glenn L. Martin Company stronger than ever, employing more men and women than at any previous time in its history.

Just as November 11th, 1918, found the Martin Bomber in the limelight by reason of its remarkable performance in official tests, so November of 1919 found the plane still in the forefront by reason of its outstanding success in actual performance. One year of active usage, carrying heavy loads over long distances brought out and emphasized the qualities in the design and workmanship on the plane and it stood at the end of a year of service the one type of airplane used by the Government which had not been superseded by some other model. Cross country work of hazardous nature was undertaken by the bombers and the many long successful journeys between large cities brought out plainly the commercial possibilities of the big twin-engined ship.

When the cessation of hostilities put an end to the army program, part of which called for a large order of Martin Bombers, the Air Service then awarded the Glenn L. Martin Company a contract for four of the ships to be delivered on completion of the six which were then well under way. The completion of this order of ten planes for the Army found the Cleveland company well started on an order of six mail planes for the Aerial Mail Service and at the termination of the post office order the preliminary assembly of the first of ten big twin-engined planes for the United States Navy was completed. The actual government contracts of the Glenn L. Martin Company since the signing of the armistice are considerably in excess of a million dollars.

The highest tribute that has been paid to the 800 horse-power product of the Glenn L. Martin Company is found in the fact that the basic design of the plane has remained unchanged despite the variety of uses to which it has been put. With only slight changes in the fuselage, Martin twin-engined airplanes have been used for long distance reconnaissance work, day bombing, night bombing, experimental long distance flying, cannon work, use as a 12-passenger army transport and mail and express carrying. The new navy order calls for an airplane of the same general type to fly over hundreds of miles of ocean carrying the customary men, guns and a full sized navy torpedo weighing more than a ton. No one general type of airplane has ever been put to such a variety of uses.

The first four twin-engined airplanes built by the Glenn L. Martin Company were of the long distance reconnaissance type intended for trips across the lines. This scheme called for a plane capable of fast climbing, high ceiling, great speed, good maneuverability,



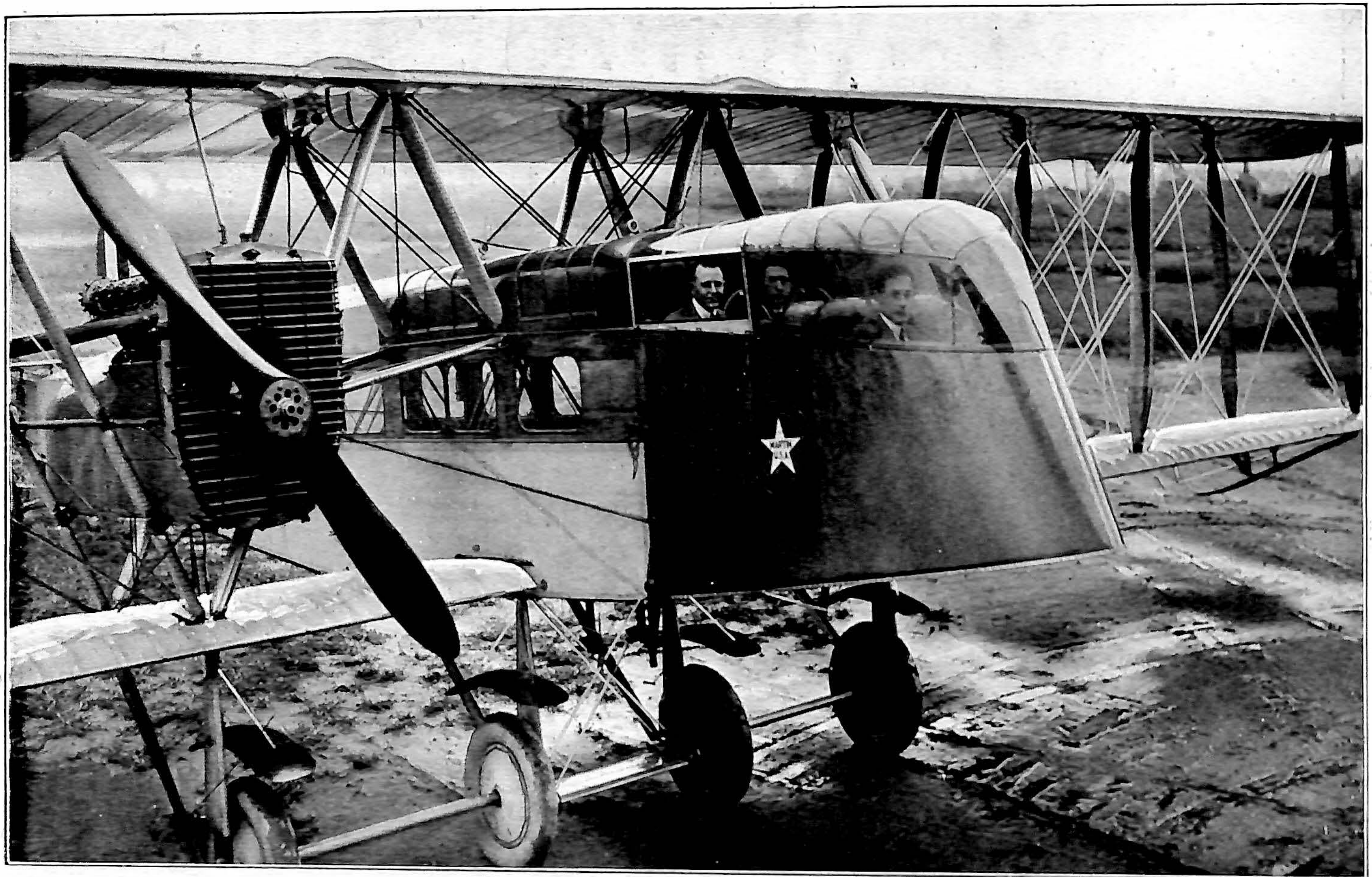
1. Martin Army Twelve Passenger Transport, Interior, looking to rear of fuselage. 2. Martin Army Twelve Passenger Transport, Interior, looking to front and pilot's seat. 3. Cockpit of Martin mail plane. 4. View from above of Martin Twelve Passenger Transport.

ability to carry heavy weight and slow landing speed. Mr. Martin's organization, which had been building aircraft exclusively for eight years, bent to the task and brought out the first all-American airplane designed for war purposes, American in conception, design and workmanship and built around the 400 horse-power Liberty motor, two of which supply the power for the Martin *corps d'armée* plane. The first of these machines was flown at the Cleveland plant in the latter part of August, 1918, and during September and October underwent tests at Wilbur Wright Field at Dayton, Ohio. During these tryouts the plane showed such remarkable performance that the army officers in charge of the tests determined to try it out with bombing equipment and the flights under heavy load were so satisfactory that it was decided to convert the plane into a night bomber.

The plane as completed had a wing spread of 71 feet 5 inches and a supporting surface of 1070 square feet. In length it measured 45 feet, in height 14 feet. Its power was supplied by two 400 horse-power Liberty motors. It carried four men, five machine guns with 1000 rounds of ammunition, 1500 pounds of bombs and sufficient gasoline and oil for a flight of six hours' duration at the cruising speed of 100 miles an hour. Its performance was remarkable. With this full load it climbed to 10,000 feet in 21 minutes and reached a ceiling of more than 16,000 feet, flew with one motor dead and showed a speed of 118.5 miles per hour at sea level. These performances were all made under official government tests at Dayton with Eric Springer, chief pilot of the Glenn L. Martin Company at the wheel.

As four planes of the *corps d'armée* type were already under way, the army officials completed them without changes but the next three planes were of the bombing type and were delivered to the Government completely equipped for bombing purposes. One of these, No. 5, was unquestionably the most completely equipped airplane in existence at that time. In addition to its regular equipment it carried navigation lights, signal lights, a searchlight for night landings, landing flares, electrically heated flying suits, telephone system between the members of the crew, complete wireless set and vacuum bottles for hot coffee for the crew.

The performances of the first seven planes disclosed such possibilities that it occurred to the Air Service that the Martin Bomber was an ideal type for flights of long duration and Martin Bomber

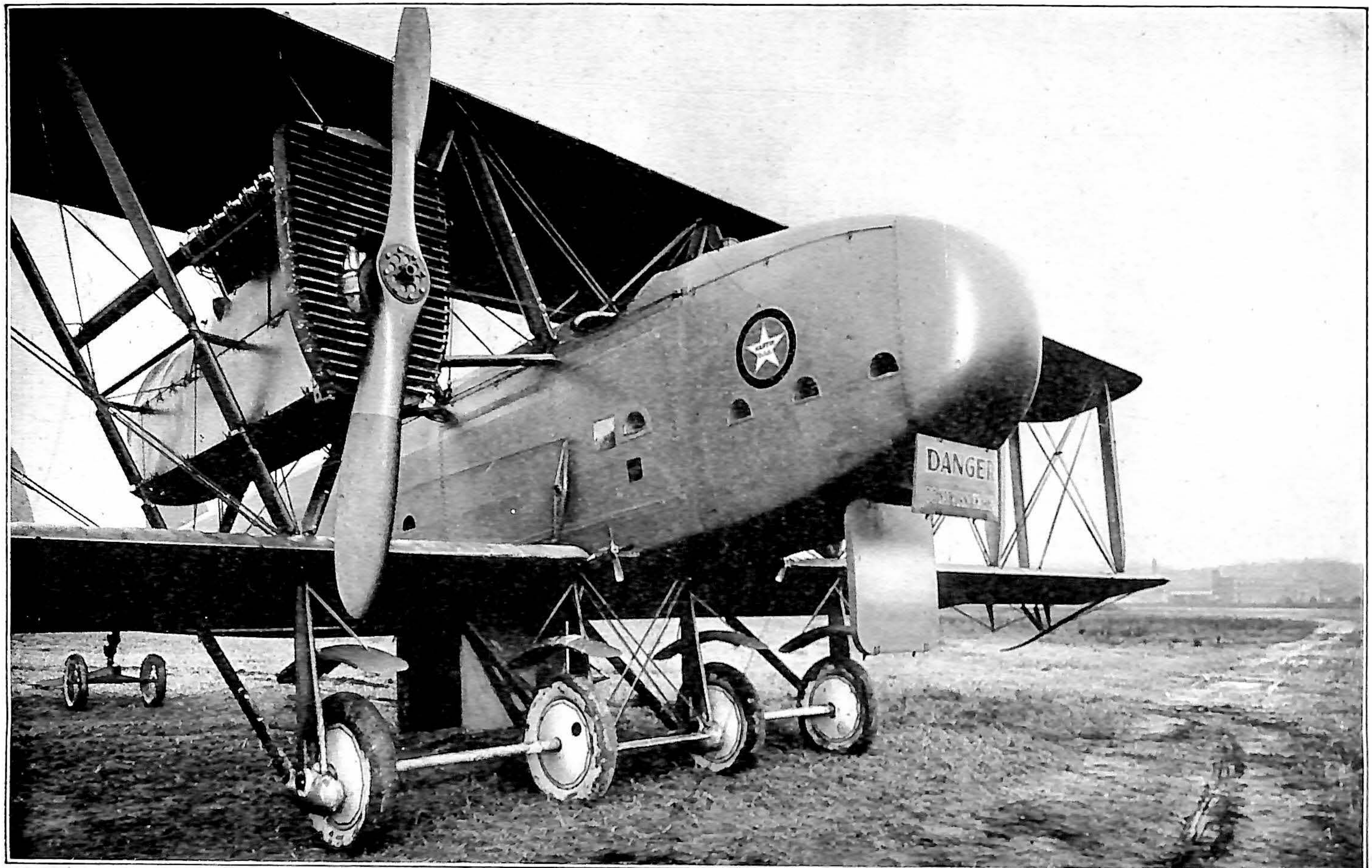


Martin Twelve Passenger Army Transport

No. 8 was accordingly fitted up with gasoline tanks carrying over two tons of fuel, sufficient for 1500 miles of flying. This plane was to be used in the first attempts to set a genuine transcontinental record, the plans calling for an initial jump from Mineola, Long Island, to North Platte, Nebraska, and a similar jump on the second day from North Platte to San Francisco. After considerable testing at Cleveland and at Dayton everything was in readiness and a non-stop flight of 635 miles from Dayton to New York was made in 6 hours and 40 minutes. Unfortunately, two days after its arrival at Mineola a hurricane struck the field, wrecking a number of airplanes and hangars. The steel hangar in which the transcontinental plane was housed, collapsed and the girders, which fell on the Martin, damaged the wings to such an extent that the Army had to abandon the proposed flight.

One of the most remarkable of all the various adaptations of the Martin Bomber was the conversion of the ninth plane into a "cannon ship." For experimental work it was decided to mount a 37 millimeter cannon in the nose of a bomber and so great was the faith of the Army in the staunch construction of the plane that the weapon was mounted in the nose of a regulation bomber without strengthening the longerons or redesigning the ship to take the strain of the recoil. That their faith was justified is shown by the fact that the cannon has been fired successfully a number of times and a complete examination has failed to disclose any tendency to warp or get out of line because of the tremendous shock of the recoil. The testing of this apparatus has been of inestimable value as the experiments show that Martin Bombers equipped with such a cannon firing either high explosive or shrapnel can blow a hostile airplane or dirigible to pieces with a single shot.

The last plane of the Army order was undoubtedly one of the most interesting and successful from the point of view of commercial aeronautics, this being an adaptation of the bomber to carry twelve men. The regulation bomber fuselage was slightly altered so that four men, including the pilot, could be carried up in the nose of the plane and eight could be comfortably seated in the main body, a sliding door connecting the two compartments. The entire body was enclosed, the nose being cowled over with a celluloid composition which gave the pilot good visibility and windows of non-shatterable glass in the sides giving a fine view to those inside. Leather covered seats with an aisle between gave the passengers comfort for the long



Martin Mail Plane with trap doors open

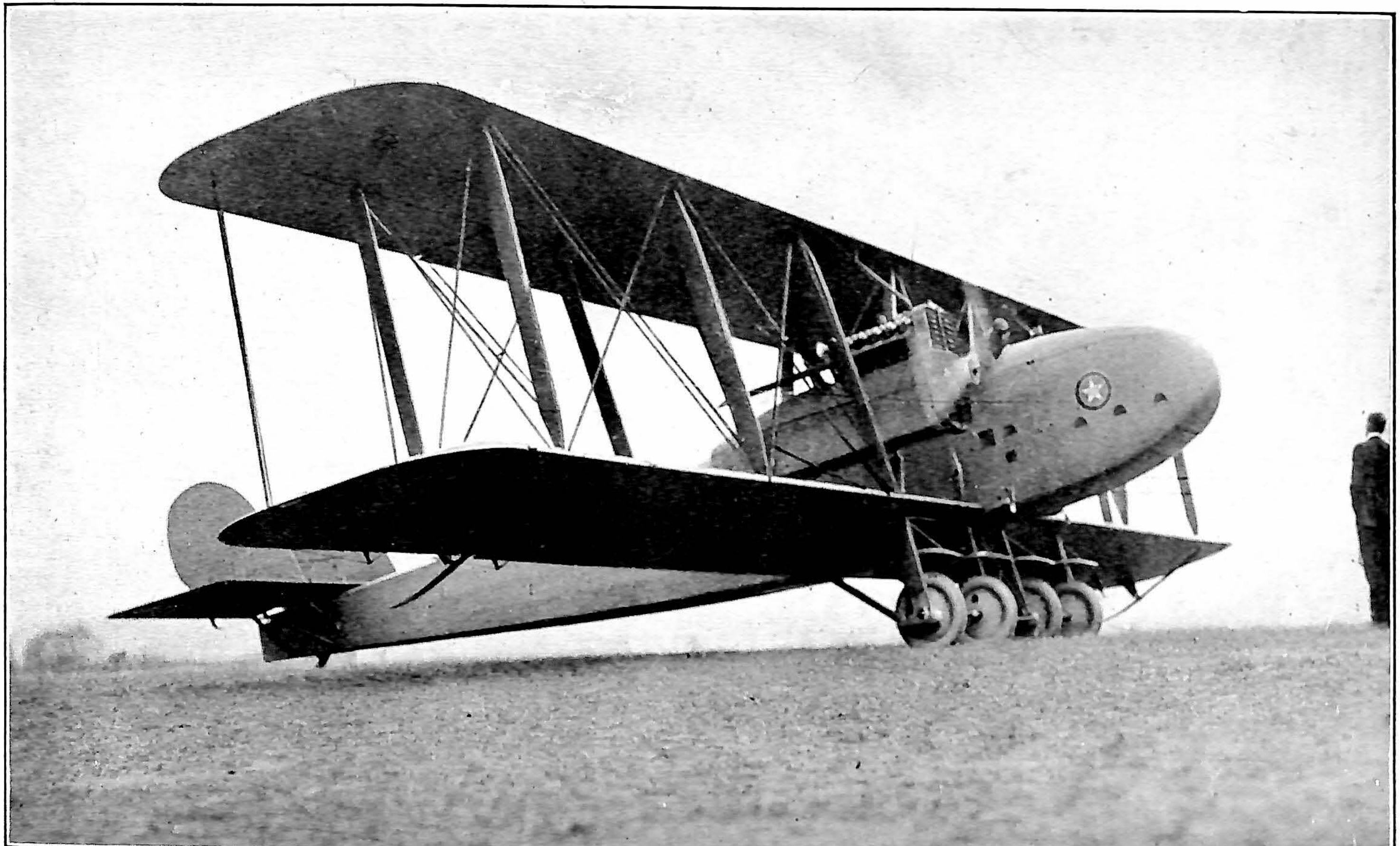
journeys of which the plane was capable. Tests on the plane at Dayton with a full load of twelve passengers disclosed remarkable speed and climb. It was shown that the ship was capable of extremely high speed at high altitudes. Approximately two miles a minute with full load was maintained demonstrating the possibilities of a plane of this type for the rapid transportation of machine gunners or other troops to threatened points.

The six Martin twin-engined planes built for the Post Office Department for use in the Aerial Mail Service are similar in general design to the types built for the Army. The specifications and dimensions are in the main identical as is the performance. The planes carry six hours of fuel, a crew of two and 1500 pounds of mail, the latter divided among five compartments, four of which are fitted with trap doors operated from the pilot's seat. These doors greatly facilitate and speed up the unloading of the plane when it reaches its destination and in addition are so designed that they may be used for the purpose of dropping the mail while in flight in case the postal authorities should desire to deliver portions of their cargo by this method.

An additional feature attracting a great deal of interest is a very solidly built detachable nose so designed that in case of an accident such as might happen through a bad landing, the nose can be removed by pulling out four bolts and a new nose immediately put on. By means of this device an accident which ordinarily would hold the plane up for two weeks or more can now be repaired in a few minutes. These planes are used in the New York to Chicago service making only one stop en route at Cleveland.

The latest development of the Martin twin-engined airplane is found in the navy order, which is now well under way. Changes and improvements, in keeping with the Martin policy of progress have been made which make certain even better performances than those which have been made by the earlier twin motored planes. Designed to carry a full sized navy torpedo weighing over a ton these planes can be operated as an aerial coast patrol from landing fields along our shores or can be taken out to sea on warships or sea sleds and there used as an active adjunct of the fleet.

Just as the eight years of experience in designing and building aircraft prior to 1917 assisted materially in enabling the Glenn L. Martin Company to produce the Martin Bomber, so the two years of experiment and construction on the Martin Bomber have enabled



The Glenn L. Martin Mail Plane, First of the Post Office's fleet for New York-Chicago service.

the Glenn L. Martin organization to produce commercial aircraft of a superior quality. With an eye to the future, the Glenn L. Martin Company during the war designed a type of airplane whose general characteristics and qualities were similar to those demanded of a commercial airplane. The combination of safety, speed, steadiness, strength and controllability so necessary in the *corps d'armée* and bombing type of military planes formed exactly the same combination of qualities called for in the airplane of commerce so that the experience gained during the war served to develop the Martin Commercial Airplane. In other words the Martin passenger, freight and mail carrying airplane is not in any sense of the word an experiment but is a pedigreed product with actual performance to its credit.

Long cross-country trips by Martin Bombers and Martin mail planes have definitely established the ability of this type of plane to link the important centers of the United States by aerial transportation. Martin twin-engined airplanes have flown over long distances carrying as many as twelve passengers and as much as a ton of dead weight. The ton mile efficiency of the Martin twin-engined airplane is an established fact while the ability of the plane to fly with a full load on a single motor reduced to a minimum the danger which accompanies forced landings.

No airplane has ever approached the service record of Martin Bomber No. 2 which, with 10,000 miles of cross-country flying to its credit was started off on a pioneering trip around the rim of the United States in command of Col. R. S. Hartz. On Sunday, November 9th, Col. Hartz completed his journey, having covered 9823 miles in 114 hours 25 minutes. This included 100 separate flights and the crossing of the Rockies at an altitude of 13,000 feet. The average speed was 94 miles per hour. The gasoline consumption was less than 46 gallons to the hour. The plane landed in Washington with a total of 225 hours and 24 minutes of actual flying or practically 20,000 miles and still retained its original fabric. It was in perfect alignment and in condition to continue, if necessary, with but slight repairs. So remarkable was the demonstration of the fine construction of this plane that the Smithsonian Institution has asked to have the plane turned over to it that it may be preserved for future generations.

The Glenn L. Martin Company as an organization has been in existence for a long time as time is reckoned in aviation. The first relationship between Mr. Martin and the United States Army came in June, 1913, when the first plane was made and delivered from the Los Angeles plant. The following year found increased orders and Mr. Martin delivered military planes to both the Holland Government and the Netherlands East India Government. The first Martin plane for the United States Army proved a success and the relationship between the Martin organization and the Army has continued.

Mr. Martin is a pioneer flyer, having built his first airplane in 1908 and taught himself to fly. Every year saw a new model, with marked improvements, and with which Mr. Martin traveled thousands of miles — the beginning of the development and establishment of an individual group who have widened and improved the types to a great degree.

Mr. Martin began, as early as 1912, to surround himself with men of marked ability in their various specialized positions in his company, and have cooperated to carry out his ideas for superior aircraft and the highest possible development of the art.

Two men in particular whose development and advancement has been very rapid, are Lawrence D. Bell, Factory Manager, whose unquestioned ability as a producer is a valuable asset to the organization. He has been with the organization since 1912.

Mr. Martin has great confidence in the unusual qualities of Donald W. Douglas, his Chief Engineer, who is nationally known for his ability. Mr. Douglas came directly to the organization from the Massachusetts Institute of Technology in 1915.

Eric Springer, Chief Pilot, is known nationally because of his wonderful successes in test flying and cross-country work with Martin airplanes. He graduated from the Martin school in 1915 and has been connected with the Martin forces ever since.

The harmony of the entire organization and its loyalty to the policies of the company is a very notable feature, which together with the skill and ability of the entire personnel, has made a very efficient aircraft factory.

Alvan Macauley

PACKARD MOTOR CAR COMPANY

DETROIT, MICH.

President and General Manager	ALVAN MACAULEY
Vice-President of Engineering	J. G. VINCENT
Vice-President of Manufacturing	F. F. BEALL
Vice-President of Distribution	H. H. HILLS
Secretary and Treasurer	F. L. JANDRON

SINCE the war period, the principal aviation work of the Packard Motor Car Company has been the development of motors and planes by their experimental department. New engines and planes of the highest efficiency have gone through very satisfactory tests. With the exception of the Packard aviation engine, Model I.-A.-1650, none of their air products will be put on the market for the present Packard engine Model I.-A.-1650 has specifications practically identical with the famous Liberty, in the development of which this company played such an important part. Manufacturers and those requiring high-powered motors are invited to direct their inquiries to the Aviation Department, Packard Motor Car Company, Detroit, Michigan.

STURTEVANT AEROPLANE COMPANY

The offices of the Sturtevant Aeroplane Company are now located in Framingham, Massachusetts, having been removed from Jamaica Plain during March, 1919.

Officers

President	NOBLE FOSS
Vice-President	BENJAMIN S. FOSS
Treasurer	W. EMERSON BARRETT
Clerk	HORATIO ALDEN

Directors

NOBLE FOSS	E. B. FREEMAN
BENJAMIN S. FOSS	NEAL RANTOUL
W. EMERSON BARRETT	GALEN STONE

WILLIAM A. GASTON

Chief Engineer	JOHN J. MCELROY
General Superintendent	F. S. CHANNONHOUSE

WHEN the Armistice was signed, the Sturtevant Aeroplane Company had uncompleted orders for D. H.-4, J. N.-4, D. and V. E.-7 airplanes, and had attained nearly the maximum production permitted by the then occupied buildings. Plans had been completed for additional final assembly building to provide for increased assembly of 5 V. E.-7 planes per day. Production was gradually reduced upon cancelation of contracts until January 6th, 1919, when all production of every nature was discontinued.

At that time an organization of over 1,000 persons had been practically disseminated, leaving a skeleton organization of major department heads which the company continues to maintain, although no further contracts for airplanes have been entered into with the United States Government or others.

It is the established policy of the company to hold itself in readiness for production at any time conditions may warrant.

The Aeronautical Department of the B. F. Sturtevant Company has been maintained with small production, and a great many improvements and developments have been made in the Sturtevant motor during the past year.

THOMAS-MORSE AIRCRAFT CORPORATION

MAIN OFFICE AND PLANT, South Hill, Ithaca, New York
AUXILIARY PLANT, Brindley Street, Ithaca, New York

President	F. L. MORSE
Vice-President	WILLIAM T. THOMAS
Treasurer	JEROME A. FRIED
Secretary	RAYMOND WARE
Chief Engineer	B. DOUGLAS THOMAS

UPON the signing of the Armistice, the quantity manufacture of airplanes for war purposes was quickly brought to a standstill, except for the completion of some one hundred planes and a number of spare parts which were well under way.

During the war the experimental department was working on the construction of four experimental single-seater pursuit machines built to take the 300 horse-power Hispano-Suiza engine for the Engineering Division of the Air Service at McCook Field, Dayton, Ohio.

As a result of much painstaking effort a special design was developed employing unusually light weight construction of exceptional strength. Particular attention was given to reducing head resistance to a minimum to secure the maximum speed consistent with a reasonable wing loading and therefore a low landing speed. That success was achieved is shown by the very remarkable performance both in speed range and climb with load. In test flights made by the manufacturer at Ithaca on the 21st of February, witnessed by officials from Washington and Dayton, a speed of 164 miles per hour was attained, and a climb to ten thousand feet in four minutes fifty-two seconds. The first one thousand feet was made in twenty seconds, equivalent to a vertical ascent at the rate of 34.4 per hour, which gives a very good idea of its extraordinary climbing speed. This performance, which is understood to be a world's record, was officially recognized by telegram to the Corporation from the Director of Military Aeronautics. During these trials, the machine balanced perfectly in the air and was extremely maneuverable at all speeds. In addition it was found to handle in a most satisfactory manner both in landing and taxi-ing on the field.

Thomas Morse Fighter M.B.-3

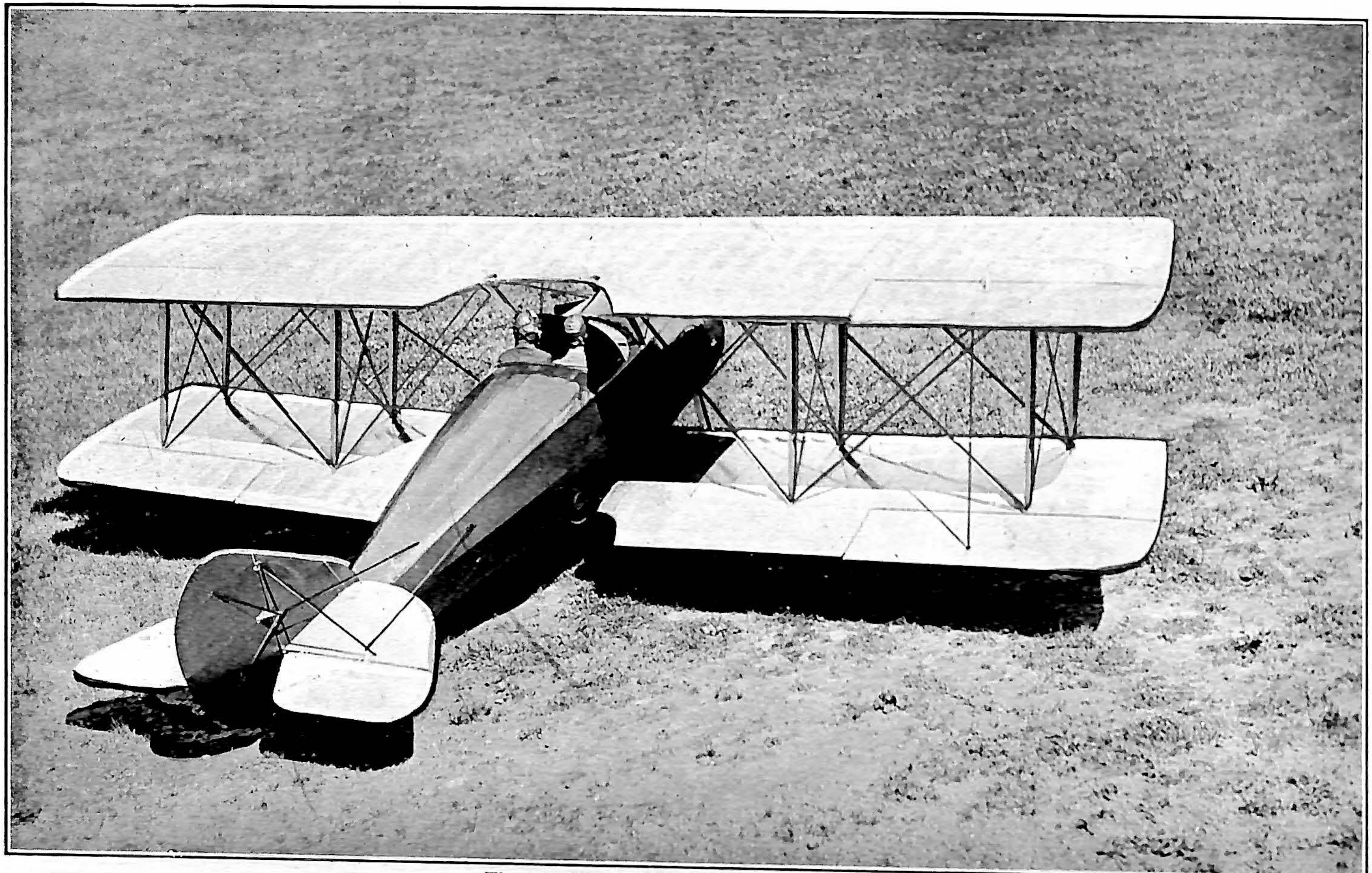
The results of the sandload tests on one of the four machines carried out at Dayton by the Engineering Division were none the less remarkable. Where a factor of safety of eight was required in the wing structure, a factor of over ten was found. In the case of the control surfaces a sandload of over fifty per cent. greater than that called for in the contract was placed upon them without failure or serious deflection. As the wing structure itself did not fail, a subsequent test was made upon the laminated wood wing beams, resulting in a factor of safety of over fifteen or almost twice that required. Although this type of construction was developed for war machines, its light weight-strength characteristics are well suited to machines for peace purposes.

An interesting speed comparison was made between the Thomas-Morse type S.-4-C single-seater advanced army training machine and the M. B.-3 pursuit type. With the 80 horse-power LeRhone engine in the S.-4-C machine all out, making a speed of approximately ninety-seven miles per hour, it was not able to hold the pursuit machine with its 300 horse-power Hispano engine, throttled to approximately 25 per cent. of its maximum power.

With a view to anticipating the demand for an all purpose two-seater training or sport machine, two designs, type S.-6 and S.-7, were brought out. The former, a tandem two-seater, the latter, a side-by-side two-seater, both fitted with the 80 horse-power LeRhone engine. These machines were completed in time for the New York Aero Show held at Madison Square Garden in March, and exhibited together with the 80 horse-power type S.-4-C and the 300 horse-power Hispano-Suiza M. B.-3 type.

Both machines gave exceptional performances, considering the horse-power available. In the trial flights the tandem two-seater showed an average of 105 miles per hour and the side-by-side two-seater 95 miles per hour. The climbs in ten minutes with full load were 8,000 feet and 6,500 feet, respectively. A low landing speed was particularly sought in these machines, and with this end in view, wings were constructed giving a loading of but four and one-half pounds per square foot. In repeated tests a landing speed in the neighborhood of 38 miles per hour has been made in still air.

In connection with extensive flight tests on the type S.-6, a flexible dual control was developed, which allows the pupil or passenger to control the machine in the usual manner through the medium of rubber shock absorber bands connecting his control stick and rudder



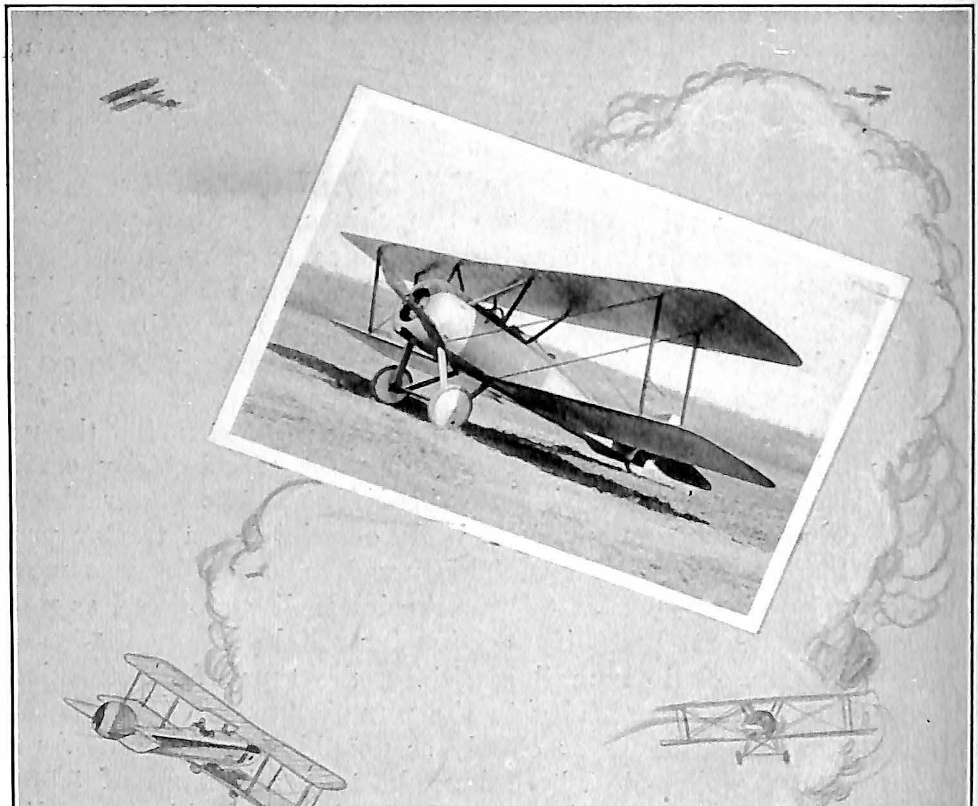
Thomas-Morse Sociable Seater Model S.-7

footbar to the pilot's controls. This method of interconnecting the pilot and passenger controls has proved very satisfactory, permitting the pilot control at all times even against the will of the passenger or student receiving instruction, without, however, actually disconnecting the secondary control.

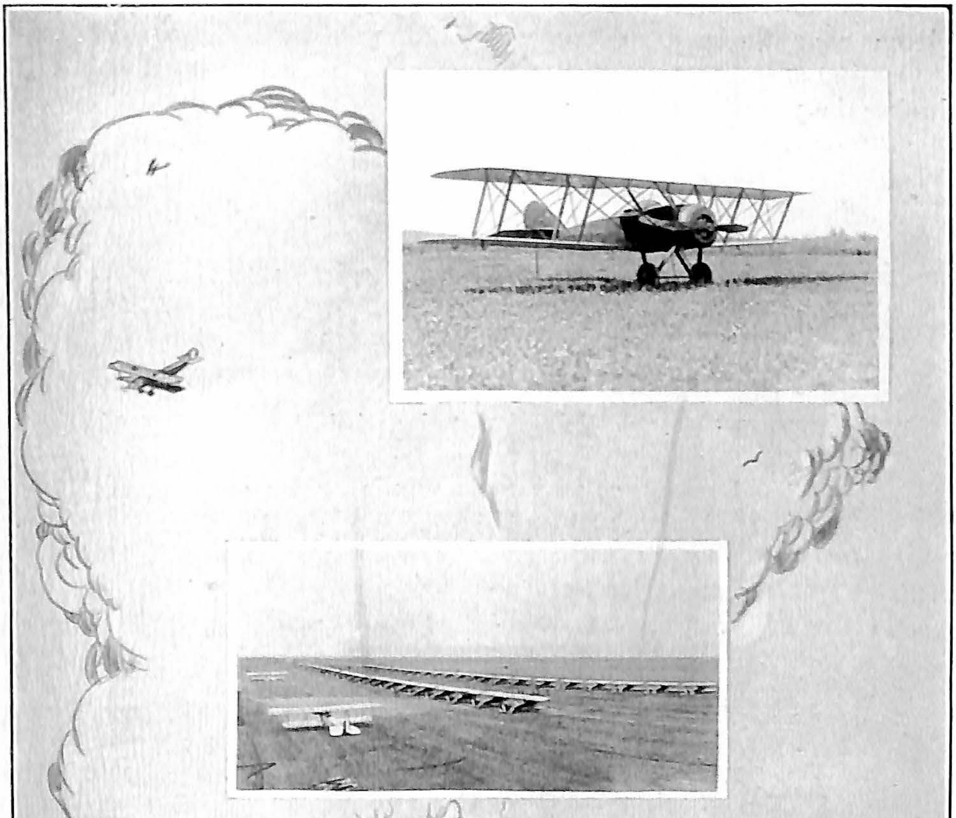
In June, 1919, the United States Post Office Department requested bids for the construction of ten mail machines to be equipped with two or three Liberty or Hispano-Suiza engines, to carry from fifteen hundred to three thousand pounds of mail. As a result of its bid, the Corporation was awarded an order for four machines, to be equipped with two 300 horse-power Hispano-Suiza engines to carry fifteen hundred pounds of mail. One of the requirements of the contract was that the machines must be capable of carrying the required mail load with one engine. To most satisfactorily carry out this requirement, the design provided for the two power plants in a center nacelle, placed back to back, one driving a tractor propeller and the other a pusher. This novel arrangement was most favorably received by the Post Office Aerial Mail committee, as providing the best power plant installation for reliability.

In the design of these mail machines, the type of construction which was used so successfully in the pursuit type, fitted with the same engine, was followed as closely as possible throughout. As a result the total weight has been brought to a minimum of 5,564 pounds, fifty per cent. of which is useful load. With this unusually large percentage of useful load, it has been possible to restrict the wing span to forty-five and one-half feet, at the same time providing sufficient wing area to give a satisfactory landing speed. The two fuselages are arranged one on each side of the center engine nacelle, with pilot located in the nose of the one at the left and the pilot mechanic in the one at the right. The latter is provided with the Thomas-Morse type flexible control. Wing radiators are fitted in the top wing above the engine nacelle. Streamline wire is used throughout the wing bracing, and all control surfaces are balanced. The fifteen hundred pound mail load is placed in the center nacelle between the two engines, and in each fuselage behind the pilot and pilot-mechanic.

The high speed is estimated at 132 miles per hour with full load, and 102 miles per hour with but one engine, the machine having sufficiently low power loading to enable it to fly satisfactorily or climb on one engine. The first machine of this new type was com-



Thomas-Morse Model S.-6



1. Front quarter view of Thomas-Morse S.-7. 2. Line-up of Thomas-Morse Scouts.
3. Side view of Thomas-Morse M.B.-3 Fighter.

pleted near the end of the year and was tested early in 1920.

Outline specifications of the Thomas-Morse machines brought out during the year 1919 follow:

THOMAS-MORSE AIRCRAFT CORPORATION

AIRPLANE SPECIFICATIONS

MODEL M.B.-3. PURSUIT MACHINE

Dimensions: Length, 19 ft. 11 in.; span, 26 ft.; height, 8 ft.
Areas and Weights: Wing area, 250.5 sq. ft.; gross weight, 2037 lbs.
Power Plant: One Hispano-Suiza, Model H, 300 horse-power; tractor propeller.
Performances: Speed, 60–163⅔ m. p. h.; climb, 10,000 ft. in 4 min. 52 sec.

MODEL S.-7. ADVANCE TRAINING MACHINE. SIDE-BY-SIDE SEATER

Dimensions: Length, 21 ft. 6 in.; span, 32 ft.; height, 9 ft.
Areas and Weights: Wing area, 360 sq. ft.; gross weight, 1480 pounds; useful load, 475 pounds.
Power Plant: One LeRhone 80 horse-power rotary; tractor propeller.
Performances: Speed, 38–95 m. p. h.; climb, 6500 ft. in 10 min.

MODEL S.-6. ADVANCE TRAINING MACHINE. TANDEM TWO-SEATER

Dimensions: Length, 20 ft. 8 in.; span, 29 ft.; height, 8 ft.
Areas and Weights: Wing area, 269 sq. ft.; gross weight, 1396 pounds; useful load, 472 pounds.
Power Plant: One LeRhone, 80 horse-power rotary; tractor propeller.
Performancess Speed, 40–105 m. p. h.; climb 8000 ft. in 10 min.

MODEL M.B.-4. TWIN ENGINE MAIL MACHINE

Dimensions: Length, 25 ft. 5 in.; span, 45 ft. 6 in.; height 11 ft.
Areas and Weights: Wing area, 645 ft.; gross weight, 5564 pounds; mail load, 1500 pounds.

WEST VIRGINIA AIRCRAFT CO.

MAIN OFFICES AND PLANT, Wheeling, West Virginia

Officers

President . . . . J. C. MCKINLEY
Vice-President . . . . N. A. HANING
General Manager and Vice-President . . . . . C. H. PHILLIPS

THE activities of the West Virginia Aircraft Company since the signing of the Armistice have been principally engineering experimental work in perfecting a design that would be practical and cost of production would be reduced to a minimum, which would be consistent with durability and efficiency, to carry not less than three passengers. The manufacture has been reduced to simply rebuilding machines for individuals.

Our engineering department reports that their plans for the three passenger machine are about completed, and we contemplate building three or four of these craft at an early date, although we have not indicated to the public that we would build any of these machines at the present for the market.

Our engineering department has been held intact, although the mill and the assembling department have been temporarily diverted to other lines, but at any time when the airplane business justifies it and shows some signs of stability, our entire plant could be brought back to its full capacity.

For quite a few months after the Armistice was signed, we continued to the completion of our contract with the Government, but since the completion of this contract, we have not built any new complete machines.

When the Armistice was signed, we again placed in operation our Flying Schools at Princeton and Daytona.

WRIGHT AERONAUTICAL CORPORATION

Frelinguysen Avenue, Newark, New Jersey

Officers

President	GEORGE H. HOUSTON
Vice-President and General Manager	F. B. RENTSCHLER
Vice-President and Chief Engineer	HENRY M. CRANE
Secretary and Treasurer	JAMES F. PRINCE
Sales Manager	JOHN R. CAUTLEY
Factory Manager	HAROLD L. POPE

THE Wright Aeronautical Corporation has taken over certain of the assets and liabilities of the Wright-Martin Aircraft Corporation. This reorganization is for the purpose of putting the operations of the older corporation on a satisfactory peace-time basis.

The new corporation has possession of the Wright patents and the Hispano-Suiza license for the United States and is continuing the manufacture of the Hispano-Suiza engine. In order to maintain its place as the foremost individual aeronautical engine builder in this country, the corporation expects to develop new and improved types of aircraft engines and thus keep abreast of the times.

Ordnance Scout, Hispano-Suiza powered

In order that the corporation may be in the best possible position to continue the production of improved Wright Hispano engines and to work out new problems under proper conditions the New Brunswick plant has been sold to the International Motor Truck Company. This sale has enabled the corporation to purchase a new site on Frelinghuysen Avenue in Newark, upon which a new factory, especially designed for the needs of aviation engine work, is being constructed. Special attention is being paid in the initial construction to immediate requirements but all plans are being laid out with a view to expansion, so that the factory will be able to increase its production with the greatest possible rapidity and with practically no interference with operations at any time.

Manufacturing on a small scale will be carried on in the Experimental Department at New Brunswick until the new factory is completed.

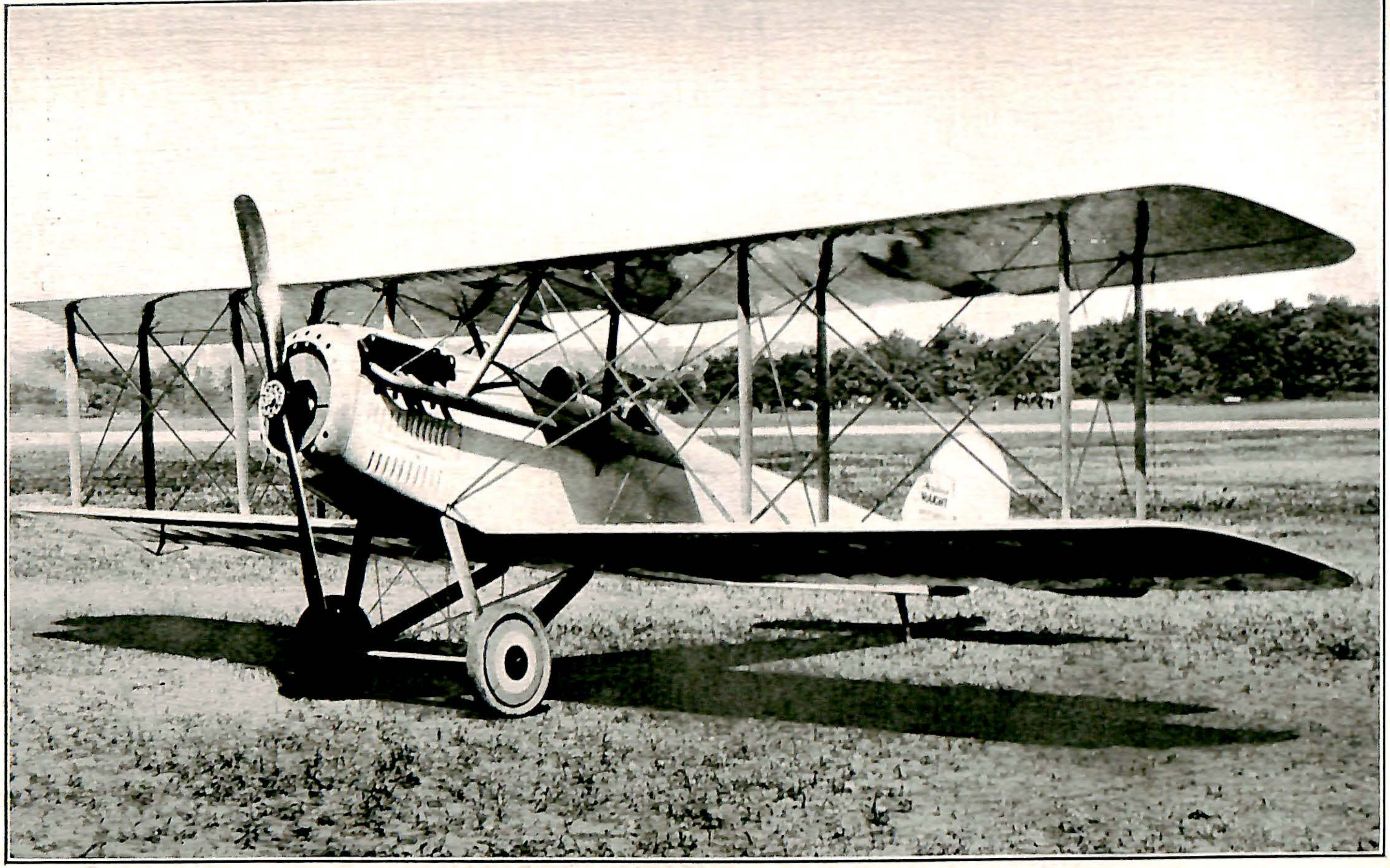
After the signing of the Armistice a period of approximately six months was taken for the completion of the corporation's government contracts. Since that time a small amount of experimental work has been carried on for both the Army and Navy Departments and at the present time the 180 horse-power Model "E" engine is being produced in small quantities.

The record made by the Hispano-Suiza engine is too well known to discuss at length. It is generally acknowledged to be the most successful pursuit plane engine in the United States. In spite of the fact that the machine was built for scouting purposes with little more than two hours fuel capacity, the first airplane to complete the round trip from New York to San Francisco without change of or repair to engine was a single seater scout fitted with one of the small 180 horse-power Hispano-Suiza engines, notwithstanding the fact that it was competing with engines over twice its power.

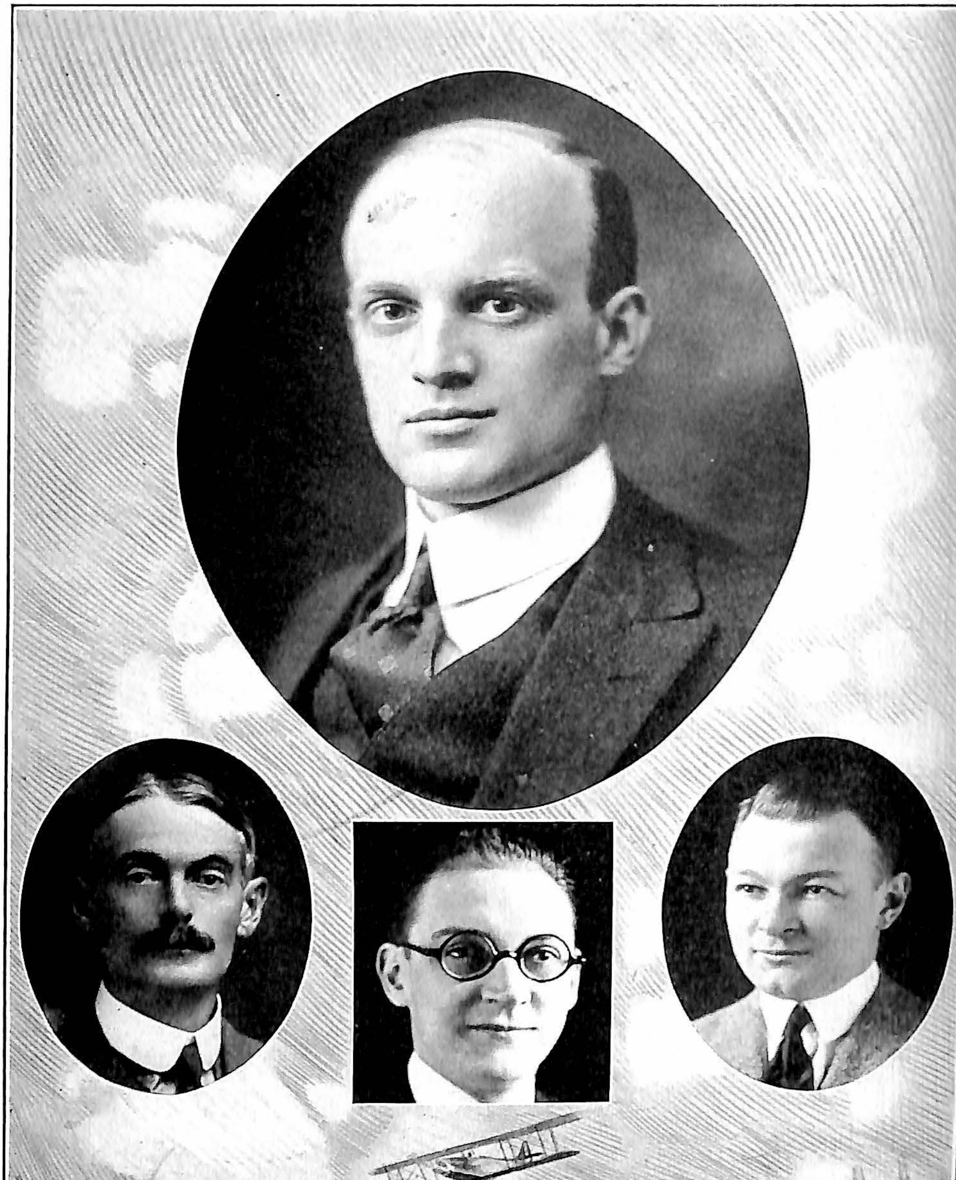
In the New York–Toronto race, although there were fewer than twenty per cent. of the planes entered using Hispano-Suiza engines, the first four places in the reliability contest were taken by Hispanos.

At the present time developments for advanced training planes in the Army, development for high speed single seater pursuit machines, and a considerable portion of the development for two seater fighters is based on Hispano engines. In the Navy the program for battle planes for the fleet, both of the small single seater type and the larger two seater type, is based on the 180 horse-power Hispano and the 300 horse-power Hispano engines.

Loening Monoplane, Hispano-Suiza powered



Vought Blue Bird, Hispano-Suiza powered



1. George H. Houston, President. 2. Henry M. Crane, Vice-President in Charge of Engineering. 3. John R. Cautley, Sales Manager. 4. F. B. Rentschler, Vice-President and General Manager.

The illustrations accompanying this article show three typical examples of plane installations using the Hispano-Suiza motor. There are a number of others, such as the Thomas-Morse Scout illustrated elsewhere, but the three shown will serve as reasonable examples of developments around the " Wright Hispano."

The Loening two seater fighter was designed especially to meet the call of the Army toward the end of the war for a very high speed two seater machine of great maneuverability. This machine has not only shown its ability as a land ship but is being built for the Navy as a pontoon type seaplane. It is equipped with a 300 horse-power Type " H " Wright Hispano motor.

The Ordnance Scout was built in response to the request of the War Department for an ultra high speed single seater machine. The performance has been exceptionally high. As it was developed for the Air Service, the exact figures are not available. It is equipped with a 300 horse-power Type " H " Wright Hispano.

The V.E.-7, or Vought Bluebird, was especially developed as an advanced training machine for the Air Service. It has shown very marked ability for a machine designed for a 150 horse-power motor and is widely used to-day in the Air Service. It is equipped either with 150 horse-power Type " I " or 180 horse-power Type " E " Hispano.

The Wright Aeronautical Corporation believes in the Wright Hispano engine and that the developments which are in hand at the present time make it not only wise for the corporation to continue in the aeronautical engine business, but that it is its duty as an American corporation to do so as it is the only corporation in the United States which was a large producer of fighting engines, which proposes to continue in the business with aviation engines as its sole product.

The Wright Aeronautical Corporation therefore believes in aviation and the necessity for a strong organization which will bend its whole efforts toward the continued development of the aviation engine. The corporation is in position to accept orders for Wright Hispano engines of the 150 and 180 horse-power and 300 horse-power sizes. It is developing in a conservative manner other types of engines which it believes will be needed. The corporation will undertake the development of any particular type or engine auxiliary equipment for the use of private concerns or military establishment in the United States and abroad.

CHAPTER IX

CHRONOLOGY OF AERONAUTICS

Nov. 15, 1918 — Jan. 4, 1920

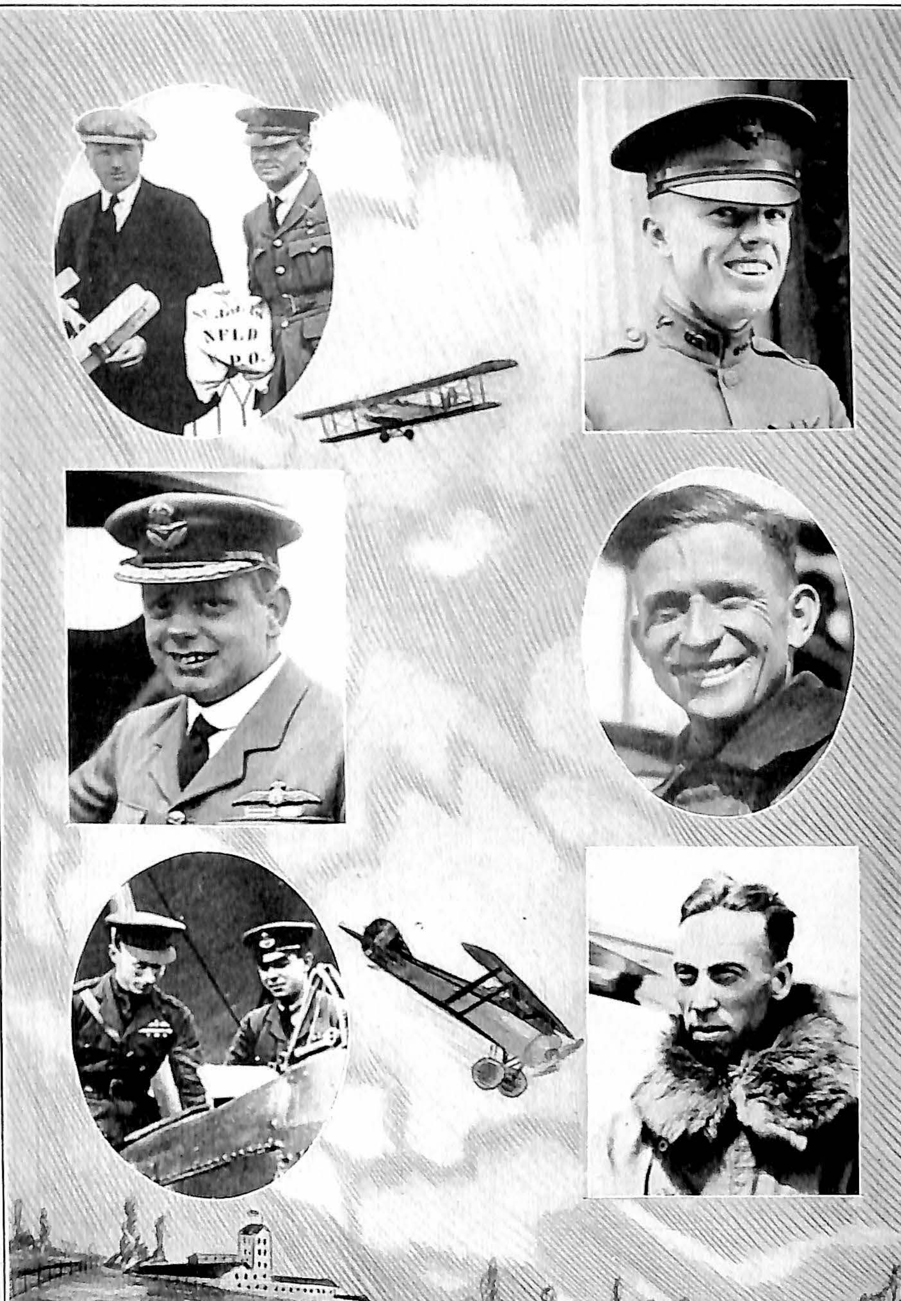
(For Earlier Chronology, see "Aircraft Year Book, 1919")

* See amplification at close of this chapter.

1918	
November 15	Handley-Page at Cricklewood Field, England, carries 40 people 30 minutes at altitude of 6,500 feet.
Dec. 13–Jan. 16	*England to India.* Four motored Handley-Page piloted by Major MacLaren and General McEwen of the Royal Air Force arrives in Calcutta, a distance of approximately 6,500 miles from England.
December 24	United States Naval non-rigid dirigible A-236 flies from Key West to Tampa, Cape Sable, Palm Beach and return, covering approximately 691 miles and maintaining continuous flight for 40 hours and 48 minutes.
December 31	Lieutenant-Commander P. N. L. Bellinger carries 5 passengers and 542 pounds additional weight 668 miles in 9 hours and 1 minute continuous flying.
1919	
January 2	*New altitude record* established by Captain Lang, R. A. F., at Ipswich, England, with passenger. Altitude of 30,500 feet reached unofficially.
January 6	*Transcontinental Pathfinding Tour.* Four army Curtiss J.N.-4-H (Hispano-Suiza) airplanes complete 4,000 mile flight in 50 flying hours. Aerial photographs and maps taken and aerial mail routes and landing fields selected.
January 12	*Rockaway to Key West.* United States Naval dirigible C1 (Goodyear) flies 1,450 miles.
January 24	*New Italian Record.* Italian biplane, the Marchetti Vickers Terni, equipped with 200 horse-power Spa motor, and piloted by Sergeant Elia Lint, attains, under official tests, and over a closed circuit, an average speed of 160 miles per hour.
January	Navy airplane successfully launched from dirigible in flight.
January 26	*Marseilles to Algeria.* Lieutenant Roget and Captain Coli pilot French Breguet airplane across Mediterranean Sea, a distance of 457 miles in five hours.
February 1	*Endurance flight.* Cape May, New Jersey. Goodyear Airship flies 33 hours. Assuming average speed to have been 40 miles per hour, approximately 1320 miles were flown.
February 2	*Annual Flying Circus* held at Rockwell Field, San Diego, California, in which more than 200 airplanes of all types take part.
February 12	*Paris to Brussels and return.* Farman Goliath carrying 17 passengers flies 325 miles in 4 hours and 52 minutes.
February 12	*New looping record.* Lieutenant B. W. Maynard, a test pilot at American assembly plant at Romorantin, France, loops 318 times without losing altitude, flying a British Sopwith Camel.
February 13	British non-rigid airship N.S.11 patrols North Sea for four days, four hours and fifty minutes with crew of 10.
February 13	*London to Paris flight.* Airco D.H.-4 airplane flies to Paris from London in 1 hour and 50 minutes.
February 19	Lieutenant E. E. Harmon, piloting a Lepere biplane, 400 horse-power Liberty engine, flies from Mineola, Long Island, to Washington, in 85 minutes.

Famous Air Pilots — 1. Lieut.-Com. A. C. Read, first trans-atlantic Flight, Navy-Curtiss N.C.-4. 2. C. J. Zimmerman, Aeromarine, New York to Cuba and return. 3. Com. J. H. Towers, N.C.-3, Commanding Officer of Trans-atlantic Flight operation. 4. Lieut.-Com. P. N. L. Bellinger, N.C.-1. 5. Roland Rohlfs, Official World's Altitude Record, 34,910 feet in Curtiss *Wasp*. 6. Lieut.-Col. R. S. Hartz, Around U. S. in Glenn L. Martin Bomber.

February 21	*American Speed Record.* Thomas-Morse Scout, equipped with 300 horse-power Hispano-Suiza motor, attains speed of 164 miles an hour at Ithaca, N. Y., recorded as witnessed and officially recognized by Director of Military Aeronautics.
March 1–15	First Annual Aeronautical Exposition of Manufacturers Aircraft Association at Madison Square Garden and 69th Regiment Armory, New York City.
March 1	*French Aerial Mail Service* established between Paris, Bordeaux and Marseilles.
March 2	*Italian Aerial Mail Service* established between Padua, Italy, and Vienna, Austria, a distance of 304 miles.
March 3	*Canada–United States Air Mail.* W. E. Boeing, in a Boeing seaplane, flies from Vancouver, British Columbia, to Seattle, a distance of 200 miles. The trip was authorized by the Canadian Post Office and the bag was officially received in Seattle by the Mayor of that city.
March 6	Pilot C. J. Zimmerman in an Aeromarine Model 40 Flying Boat, meets S.S. *Leviathan* carrying the 27th Division at sea, and drops a bag of letters of welcome on board addressed to Major-General John J. O'Ryan.
March 12	Commercial delivery by airplane made in Curtiss J.N. by Roland Rohlfs for New York department store,—Mineola, Long Island, to Mt. Vernon.
March 13	Curtiss M.F. boat sent by Commander Schofield as aerial ambulance from Far Rockaway, Long Island, to St. Luke's Hospital, New York City.
March 20	*150 mile radio telephone conversation.* Secretary of Navy Daniels talks to pilot in seaplane in flight.
March 22	*3 D.H.-4 airplanes cross Sierra Nevada* mountains at altitude of 14,000 feet, flying from Mather Field, Sacramento, to Carson City, Nevada, in 85 minutes, as compared with average train time of 9½ hours.
March 23	*Marseilles to Paris.* M. Roget covers approximate distance of 500 miles in 3 hours and 45 minutes.
April 4	Lieutenant Cortinez, of Chilean Army, crosses Andes Mountains at altitude of 19,800 feet in British Bristol monoplane.
April 6	*Lyon, France–Rome, Italy.* M. Goget makes non-stop flight from Lyon to Rome, distance of 684 miles in 7 hours.
April 16	*Flight across Continent.* Major T. C. Macauley piloting D.H.-4 airplane, arrives at Souther Field, Americus, Georgia, from San Diego, California, distance of 2,400 miles, in 19 hours flying time, completing round trip flight in 44 hours and 15 minutes.
April 19	Captain E. F. White, piloting D.H.-4 army biplane, makes first non-stop flight between Chicago and New York City. An average speed of 106 miles per hour is maintained for the 727 miles.
April 10–May 10	*Remarkable records made by Victory Loan Flying Circus.* The circus, composed three flights, each flight consisting of 15 pilots and many types of airplanes, tours country. Performances given in 88 cities in 45 states. Total of 1,275 flights made, 368 civilians taken as passengers and 19,124 miles flown.
April 23	*Sixth National Foreign Trade Convention held in Chicago adopts following resolution calling for establishment of separate department of Aeronautics:* "Realizing the unquestioned advantages of having the speediest possible mail and express service in enabling American enterprise to compete successfully in securing the specifications and requirements of our foreign contracts, this convention urges prompt Con-



Famous Air Pilots — 1. Capt. John Alcock and Lieut. A. W. Brown, first Non-Stop Trans-Atlantic Flight. 2. Lieut. Alex. Pearson, Jr., Winner in actual flying time, New York–San Francisco Race. 3. Major G. H. Scott, Commanding Dirigible R.-34, Round trip Trans-Atlantic Flight. 4. Lieut. Belvin W. Maynard, first to make round trip New York–San Francisco Race. 5. Capt. R. Smith and Lieut. K. M. Smith, R. A. F., first to make flight from London to Australia. 6. Major R. W. Schroeder, World's two man altitude record, 31,796 feet in Lepere motored biplane, equipped with supercharger.

gressional consideration of suitable plans for developing aerial navigation. The establishment of the necessary aids to such navgation, the investigation of development of the fundamental principles of commercial aeronautics, the promotion of airship service to distant countries, are matters which demand the prompt establishment of a separate department of the government. One of its chief duties should be to provide the necessary information which will make possible the use of aerial navigation as an aid to foreign trade."

April 26 — Final speed tests on Curtiss *Wasp* at Garden City show 160.1 to 162 miles per hour with full military load.

April 26 — *World Duration Record.* United States Naval F-5-L flying boat remains in air 20 hours and 19 minutes with crew of four; 1,250 nautical miles covered.

May 2–10 — Southeastern Aeronautical Congress meets at Macon, Georgia.

May 3 — *First Passenger Air Service in United States.* Mrs. J. A. Hoagland and Miss Ethel Hodges are carried from New York to Atlantic City and return by pilot Robert Hewitt in an Aeromarine Model 50 "S" Flying Boat.

May 5 — French machine climbs to altitude of 4,860 meters with 24 passengers.

*May 8 — Departure of N.C. 1-3-4 from Rockaway on first leg of Trans-Atlantic flight.

May 8 — Martin Bomber flies 650 miles in 7 hours and 55 minutes completing round trip flight from Macon, Georgia, to Washington.

May 8 — United States Naval Macchi flying boat establishes altitude record of 10,800 feet in 15 minutes at Hampton Roads, Virginia, with one passenger.

May 10 — German machine flies from Berlin to Stockholm, 570 miles, in 7 hours.

May 10 — French machine flies 690 miles from Paris to Copenhagen in 8 hours.

May 11 — Navy's free balloon race won by Lieutenant P. D. Collins. Winner remains aloft 21 hours 9 minutes and covers 420 miles.

May 14 — Navy's C.-5 dirigible (Goodyear) makes record flight of 1,115 miles from Montauk Point, Long Island, to St. Johns, Newfoundland, in 25 hours and 40 minutes on first leg of Trans-Atlantic flight. Severe storms after landing tears dirigible from its moorings and carries it out to sea, where it is lost.

May 15 — *Boston to Atlantic City.* M. W. Hodgden in a Whittemore-Hamm I-2 biplane with a 90 horse-power engine flies from Boston to Atlantic City in 3 hours and 59 minutes.

May 15 — Aerial Mail Service established between Chicago and Cleveland.

May 17 — Colonel G. C. Brant, U. S. A., flies D.H.-4 army airplane from Houston, Texas, to Belleville, Ill. 720 miles in 453 minutes.

May 18 — *Harry G. Hawker and Lieutenant-Commander Kenneth Grieve* attempt Trans-Atlantic flight in Sopwith biplane equipped with 375 horse-power Rolls-Royce motor. Motor trouble develops after about 1,200 miles are covered and machine is forced down near passing steamer and pilot and observer are rescued.

May 19 — Three-engined Caproni, with crew of eight, makes non-stop flight from Turin, Italy, to London, England, 600 miles.

May 22 — *Departure of American Aviation Mission* to study aviation problems of foreign countries.

May 23 — *Lands on hotel roof.* Army Goodyear dirigible A-4, piloted by James Shade, lands on roof of Cleveland hotel.

May 24 — First visit of surgeon to patient made by Dr. F. A. Brewster, Beaver City, in a Curtiss J.N.

May 24	Lieutenant Roget of French Army flies 1,375 miles in non-stop flight from Paris to Morocco.
*May 27	*First Trans-Atlantic flight.* United States Navy's N.C.-4 (Navy-Curtiss) successfully completes Trans-Atlantic flight, landing at Lisbon, Portugal.
*May 31	N.C.-4 arrives at Plymouth, England, completing last leg of first Trans-Atlantic flight.
June 1	*Establishment of aerial forest patrol.*
June 1	Baroness de la Roche ascends 12,870 feet in single motored G3 Caudron, breaking world's altitude record for women.
June 3	Regular merchandise delivery begun at Chicago with Curtiss J.N.'s by cloak manufacturers.
June 13	Lieutenant Casale, of French Army, reported to have reached altitude of 33,100 feet in type 29 Nieuport airplane. This reading of the barograph is without air temperature and other corrections.
*June 14	*First non-stop Trans-Atlantic flight.* Captain John Alcock, pilot, and Lieutenant Arthur Whitten Brown, navigator, complete first non-stop flight across Atlantic Ocean in 15 hours and 57 minutes.
June 17–20	R-34, largest of British dirigibles, cruises for 56 hours.
July 2	N.C. heroes officially dined by the American Flying Club in New York City.
*July 6	*First Trans-Atlantic dirigible flight.* R-34 lands at Roosevelt Field after having successfully completed the first leg of its round-trip Trans-Atlantic flight.
July 7	*Non-stop speed record.* Captain L. H. Smith in a DeHaviland Bluebird flies from San Francisco to San Diego, 610 miles in 246½ minutes.
*July 9	R-34 starts on return trip to England.
July 10	*Curtiss Trans-Atlantic Dinner.* Glenn H. Curtiss host to naval officials, including Lieutenant-Commander A. C. Read, in honor of first Trans-Atlantic flight, gives dinner at Hotel Commodore.
July 11–14	W. H. Blair pilots Curtiss *Seagull* from New York to Detroit, Michigan, via Hudson River, Barge Canal, and Great Lakes.
July 11	Navy mail left by a destroyer fleet is brought to New York from Block Island in a seaplane.
July 11	Army airship A-4 flight from Akron, Ohio, to Langley Field, Virginia. Makes 407 miles in 18 hours. Lieutenant G. W. McEntire in command.
*July 12	R-34 arrives in England completing round trip Trans-Atlantic flight.
July 12	*Seaplane crosses Alps.* Taddioli, Swiss aviator, first flier to cross in this type of plane.
July 12	Army Balloon School's carnival at Fort Omaha.
July 12	*Night altitude flight.* Lieutenant C. C. Chauncey in a Lepere attains an altitude of 20,000 feet at Arcadia, Florida.
July 13	First permits granted by Canadian Military authorities for flight across international boundary are given to Lieutenant O. S. Parmer and Ensign G. D. Garman, Americans.
July 15	Sid Chaplin Aircraft Company establishes Los Angeles-Catalina Island daily passenger service with Curtiss *Seagulls*, first regular passenger-carrying line in United States.
July 16	*Rome to England.* Lieutenant F. Brockpapa makes flight via Paris in 8 hours, 30 minutes — distance, 950 miles.
July 18	Air delivery available for all first class United States mail.
July 20	*Mediterranean crossed.* Captain Marchal, French, flies 450 miles from St. Raphael to Bigerta in 5 hours, 40 minutes in a seaplane.

July 23	*South American record.* Antonio Merolla, the Argentine aviator, ascends 16,500 feet in a seaplane with one passenger.
*July 24–Nov. 9	*"Round the rim" flight.* Lieutenant-Colonel R. L. Hartz and Lieutenant E. E. Harman in a Martin Bomber start from Bolling Field, Washington, District of Columbia. Complete circuit of the United States is made covering 9,823 miles.
July 28	First test by United States Bureau of Fisheries of observation of fish schools from aircraft is made at Cape May, New Jersey, with the cooperation of Naval Air Station, showing possibilities of aircraft in research and commercial lines.
July 28	*Independent Air Service.* Representative Curry introduces bill to establish a Department of Aeronautics, which is referred to the Committee on Military Affairs.
July 30	*Flight over the Andes.* Lieutenant Locatelli, Italian, first to cross South American Continent by air — from Buenos Aires to Valparaiso, 800 miles.
July 30	*New American altitude record.* Officially made by Roland Rohlfs in Curtiss *Wasp* triplane when he ascends 30,300 feet.
July 31	*Flight over the Sierra Nevadas.* Lieutenants J. M. Fetter and Tobin S. Curtiss make a trip from Sacramento, California, to Ogden, Utah, 540 miles in Curtiss-Hispano machines.
July 31	*Independent Air Service.* Senator New introduces a bill to create a Department of Aeronautics, which is referred to Committee on Military affairs.
Aug. 1–Sept. 14	*International Aircraft Exposition, Amsterdam, Holland.* First exposition in Europe since Armistice. Among aircraft flown to the show was an 8 passenger Blackburn which flew from Leeds via London and Brussels — 440 miles. By night, planes flew to London for theater, returning in morning. 10,000 flights were made during show.
August 1	Lieutenant J. P. Corkville with Sergeant J. R. Cook in Lepere fly 186 miles from Arcadia, Florida, to Daytona Beach in 75 minutes, flying 148 miles an hour at 6,000 feet altitude.
August 2	*137 miles an hour at altitude of 18,400 feet.* Lepere machine piloted by Major R. W. Schroeder, and equipped with a 400 horse-power Liberty motor establishes a record at McCook Field, Dayton, Ohio.
August 2	*Glides 35 miles.* "Tex" Marshall in Thomas-Morse plane, makes record from altitude of 17,000 feet, when he glides 35 miles, renewing power at an altitude of 6,000 feet.
August 4	Pikes Peak circled by Lieutenants A. Landrum and Ira J. Humphries.
August 3	*London to Madrid.* British service plane flies 900 miles in 7 hours, 45 minutes.
August 5	*Test Flight.* Major S. M. Strong and associates arrive at Arcadia, Florida, completing round trip flight to New York, 2,972 miles in 2,851 minutes flying time. Stops were made in 20 cities.
August 5	*Andes again crossed.* Lieutenant Locatelli, Italian, flies 750 miles from Santiago, Chili, to Buenos Aires, in 7 hours, 10 minutes.
August 6	*Madrid to Rome.* Aviator Stopanni makes a non-stop flight of 900 miles in 11 hours, 45 minutes using Italian seaplane.
August 7	*Flight over Canadian Rockies.* Captain A. C. Hoy, D. F. C., makes trip from Vancouver, British Columbia, to Lethbridge, Alberta.
August 8	*Passenger height record.* Maurice Walbaum and mechanic at Villacoublay, climb 25,740 feet.

August 8	*Speed record.* Colonel H. B. Claggett in a D.H.-4 flies from Washington to the Statue of Liberty, 210 miles, in 1 hour, 24 minutes.
August 11	*Paris to Morocco.* Farman Goliath carrying 10 passengers, makes 1,116 miles in 16 hours, 20 minutes.
August 13	*One passenger record.* Lieutenant Weiss with mechanician Begul, both French, attains an altitude of 30,000 feet in 52 minutes.
August 13	*All-American Pathfinders.* Thirteen army airplanes fly 4,000 miles through 15 states to collect landing field and mapping data and stimulate recruiting.
August 14	*First mail delivered by flying boat to steamer at sea.* Aeromarine flying boat drops bag on forward deck of White Star liner *Adriatic* 1½ hours after she leaves her pier in New York.
August 18	Lieutenant De Rissis flies from Buenos Aires to Asuncion and return, 1,300 miles, in Bristol airplane.
August 18	*England to Denmark.* Major F. Gron with 7 passengers in Handley-Page machine, flies from London to Copenhagen, 640 miles.
August 22	*Buffalo to New York.* Curtiss 3 passenger Oriole biplane, piloted by J.D. Hill, flies 440 miles in 4 hours, 10 minutes.
August 22	*Aerial Mail Day in Cleveland.* Members of Manufacturers Aircraft Association, Officials of Army Air Service, and Aerial Mail participate in ceremony under auspices of Cleveland Aero Club and Cleveland Chamber of Commerce.
August 24	*Airship over Berlin.* With 35 passengers the "Bodensee," 394 feet long, circled Berlin at a speed of 75 miles an hour.
*August 25–29	*New York–Toronto Aerial Derby.* Conducted by American Flying Club.
August 25–29	Curtiss *Oriole* takes first prizes for speed and reliability among commercial machines in New York–Toronto Air Race.
August 25	*Italian dirigible circles Naples* with 20 passengers — arrives over city after three hour flight from Rome and makes return trip in afternoon.
August 25	*Indian Aerial Mail.* Sites for aerial mail aerodromes have been selected at all the principal cities of India, excepting Bombay where land is very expensive. British mails will be landed at Karachi and distributed over country by subsidiary aerial services.
August 28	*Low parachute drop.* Major O. Lees, R. A. F., makes 250 foot jump from seaplane into New York Harbor.
August 29	*Airplane with passenger lands on roof.* Edwin E. Ballough, pilot, then hops off at Newark, New Jersey.
August 29	*Timber hunting.* Captain Daniel Owen, R. A. F., in command of expedition, hunting timber, locates by use of airplanes great timber lands in Labrador.
August 29	Norwegian fishermen buy a seaplane to search for herring shoals.
September 2	*Speed record.* Sadi Lecointe in Spad flies 125 miles in 48 minutes, 8 seconds. Performance in Italy, not officially observed.
September 2	*France to Italy.* Pilot Maneyvol, French, in Morane monoplane flies from Paris to Rome, 1,250 kilometers in 5 hours, 59 minutes.
September 4	*Spain to Italy.* Aviators Busco and Casatti, flying Nieuport machine, make the trip from Barcelona to Varise in 5 hours, 50 minutes, 500 miles.
September 5	*Naval speed record.* Pontoon seaplane, piloted by Lieutenant L. T. Barin and carrying Lieutenant-Commander N. H.

	White, Jr., U. S. N., commanding Naval Air Station, Hampton Roads, flies from Hampton Roads to Philadelphia, covering a course of approximately 270 miles in 135 minutes at the rate of 2 miles a minute.
September 5	*Berlin to Switzerland.* Regular passenger air service is opened between resorts of these countries.
September 5	*Whale-hunting with airplanes.* Machines patrol west coast of Vancouver Island, and when whales are spotted the news is wirelessed to whaling ships.
September 5	*Air service for Belgian Congo.* An aeronautic mission is now in the Belgian Congo, organizing a passenger carrying air service. Twelve seaplanes will be used between Kinchasna and Stanleyville, 1,050 miles.
September 6	*New altitude record* officially made by Major R. W. Schroeder and Lieutenant G. Elfrey who ascend 29,000 feet in a Lepere airplane, at Dayton, Ohio.
September 8	*Italy to Holland.* Lieutenant Campacii and petty officer Guarnieri of the Royal Italian Navy cross Alpine mountain chain in Switzerland with a Savoia seaplane, then follow Rhine to Amsterdam.
September 13	Lawson air liner arrives in New York from Milwaukee.
September 14	*Altitude record.* Roland Rohlfs makes a new record of 34,200 feet flying Curtiss Triplane. Unofficial.
September 14	*Cairo to Paris.* Commander Vuillemin, French, makes a trip of 2,500 miles, stopping at Constantinople and Istris near Marseilles, using a French service plane.
September 15	*Holland to England.* Vickers-Vimy commercial machine with 8 passengers makes trip from Amsterdam to Hounslow in 2 hours, 50 minutes.
September 16	*Radio test.* Airplane 2,000 feet up sends radio to submerged submarine. Test is made at Fishers Island.
September 17	*Austria to France.* Lieutenants Story and Blizence of the Czecho-Slovak aviation service make flight from Prague to Paris via Mayence, approximately 600 miles.
September 17	Twelve passenger Glenn L. Martin army transport flies to Dayton, Ohio, from Cleveland at 117 miles an hour.
*September 18	*Official World's Altitude Record.* Roland Rohlfs climbs 34,910 feet in a Curtiss *Wasp* triplane, equipped with a Curtiss K-12 400 horse power motor. For purposes of international comparison the barograph was read without air temperature corrections, thus conforming with European practise. After calibration by the Bureau of Standards, Rohlfs' barograph showed a minimum corrected altitude of 32,450 feet. These readings give Rohlfs the official record in both corrected and uncorrected classes, his nearest rival being Lieutenant Casale, who is reported to have reached an uncorrected altitude of 33,100 feet.
September 19	Roland Rohlfs in Curtiss *Wasp* climbs 19,200 feet in 10 minutes and in the first two minutes of flight climbs 4,800 feet. Ten minute climb approved by Bureau of Standards.
September 21	*Swedish record flight.* Aviator Rodehn, flying a 260 horse power Swedish airplane, makes non-stop flight from Ystad to Haparanda, 1,420 kilometers, in 7½ hours.
September 23	N.C.-4 off on a recruiting trip.
September 26	Army-Navy Balloon Race starts at St. Louis.
September 29	*New hydro-monoplane altitude record.* Caleb S. Bragg with passenger makes new world's altitude record of 18,759 feet in Loening 300 horse-power Hispano-Suiza hydro-monoplane.
September 29	Loening Monoplane, as a seaplane with Twin Floats, breaks the world's seaplane altitude record for two passengers,

climbing to 18,759 feet, developing at the same time a speed of 131 miles per hour which is said to be considerably faster than any other American Seaplane.

October 1 — Goodyear airship wins 1,021 mile National Free Balloon Race, St. Louis, Missouri.

October 4 — *Two man Altitude Flight.* Major R. W. Schroeder, Pilot, and Lieutenant George W. Elsey, Observer, reach indicated and uncorrected altitude of 33,335 feet, in Lepere biplane, equipped with 400 horse-power Liberty motor. The engine was fitted with a supercharger and the plane was otherwise specially prepared. Barographs to the date of this writing had not been corrected by the Bureau of Standards. McCook Field, Dayton, Ohio, where the flight was made, reports corrections bringing the record down to 31,796 feet.

October 7 — *Boy flies 2,000 miles with mother.* A Curtiss Oriole 3 passenger biplane, piloted by Ralph Block arrives at Mineola, Long Island, from Houston, Texas, with Mrs. Seymour E. J. Cox and her nine year old son, Seymour, as passengers, establishing a new record for a cross country airplane flight by civilians.

October 8–30 — *New York to San Francisco airplane reliability test.* Race under auspices of American Flying Club.

October 14 — *Air mail in Colombia (South America).* Experimental aerial mail service starts between Barranquilla and Puerto, Colombia.

October 14 — *France to Australia flight.* Begun by Lieutenant Poulet, French pilot in French biplane.

*Oct. 14–Dec. 10 — *London to Australia, 11,500 miles.* Four machines enter. Trip carries pilots over three continents and many seas with a 1,750 mile hop at the end of the journey, from Bandoeng (Java) to Port Darwin (North Australia). Captain Ross Smith left London at 9 o'clock, November 12, and December 10 arrived at Port Darwin.

October 17 — Japan appropriates the equivalent of $125,000,000 for air service.

October 17 — *Air mail in Brazil.* Brazilian budget for 1920 includes the establishment of aerial mail service. Government's loan will amount to $25,000,000.

October 17 — *Iceland sees airplane for first time.* Captain Cecil Farber, late R. A. F., establishes commercial aviation at Danish Island Colony.

October 18 — *Speed record between London and Paris.* Captain Gathergood, flying an Airco D.H.-4 machine with a Napier engine makes a new record of 80 minutes for a distance of 250 miles.

October 21 — *Chinese aviation.* The Vickers Company of England contracts to supply airplanes and equipment to the Chinese Government for $43,000,000.

October 21 — *London to Australia flight.* Captain George Matthews, English, with Sergeant Kay, Australian, begins 13,000 mile flight in Sopwith two-seater.

October 21 — Air route covers Finland from Sortavala on the Lagoda to Murmansk.

October 24 — The Curtiss *Eagle*, an eight passenger aerial liner, and first American three motored machine, makes its first public flight, Garden City, Long Island, to Washington, District of Columbia, and return. In ten days in Washington it made 82 flights and carried 476 people, mostly United States government and foreign government officials.

October 27 — *Keyport, New Jersey, to Havana, Cuba.* C. J. Zimmerman begins 1,421 mile flight in Aeromarine flying boat.

October 27	*Key West to Cuba Air Service.* Three Aeromarine flying boats, models 50 "S," 40 "C," 40 "L" fly from Key West to Cuba, inaugurating the service between these points.
October 28	*New looping record.* Alfred Flamval, French, in military airplane, loops 624 times in 2 hours at Villacoublay, France.
October 28	R-38, England's largest airship, is purchased by United States Navy for $2,500,000.
October 28	New York to Cuba air freight service is begun.
October 29	Glenn L. Martin mail plane, the first twin motored mail ship, begins service.
October 30 November 1	*Reversible propeller.* New American device tested at McCook Field, Dayton, Ohio, permits airplane to land and be brought to a stop within 50 feet.
November 1	Two Aeromarine boats leave New York for Miami, covering 1,350 miles in 19½ hours flying time.
November 6	Aerial flower service from Paris to Copenhagen. French plane covers trip with one intermediate landing in Holland, in one day, carrying half a ton of flowers.
November 9	*Morocco to Tunis.* Major Chentin and Lieutenant Pontanchan flies 1,250 miles without a stop.
November 17	Navy reports total hours of flight in heavier than air machines on other than patrol duty, for the year 1919, up to November 17th, 1919, to total 57,452. There were 3,399 hours spent in lighter-than-air flights — approximately 1,000 hours were spent in patrol flights of all kinds.
December 2	*Aerial mail speed record.* An L. W. F. remodelled D.H. mail airplane, equipped with two Hall-Scott motors, establishes new speed record from Washington, District of Columbia, to Belmont Park. Time, 1 hour, 34 minutes. Distance flown, 218 miles; speed, 138 miles an hour. 30,000 letters weighing 630 pounds carried.
December 3	*Havana to New York.* Pilot Zimmerman, in Aeromarine flying boat, makes return flight from Havana.
December 3	*Airplane Coast Patrol starts from Mineola, L. I.* Two D.H. machines leave Mitchel Field on flight to Langley Field, Virginia, establishing first coast patrol. The pilots will report ships between New York and Virginia and in the case of accident will wireless the position of the disabled vessels.
December 5	Senate Military Affairs Committee by a vote of 9 to 2, approves the Senate bill recommending a Department of Aeronautics, headed by a member of the President's cabinet.
December 5	*Endurance flight.* Goodyear airship flies 41 hours, 50 minutes at Key West, Florida. Assuming average speed to have been 30 miles per hour, the ship probably flew 1,255 miles.
December 16	*Three and three quarter miles a minute reported.* Sadi Lecointe, French Aviator, said to have attained speed of approximately 226 miles an hour in an airplane test. He covered the distance of a kilometer at an average speed of 307.225 kilometers (about 190 miles) an hour. During some seconds of his flight he reached a speed of 364.5 kilometers (226 miles) an hour or about 3¾ miles a minute.
December 17–18	*Mineola, N. Y., Hampton, Va., and Return — Non-stop.* 1st Lieutenant C. E. Duncan and 1st Lieutenant L. M. Wightman, in a D.H.-4, flew from Mitchel Field, Mineola, L. I., N. Y., to Langley Field, Hampton, Va., non-stop in 190 min.; and on the following day return was made in 215 min.
Dec. 19–Jan. 4	International Aeronautical Exposition held at the Grand Palais, Paris, France. The commercial application of aerial navigation was given prominence in this exposition.

NC-4 Trans-Atlantic Flight

(May 16th–31st)

At the close of the war the United States Navy laid its plans for an attempt to fly to Europe, to be made early in 1919. Route, seaplanes, commanders, fuel and auxiliary service were carefully discussed in Washington. The extensive organization which characterized the N.C. Flight, (the letters N.C. stand for Navy-Curtiss) the development of the Navy-Curtiss flying boats, and the selection of the Newfoundland-Azores-Lisbon-Plymouth route resulted from these Washington conferences. The Chief features of the organization were government weather reports, the extensive use of radio equipment, the assigning of government destroyers to act as tenders, and the establishing of a line of destroyers reaching from Trepassey, Newfoundland, to Lisbon, Portugal.

Commander John H. Towers was designated as Commanding Officer of N.C. seaplanes, Division 1, New York Department. On May 8th the N.C.-3 (Flagship), Commander Towers; the N.C.-4, Commanding Officer Lieutenant-Commander A. C. Read; and the N.C.-1, Commanding Officer Lieutenant-Commander P. N. L. Bellinger, left the station at Far Rockaway, Long Island, for Trespassey, Newfoundland. The three planes had all covered this distance by May 15th, the N.C.-4 arriving six days after the N.C.-1 and N.C.-3. Engine trouble caused a descent on the open sea near Cape Cod, and by taxiing for five hours brought herself to the Naval Air Station at Chatham. On May 16th the three N.C. craft took the air, bound for the Azores. The N.C.-4 was the first to arrive at Horta, Azores; but the N.C.-1 and the N.C.-3 were not so fortunate. The N.C.-1 lost her bearings and alighted 100 miles west of Flores. The N.C.-3 ran through five hours of rain squalls and fog and finally alighted 45 miles southeast of Fayal. In landing, however, the crews of both boats found the ocean heavier than they expected. Damage from high waves which made the resumption of flight impossible, even if a take-off on so heavy a sea could have been managed. The N.C.-1, after running on the surface for five hours, was discovered by the Steamship *Ionia*. Twenty minutes later the *Ionia's* boat took off the crew. An attempt was made to tow the seaplane but the line broke and after a time the first N.C. flying boat sank.

Meanwhile the 12 foot sea on which the N.C.-3 came down wrecked hull, struts and control connections. She could not take the air again. Night came and the boat was buffeted by wind and rain. One of the elevators, badly damaged, had to be cut loose. The crew took turns steering, those off duty attempting to sleep. With morning, in the 22 hours of surface riding, the left wing tip was washed away. One of the crew crawled out on the right wing and clung there, deluged repeatedly by waves, to keep the left wing from being submerged. The wireless apparatus could receive but not send, and Commander Towers learned that the searching ships were looking for him west instead of south of Flores. Rescue seemed improbable, and the crew with rusty radiator water to drink, and scant supplies of chocolate and salty sandwiches, faced the task of bringing the damaged hull for hundreds of miles over seas running as high as thirty feet. For the next twenty-five hours, coasting backward over the great waves, beaten by rain, sleepless and hungry and worn, the five endured more than ever they can tell. Finally under their own power they taxied over the breakwater and into the harbor of Ponta Delgada. So ended a 52 hour, 205 mile journey over the open sea. The gloriously battered N.C.-3, though making port, was unable to continue the voyage to Portugal. The N.C.-4, arriving at Ponta Delgada from Horta on May 20th, went on alone.

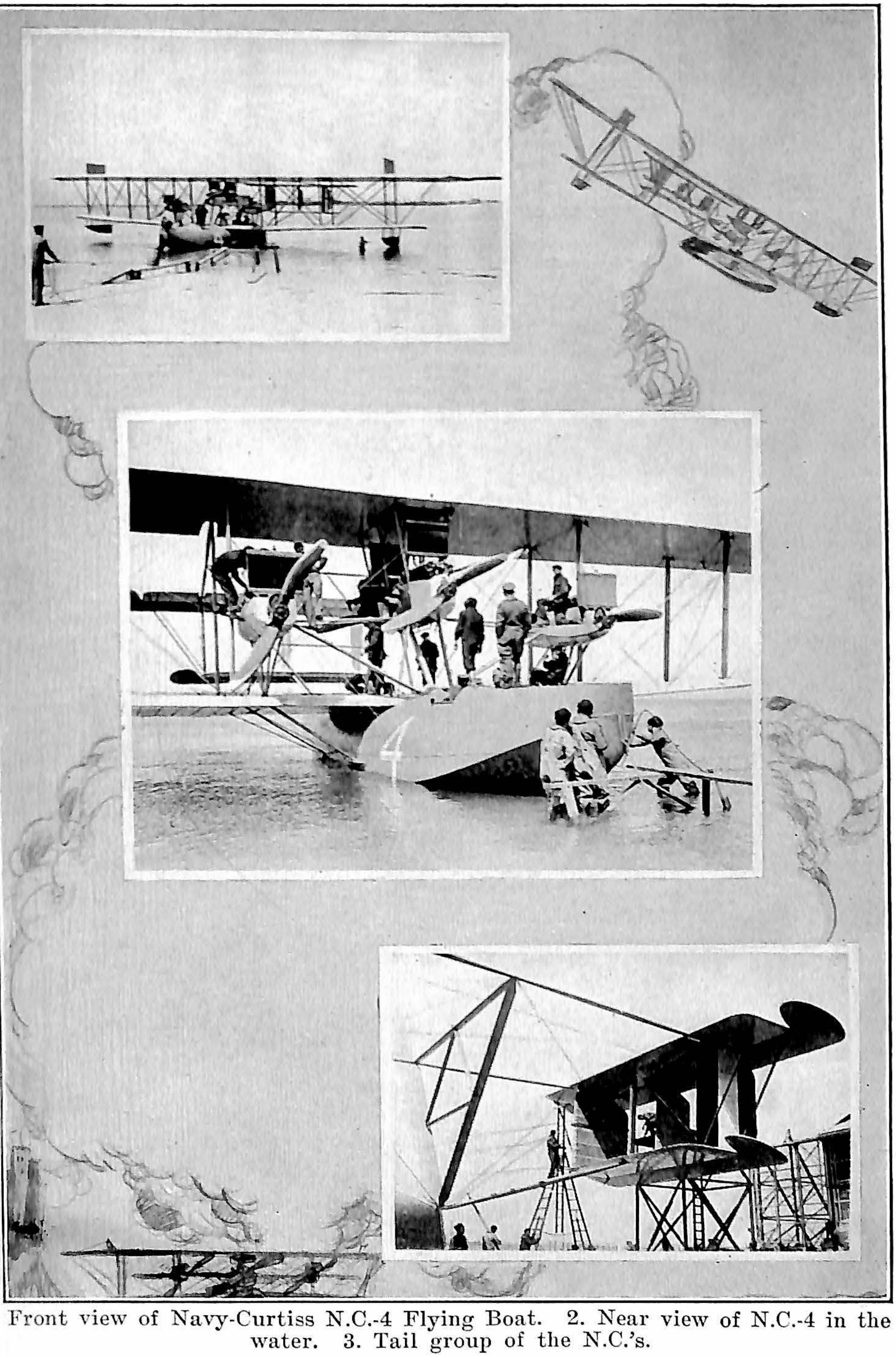
The story of how Lieutenant-Commander Read completed the first flight across the Atlantic Ocean in an American-built flying boat with American-built engines, is best told in his official report to Commander John H. Towers, the commanding officer of the N.C. seaplanes, Division 1.

Picking up Lieutenant-Commander Read's story at Trepassey Bay:

Landing was made at Trepassey at 9.39 (May 15th) and once again the N.C. Seaplane Division I was a complete unit. The principal work done here was the removal of the center forward (low compression) engine and replacing with a high compression, and the replacing of the three Olmstead propellers (the fourth had been changed at Halifax) with propellers of Bureau Steam Engineering design.

In attempting a start for the Azores the following day (16th), N.C.-3 failed to get off. N.C.-4, starting a minute later, took off, staying up 18 minutes, to give all installations a test. Everything worked well. Landed and waited for N.C.-3's next trial. This time she was successful; N.C.-4 followed and took the air at 10.05 P. M. G. M. T.

The wind at start was blowing about 30 knots, but it fell somewhat as land was left behind. Sea appeared slightly rough. N.C.-1 was well behind. Lights of N.C.-3 did not work and 3 and 4 separated at dark. The functioning of power plant during this entire run was excellent. Each destroyer was sighted



Front view of Navy-Curtiss N.C.-4 Flying Boat. 2. Near view of N.C.-4 in the water. 3. Tail group of the N.C.'s.

in turn up to and including number 16, first by means of the star shells (during the night only), second by the search-lights, and third by the destroyers' lights. In daylight the smoke was always picked up first, except once in a while, during semi-darkness or thick weather, the searchlights would be seen first. Several destroyers were considerably out of position, estimated not more than 12 miles: some appeared exactly on.

Ran through light lumps of fog from 8 to 8: 15 A. M. 17th, and again at 9: 25. Soon afterward ran into thick fog at 1,200 feet. Nearly lost control, but straightened out and got above the fog into sunlight at 9: 58, 1,400 feet. Ran between fog layer and cloud layer, gradually climbing to keep above fog, occasionally changing course or reducing altitude again to avoid thick weather. Saw occasional glimpses of water. Appeared thick to port, with a strip of clear sky to starboard, gradually edging to south avoiding clouds. Occasional light rain. Radio compass indicated not much divergence from course. Destroyers 20 and 21 reported thick fog near water. No. 22 reported visibility 10 miles: air above fog very smooth. Altitude averaged 3,000 feet.

At 11: 27 sighted southern end of Flores through rift in fog. Altitude then 3,400 feet. Spiraled down and found fog 200 feet above water. Apparently a strong northwest wind had set in during latter part of time above the fog. On the surface the wind was about west, and force of 20 to 25 knots.

Laid course and picked up destroyer 23, visibility 10-12 miles. Weather then thickened. Missed No. 24 and decided to make Horta if possible. Sighted northern end of Fayal, air cleared in lee of that island. Rounded Fayal and landed at 1: 15 in a bight mistaken for Horta in the thick weather. We took off again at 1: 20, rounded the next point and landed near the Columbia off Horta at 1: 23.

We were held at Horta by fog and later a gale until the 20th. Meanwhile the crew of N.C.-1 arrived having abandoned their wrecked plane which later sank. Word was also received on the 19th of the arrival at Ponta Delgada of the N.C.-3, partially wrecked, but taxi-ing in under their own power.

Start was made from Horta at 12: 39 P. M. 20th, wind about 260° later shifting to 300°, 25 knots. Sea rough. Visibility 20 miles or better. Air rough around Pico, later smoother but not very good. Destroyers were sighted as usual. Passed a rain squall to Starboard. Sighted San Miguel at 1: 54 and landed at Ponta Delgada at 2: 24.

The next morning, 21st, an attempt was made to start on the run to Lisbon, but the center after engine lacked 300 revolutions due to starving, and there was insufficient room to get off except with all engines delivering full power. On the 22nd the sea was too rough to even attempt a getaway. We were held up by this condition until the morning of the 27th, when the sea smoothed down somewhat, and good weather was reported along the course to Lisbon.

The wind was about 250°, force 20 knots, gradually falling during the day to nearly a calm at Lisbon. Visibility about 20 miles. Took off at 10: 18. Start had been planned for daylight but was delayed on account of starving of port engine. A new carbureter had been installed the night before on account of a stiff butterfly valve, and the work had not been done with sufficient care. Pieces of rubber were found. The carbureter was again changed and functioned properly.

One rather hard porpoise was made in getting away. This caused one gimbal of the navigator's compass to jump out, causing an error of 7 to 8 degrees, although it was not noticed until sometime later. The first destroyer was picked up apparently in its proper place, but it must have been out of position to the southward. Number 2 was passed 10 or 12 miles to the north of us and only the smoke sighted. Number 3 was not seen at all. Headed on a more northerly course, and with the aid of the radio compass, picked up number 4 on the port bow. All the remaining destroyers were sighted.

Visibility varied from about 5 miles to 15 to 20 miles. At 1: 02 it was necessary to head 40° to the left of course to pass around a rain squall, but the next destroyer was later found without difficulty. At 2: 44 passed between two heavy rain squalls. At 7: 39 sighted Cape Roca, and passing over the lower Tagus, we landed at 8: 01 in Lisbon Harbor, and secured to a buoy.

Left Lisbon for Plymouth, England, at 5: 29 on May 30th. Circled over the city before starting out. Destroyers had been placed between Cape Roca and Cape Finisterre at 50-mile intervals, 10 miles off shore. Weather partly cloudy, visibility excellent, 8 knot wind from WSW. Encountered a light rain at 6: 30, but we dodged the worst of it. From 6: 45 to 6: 56 we were dodging other small squalls. At 7: 05 a leak of unknown origin was discovered in port engine. Headed toward land to find smooth water for landing in order to make repairs. At 7: 21 landed in the Mondego River above Figueire, Portugal. As the river was full of sand bars, found it necessary to wait until high tide in the afternoon for making getaway. The water pump of port engine was leaking, but leak stopped after some radiator preparation was put in the system.

Left at 1: 38 for Ferrol, Spain, as it was doubtful if Plymouth could be made before dark. Frequent changes of course were necessary to pass around rain squalls. Visibility remained excellent except for squalls. North of Cape Finisterre, the wind increased considerably from the same direction WSW. Passed over Ferrel and landed in the harbor at 4: 47. Secured to a buoy, and the *U. S. S. Harding* arrived a few minutes later.

We left Ferrol for Plymouth at 6: 27 the following morning, May 31st. Passed through light rain from 6: 45 to 7: 15, changing course frequently to miss the worst of it. Visibility was seldom over 10 and usually about 5 or 6. One hundred miles from Brest it gradually thickened. Reduced altitude until only a few feet from water with visibility 2 miles. During run from Ferrol to Plymouth sighted only two out of the six destroyers. Edged off to right last part of run across Bay of Biscay. Picked up Ras Pt., France, at 10: 37. Circled over Brest at 11: 05, then continued on to Plymouth. Visibility about 2 miles, increasing gradually to 6 or 8. Wind outside Brest 2 knots from N.E., increasing to 12 knots crossing the English Channel.

At 1: 12 sighted shore of England, Plymouth being slightly off port bow. Landed behind breakwater at 1: 26 and secured to buoy. Plane and personnel in excellent condition. The two wing and after center engines were those installed at Rockaway, and still apparently in good condition. The forward center engine had been installed at Trepassy.

The following is a table prepared by Lieutenant-Commander Read showing times of arrivals and departures:

				Elapsed Time in Air
Left Rockaway	2.02 P. M.	8 May		
Arr. 80 m. off Cape Cod	6.53 P. M.	8 May		4 hr. 51 m.
Left Chatham	1.07 P. M.	14 May		
Arr. Halifax	5.10 P. M.	14 May		4 hr. 3 m.
Left Halifax	12.53 P. M.	15 May		
Arr. Trepassy	9.59 P. M.	15 May		6 hr. 23 m.
Left Trepassy	10.05 P. M.	16 May		
Arr. Horta	1.23 P. M.	17 May		15 hr. 13 m.
Left Horta	12.39 P. M.	20 May		
Arr. Ponta Delgada	2.24 P. M.	20 May		1 hr. 45 m.
Left Ponta Delgada	10.18 A. M.	27 May		
Arr. Lisbon	8.01 P. M.	27 May		9 hr. 43 m.
Left Lisbon	5.29 A. M.	30 May		
Arr. Mondego R.	7.21 A. M.	30 May		1 hr. 52 m.
Left Mondego R.	1.38 P. M.	30 May		
Arr. Ferrol	4.47 P. M.	30 May		3 hr. 9 m.
Left Ferrol	6.27 A. M.	31 May		
Arr. Plymouth	1.27 P. M.	31 May		6 hr. 59 m.
Total				53 hr. 58 m.
Total time to date				56 hr. 42 m.

Specifications of the N.C.-4 are: Motors 4, Liberty, 400 horsepower. Span 126 feet, Chord 12 feet, Gap 13 feet, Length over-all 68 feet and 3½ inches. Length overhull 45 feet. Total wing area 2,380 square feet. Weight of ship ready to fly 1,600 pounds. Weight of crew and equipment 1,200 pounds. Total weight 2,800 pounds. Total wing area, 2,380 feet. Air speed 80 knots, crew 6 men, cruising radius 1,400 knots.

First Non-Stop Flight Across Atlantic

(June 14th)

Flying at the rate of 117 miles an hour the Vickers-Vimy machine piloted by Captain Jack Alcock with Lieutenant Arthur Whitten Brown as navigator, which left St. Johns, Newfoundland, on June 14th, 1919, crossed the Atlantic in fifteen hours and fifty-seven minutes, landing on the Irish Coast at Clifden, thus achieving the first non-stop flight from North America to Europe.

Captain Alcock made his landing at 8:40 A. M., June 15th, (Greenwich Time), unfortunately, owing to the muddy ground, burying the nose of his machine, thereby preventing a continuance of the flight in the same plane to England. The two airmen were not severely injured in the accident.

The 1,936 miles across the ocean were flown under bad weather conditions, the plane continually running into heavy fog which prevented bearings being taken either from the sea or sky. Early in the flight the tiny propeller which actuated the generator of the wireless sending apparatus blew off and the receiving instruments were jammed by signals intended for other stations. For four hours the plane was wrapped in a sheet of ice caused by frozen sleet. Density of the fog made it impossible to see the workings of the speed indicator. Captain Alcock lost all sense of the horizon: and the plane looped and stunted.

The winds were favorable all the way — northwest and at times southwest. The engines ran well with the exception that one exhaust pipe blew off and made the pilot very deaf.

The flight must be regarded as a splendid demonstration of Lieutenant Brown's ability as a navigator. The voyage ended exactly where Brown said it should.

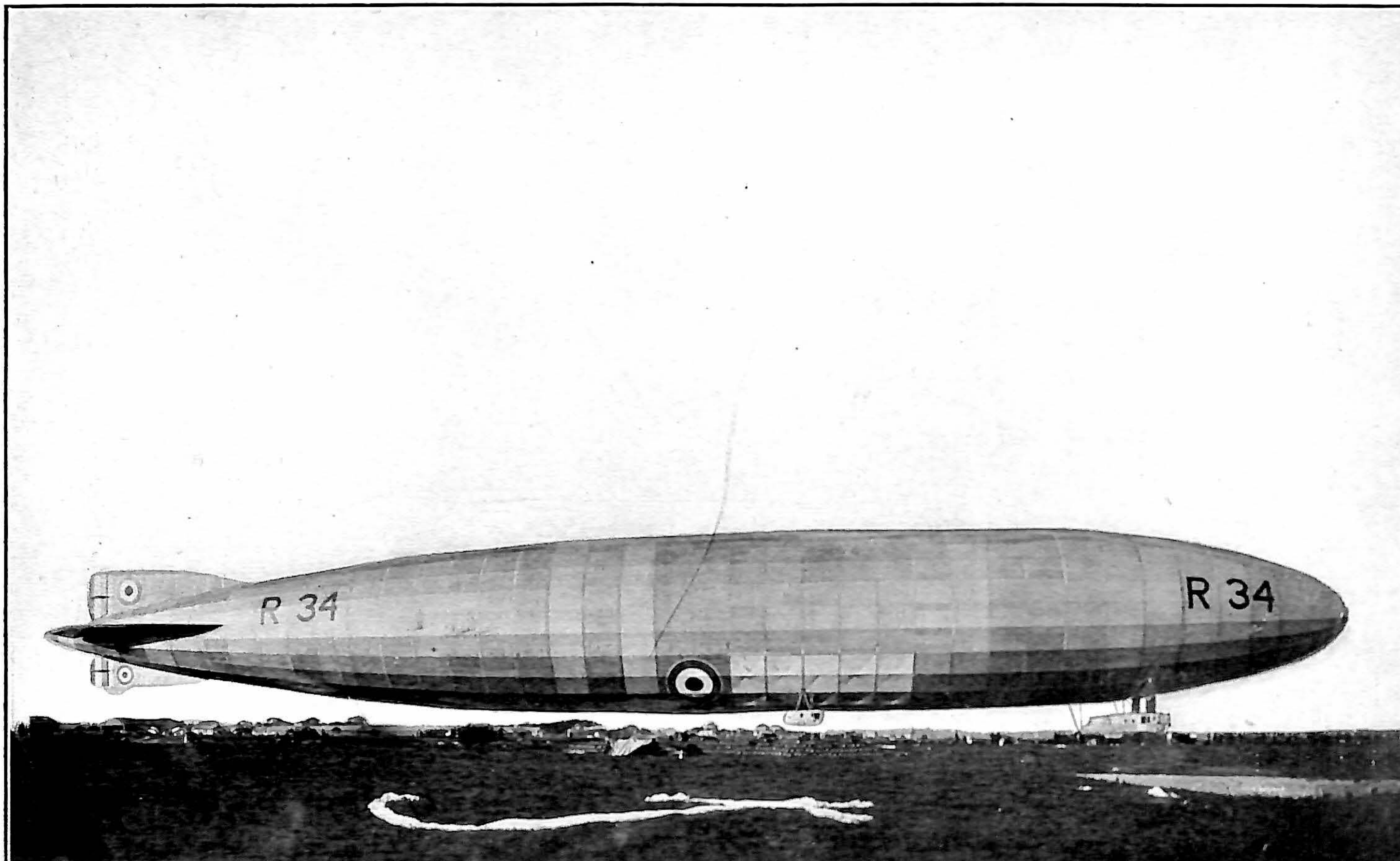
The prize of $50,000 offered by the London *Daily Mail* was divided between Alcock and Brown.

Specifications of the Trans-Atlantic Vickers-Vimy Rolls are: Motors 2 Rolls Royce Eagle VIII, 400 horse-power. Fuel capacity 865 gallons, oil capacity 50 gallons, which gives the machine an endurance of 2,440 miles. The span of both upper and lower planes is 67 feet, the chord 10 feet 6 inches the gap 10 feet, the overall length 42 feet 8 inches and the overall height 15 feet 3 inches. Wing area is 1,330 square feet. The maximum speed is 100 miles an hour.

THE FIRST AIRSHIP VOYAGE ACROSS THE ATLANTIC

THE first Trans-Atlantic flight by lighter-than-air craft and the first round-trip by aircraft across the Atlantic was made by the British airship R-34 between July 2nd and July 12th, 1919. The R-34, commanded by Squadron Leader G. H. Scott, R. A. F., took off from East Fortune, Scotland, on the morning of July 2nd and landed at Roosevelt Field, Mineola, Long Island, shortly after 9 A. M., July 6th. According to the official log, the air distances covered were as follows: From East Fortune to Trinity Bay, Newfoundland, 2,050 nautical miles; from Trinity Bay to Roosevelt Field, 1,080 nautical miles. The total distance of 3,130 nautical miles, not counting the drift, was covered in 108 hours and 12 minutes, that is, at a speed of 29.2 knots.

When the R-34 took off at East Fortune, weather conditions were

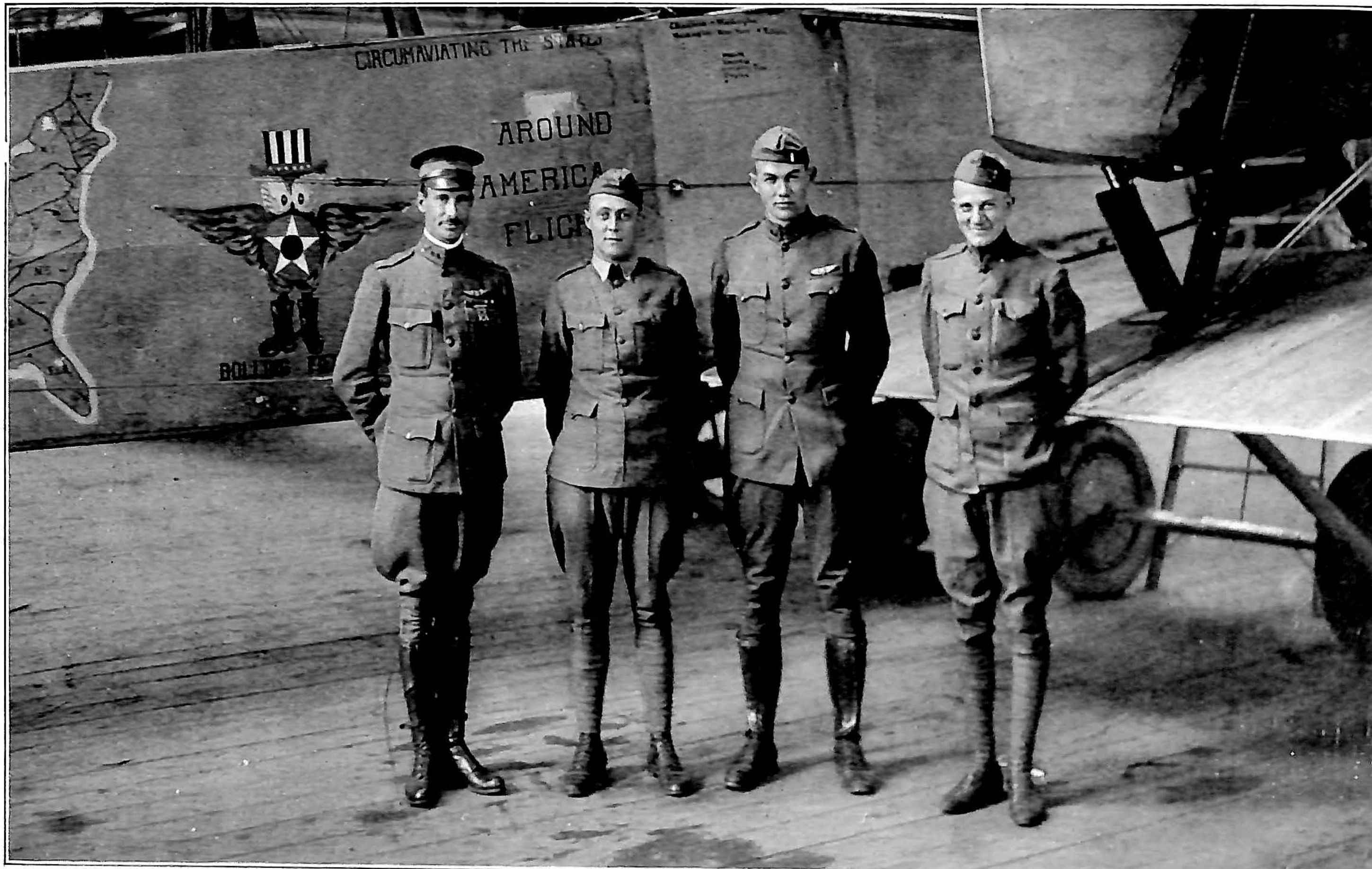


R.-34 at Roosevelt Field, Long Island, New York. First to make round trip Atlantic Flight favorable for the crossing, but soon strong head winds were encountered and these the airship had to fight all the way to Newfoundland, which was sighted 59 hours after the start. During this portion of the passage the airship flew at altitudes varying from 400 to 7,000 feet. On shaping her course down the coast from Newfoundland, the R-34 ran into violent thunder storms, with winds at 50 miles per hour, which slowed down her progress considerably. The fuel supply was getting low and the commander considered the advisability of making Boston and sent out radio calls for assistance. Shortly afterwards, however, the wind veered and enabled the R-34 to reach Roosevelt Field unassisted. There, Squadron Leader Pritchard, Executive Officer of the R-34 jumped overboard by parachute from an altitude of 2,000 feet to supervise the landing arrangements.

Owing to the lack of a hangar of sufficient size, the R-34 was moored in the open, but the weather became so threatening that the airship shortened her visit and started on her return trip at midnight on July 9th. During her stay at Roosevelt Field, the R-34 was on one occasion nearly torn from her moorings by violent gusts and was only saved from disaster by the skill of the American handling party. The Eastward passage was made under much more favorable weather conditions than the outward trip, only 75 hours and 3 minutes having been required to cover a distance of 3,200 miles, from Roosevelt Field to Pulham, England, where the ship landed. The trip was made at the speed of 42.6 knots, which was due to the fact that a light favorable wind was blowing throughout most of the journey.

The officers, crew and passengers of the R-34 totaled 30. Squadron Leader G. H. Scott was the commanding officer. Air Commodore E. M. Maitland represented the British Air Ministry, and Lieutenant-Commander Z. Lansdowne represented the United States Naval Air Service on the trip to America. On the return trip Colonel William N. Hensley, U. S. A. S., was a passenger.

Specifications of the R-34 are: Five Sunbeam Motors — 250 horse-power, length 643 feet 5 inches, height 91 feet 8 inches, beam 79 feet. Gas capacity 2,000,000 cubic feet. The hull is of streamline shape built of duralumin girders and in sections that vary in size. All along inside the keel is a triangular keel space, down the center of which is a girder covered with plywood, about one foot wide which forms a walking way and on each side of this is a fabric outer cover of the ship which must not be walked on. At intervals along each side of the gangway are fixed upright cylindrical petrol



Crew of Martin "Round the Rim" Bomber. Left to right: Lieut Col. R. S. Hartz, Sergt. John Harding, Jr., Lieut. E. E. Harmon, pilot; Sergt. Jerry Dubois.

tanks and a water tank, water ballast bags, parachute and hammocks. The crew space is near the forward car and here the whole width of the keel is floored. Below the keel, accessible by ladders, are four cars or gondolas. The forward car contains the control department and the wireless cabin.

ROUND THE RIM FLIGHT

(July 24th to November 9th)

THE longest flight yet attempted in the United States was begun by the Air Service July 24th, and ended November 9th, 1919. Lieutenant-Colonel R. S. Hartz, commanding, with Lieutenant E. E. Harmon, assistant pilot, and M. S. E., S. J. Harding and J. Dobias, mechanic, started in a Glenn L. Martin Bomber from Bolling Field, Washington, District of Columbia, and made a complete circuit of the United States, a distance of 9,823 miles.

Colonel Hartz took a rim around the country route, which traversed thirty-one states and required him to cross the continent twice. He passed over or near 95 cities, 29 national forest reservations, 36 mountain ranges and mountains, portions of 48 oceans, gulfs, bays, seas and lakes, 27 main railroads, 88 rivers and 13 transcontinental routes.

The purpose of the flight was to test the endurance of the Glenn L. Martin Bomber, to encourage enlistment in the Air Service and chart routes and locate landing fields.

At the time of starting, the bomber had already had approximately 111 hours in the air, with only the fabric being changed on part of the wing and tail surfaces. This time added to the time of the flight which was 114 hours and 45 minutes, made a total of 225½ hours in the air, or approximately 19,195 miles flown.

The Liberty 400 horse-power motors which had been run 32 hours and 12 minutes before the flight, at the end of the trip had a total of 147 running hours. A remarkable record both for motors and plane.

Leaving Bolling Field, July 24th, the Colonel, in the course of 78 days, much of it taken up by delays, ascended and descended at 100 points, reporting accurately with regard to landing, meteorological conditions, altitudes necessary, fogs, haze, and cross currents of air. He studied the country over which he flew and noted on his maps where good emergency landing fields might be found and where the dangerous stretches were located.

The machine made 100 flights altogether in going the 9,823 miles. It required approximately 104 hours and 24 minutes to "circum-aviate" the United States while his total flying time was 114 hours and 25 minutes.

During the trip the bomber's motors consumed 5,225 gallons of gasoline and 294 gallons of oil. The greatest altitude reached by the machine was 13,000 feet over the Coast Range of mountains.

On the first leg of the flight from Washington to Mineola, while flying over Baltimore it was found that the oil and water tanks were leaking. These were repaired by Master Electrician Tobias while the plane was moving 90 miles an hour, 5,000 feet over the city, from a position on the wires beneath one of the wings.

Specifications of the Martin Night Bomber are: Two Liberty Motors, 400 horse-power. Length 46 feet. Width 71 feet. Height 14 feet, biplane panels, four wheel landing gear. Weight, empty, 5,600 pounds; gasoline supply 285 gallons; crew, 4 men, bombs 1,500 pounds. Gross load 9,600 pounds. Speed landing 47 miles an hour, maximum 118.8 miles an hour, climbing 10,000 feet in 21 minutes.

NEW YORK–TORONTO AIRPLANE RACE AND HANDICAP CONTEST

(August 25th–30th)

THE New York–Toronto and return race, conducted by the American Flying Club was the biggest aeronautical sporting event in the history of aviation.

Fifteen civilian and thirty-seven army airplanes of many different types participated. Contestants were permitted to start from either New York or Toronto. Compulsory stops of thirty minutes were made at the control stops of Mineola, Albany, Syracuse, Buffalo and Toronto.

Repairs and fueling were carefully noted in the pilots' log books and log books kept at control stops. All time over the compulsory thirty minutes was counted as flying time as was all time between control stops. To comply with the handicap rules all machines were required to refill tanks at each control stop.

Of the fifty-two machines entered, thirty completed the round trip course of approximately ten hundred and forty miles. Throughout the race severe wind, rain and hail storms were encountered, but

Start of Trans-continental Airplane Race, Oct. 8, Mineola, N. Y. Conducted by U. S. Air Service and American Flying Club notwithstanding these difficulties several speed records were established, the most noteworthy being that of Lieutenant B. W. Maynard, who, piloting a D.H.-4 with a four hundred horse-power Liberty Motor, made an average speed of one hundred thirty-three and eight-tenths miles an hour for the entire distance of ten hundred and forty miles. The handicap contest, in which the machines competed against their own theoretical still air performances, was won by Major Rudolph Shroeder, piloting a Vought V.E.-7, equipped with a one hundred and fifty horse-power Hispano-Suiza motor.

Roland Rohlfs, piloting a Curtiss *Oriole* with a 150 horse-power Kirkham motor, was the first civilian to finish and established the fastest time among the civilian entries. He also won first civilian place in the Handicap event.

ROHLFS BREAKS WORLD'S ALTITUDE RECORD

When Roland Rohlfs, chief test pilot for the Curtiss Aeroplane & Motor Corp., climbed 34,910 feet above sea level, starting from Roosevelt Field, Mineola, L. I., Sept. 18th, not only did he establish a new official world's record, but revealed the possibilities that are in the upper air for commercial and pleasure flying.

Rohlfs' flight breaks his July record of 30,400 feet and also far surpasses the altitude reported to have been reached by Lieut. Casale, of the French army. Casale's barograph showed 33,100 feet, without air temperature or other corrections. Under rules followed in Europe, it was not necessary for Casale to have such corrections made. For purposes of international comparison, therefore, a similar reading of Rohlfs' barograph is given. According to the report returned by the Bureau of Standards, after the instrument had been calibrated, this shows that he reached an official altitude of 34,910 feet. After the air temperature corrections were made, a minimum altitude of 32,450 feet was shown. Rohlfs thus holds the world's altitude record in both uncorrected (European) and corrected (American) readings.

Rohlfs left the ground at 12:06 and landed at 1:54, within twenty feet of where he took off.

The specifications of the Curtiss "Wasp" Triplane are: Motor K 12-12 cylinder Curtiss 400 horse-power at 2,500 revolutions per minute. The engine did not have a super-charger; nor were any special fuel arrangements made. Weight per rated horse-power 1.70 pounds. Fuel Tank capacity 67 gallons, oil capacity 6 gallons.

Span (all planes) 31 feet 11 inches. Chord (all planes) 42 inches gap (between upper and middle planes) 42 inches gap (between middle and lower planes) 35⁹⁄₁₆ inches. Wing areas, upper wings 112.0 square feet, middle wings 87.71 square feet, lower wings 87.71 square feet. Net weight machine empty 1,825 pounds, gross weight machine and load 2,901 pounds. Useful load 1,076 pounds. Fuel 400 pounds, oil 45 pounds. Performance: speed, maximum, horizontal flight 163 miles per hour, speed minimum horizontal flight 58 miles per hour. Climbing speed 15,000 feet in 10 minutes. Maximum range at economic speed 550 miles.

THE TRANSCONTINENTAL CONTEST

THE greatest aerial contest in history under the direction of the War Department and the American Flying Club was begun on the morning of October 8th, when sixty-four airplanes, of all types, started on the trip which required them to cross the continent twice, New York to San Francisco, a distance of 5,402 miles.

The planes left from the Atlantic and Pacific coasts simultaneously; forty-nine taking off at New York and fifteen at San Francisco. Lieutenant B. W. Maynard, winner of the Toronto–New York race, gained the lead during the early stages of the race, maintaining it to the end, thus winning the contest for elapsed time, in nine days, four hours, twenty-six minutes and five seconds. His nearest competitor, Captain J. O. Donaldson, finished the round trip in nine days, twenty-one hours, five minutes and twelve seconds. Captain L. H. Smith was third, having taken eleven days, two hours, fifty-one minutes and twelve seconds to make the 5,400 miles.

In the contest for actual flying time, Lieutenant Alexander Pearson was declared the winner, his time being forty-eight hours, fourteen minutes and eight seconds. Lieutenant L. H. Smith was second, it having taken him fifty-four hours, fourteen minutes and thirteen seconds to make the double crossing. Third place was won by Lieutenant L. S. Worthington, who made the round trip in fifty-four hours, twenty-one minutes and fifty-five seconds.

The order of finish allowing for handicaps was: Pearson, Maynard, Hartney, Smith, Worthington, Donaldson, Manzelman and Reynolds.

The purpose of the race was to demonstrate the despatch with which battle planes could be flown from coast to coast; to compile data which would assist in determining the reliability and general fitness of the various types of airplanes used; to demonstrate that air mail service between the Atlantic and Pacific coasts is entirely practical: and to prove the commercial value of the airplane.

The total distance of the route from Mineola to San Francisco was 2,700 miles. Between these two points, stops were required at twenty controls, at the following points at which stops of at least twenty minutes and not more than forty-eight hours had to be made. The control stops were Binghamton, Rochester, and Buffalo, New York; Cleveland and Bryan, Ohio; Chicago and Rock Island, Illinois; Des Moines, Iowa; Omaha, St. Paul, North Platte and Sidney, Nebraska; Cheyenne, Wolcott and Green River, Wyoming; Salt Lake City and Salduro, Utah; Battle Mountain and Reno, Nevada; and Sacramento, California. The average distance between controls was 123 miles. The shortest jump was fifty-six miles between Rochester and Buffalo, the longest, 180 miles between Buffalo and Cleveland. The altitude of the land at the lowest control, San Francisco, was fifteen feet; at the highest, Wolcott, Wyoming, 6,623 feet. Time changed at Cleveland, North Platte and Salt Lake City.

The contestants covered a total of 124,777 miles, a great many times under adverse weather conditions. The race served to lay out the first transcontinental air route, with stops at not more than 180 miles apart. It also proved the necessity of weather reports and other meteorological information for pilots on cross country flights. Much valuable technical information was obtained, which would have been impossible to get in any other way.

A Hispano-Suiza engine was the only motor to make the complete round trip.

London–Australia Flight

(November 12th–December 10th)

The longest flight during 1919 — the longest in history — was made by Captain Ross Smith, flying 11,500 miles from England to Australia. Of the four entrants, the Vickers-Vimy-Rolls with Captain Smith in command, and a crew of three men, was the second to leave England. As it was stipulated that the flight should be completed in one month, Captain Smith who left Hounslow near London on November 12th, arrived at Port Darwin in "the nick of time."

On November 18th, Captain Smith reached Cairo and on November 19th continued his flight. He reached Delhi, India, November 23rd. Thence he continued east until he reached Rangoon, turning southward at that city, making a number of stops along the Malay Peninsula and in the Islands of Oceanica. He arrived at Bima, on Sunbawa Island, near Java, December 8th, and flew across the channel to Port Darwin, near the northern-most tip of Australia, December 10th.

Specifications of the Australian Vickers-Vimy-Rolls are: Motors 2, Rolls Royce "Eagle," Mark VIII, 400 horse-power. Fuel capacity 516 gallons, oil capacity 40 gallons. The span of both upper and lower planes is 67 feet, the chord 10 feet 6 inches, the gap 10 feet 8 inches and overall length 42 feet 8 inches, overall height 15 feet 3 inches. The wing area is 1,330 square feet. Weight of machine empty is 3 tons, when carrying her full load on the flight to Australia, consisting of 4 men, 516 gallons of petrol, 40 gallons of oil and 10 gallons of water, together with spares, kit, tools and sundries (adding to another 800 pounds), the weight fully loaded is 5½ tons. Maximum speed is over 100 miles per hour.

APPENDIX

I

U. S. AIRCRAFT MARKINGS

Since demobilization U. S. Army and Navy aircraft again display the "star insignia" of pre-war days.

It consists of a red circle inside of a white, five-pointed star, inside of a blue circumscribed circle. The circumference of the inner circle is tangent to the lines forming a pentagon made by connecting the inner points of the star. The inner circle is red, that portion of the star not covered by the inner circle is white, and that portion of the circumscribed circle not covered by either the inner circle or star is blue; the colors to be the same shades as those in the American Flag.

Insignia are placed on the upper and lower surfaces, respectively, of the upper and lower planes of each wing in such position that the circumference of the circumscribed circle shall be tangent to the outer tips of the planes. One point of each star is pointed directly forward and the diameter of the insignia is 60 inches.

In addition to the "star insignia" United States aircraft bear on the rudder three equally wide vertical bands — *red, white and blue.*

No provision exists in the form of a law for the marking of United States civilian aircraft. The nationality mark assigned to the United States by the International Air Navigation Convention is the letter "N." (See Chapter IV).

II

ARMY AIR SERVICE RATINGS

Following are the ratings for flying personnel in the Army Air Service.

Officers

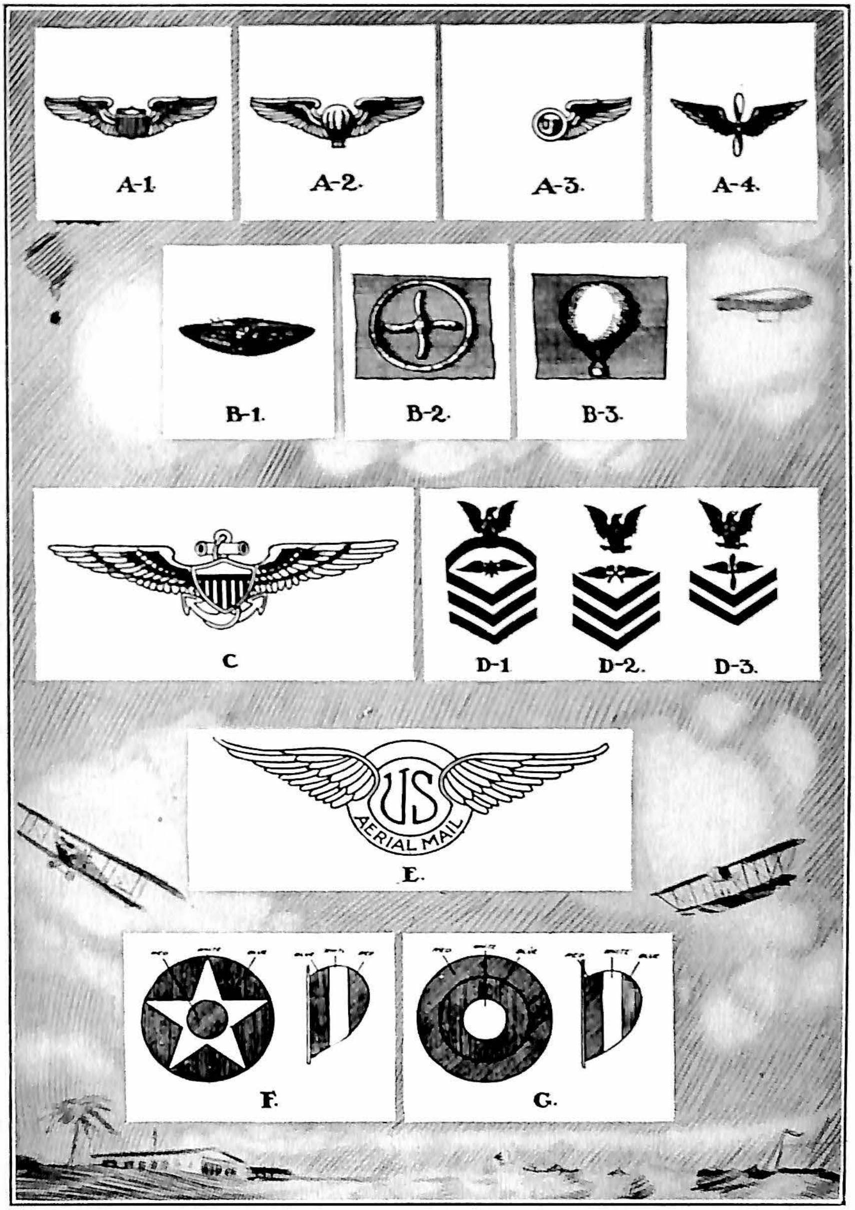
PILOTS

Airplane.

RESERVE MILITARY AVIATOR (R.M.A.), recently changed to AIRPLANE PILOT. This R.M.A. rating was given to flying cadets (student pilots) upon satisfactory completion of flying training and upon accepting commission. "Airplane Pilot" is now a substituted term for "Reserve Military Aviator," from October 16th, 1919.

JUNIOR MILITARY AVIATOR (J.M.A.), Established by Act of Congress, July, 1914. It could be earned by Regular Army officers only after passing certain prescribed tests. Under regulations of November, 1917, Reserve Military Aviators and temporary officers commissioned under Act of July 24th, 1917, could be rated as J.M.A.'s after having served satisfactorily for six months in the United States as such or after three months on active service in time of war, or after four months as such in training station and two on active service in time of war, except that in time of war, any R.M.A. who especially distinguishes himself in active service may, upon proper recommendation and approval, be rated as J:M.A.

MILITARY AVIATOR (M.A.), Instituted by Act of Congress, July, 1914, normally given to Regular Army officers only after having served three years as



A. Air Service Commissioned Insignia. Metal. 1. R.M.A. (obsolete) Airplane Pilot, I.M.A., M.A. 2. R.M.A. (obsolete) Dirigible Pilot, I.M.A., M.A. 3. Aerial Observer, Aerial Gunner, Aerial Bomber. 4. Air Service Insignia worn on collar.

B. Air Service Enlisted Insignia. Cloth. 1. Enlisted Pilot. 2. Aviation Mechanician. 3. Balloon Mechanician.

C. Naval and Marine Air Service Commissioned Insignia. Airplane Pilot. Kite Balloon Pilots.

D. Naval Air Service Petty Officers' Insignia. 1. Chief Quartermaster. 2. Carpenter's Mate, 1st class. 3. Machinist's Mate, 2nd class.

E. U. S. Aerial Mail Insignia.

F. Approved Design for Marking U. S. Government Aircraft.

G. Design used by U. S. Air Service Airplanes in A. E. F.

a J.M.A., but in time of war any officer or enlisted man who especially distinguishes himself in active service may be so rated.

Balloon and Airship.

RESERVE MILITARY AERONAUT (R.M.A.), Under Act of June 3rd, 1916, after complying with certain tests and practical work, balloon and airship pilots can be rated as such. But none was ever so rated.

DIRIGIBLE PILOT. Rating established under Army Regulations, October 16th, 1919, for officers of, detailed in, or attached to the Air Service, who have demonstrated that they possess the required qualifications.

JUNIOR MILITARY AERONAUT (J.M.A.), Same as under Regulations of November 16th, 1917, above.

MILITARY AERONAUT (M.A.), Same as Military Aviator.

OBSERVERS

Airplane.

AERIAL OBSERVER is the rating given the graduate of a school of aerial observation.

Balloon and Airship.

Same as above.

Dirigible.

No provision for rating of dirigible observer.

GUNNERS

AERIAL GUNNER is the rating given the graduate of a school of aerial gunnery, either in airplane or airship.

BOMBERS

AERIAL BOMBER is the rating given a graduate of a school for aerial bombing, either in airplane or airship.

R.M.A.'s (Airplane Pilots and Dirigible Pilots), J.M.A.'s and M.A.'s receive 25, 50 and 75 per cent. increase in pay of grade respectively, when on flying status. Aerial Observers and Gunners receive 25 per cent. increase in pay when on flying duty.

Enlisted

ENLISTED PILOT

Same tests prescribed as for Airplane Pilot.

AVIATION MECHANICIAN [1]

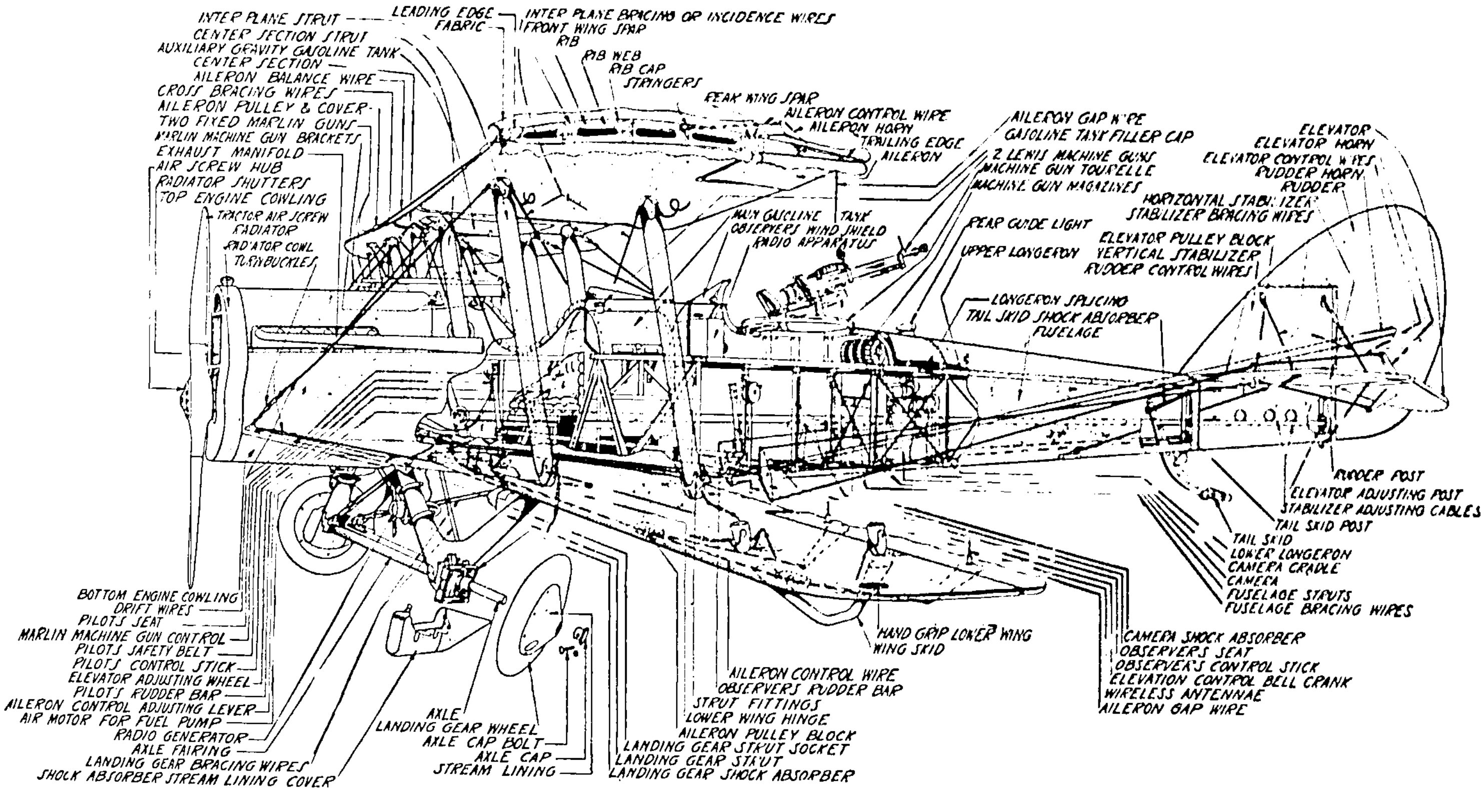
A rating given to enlisted men who are non-commissioned officers above the grade of Corporal.

Ratings given after competitive examination, but at no time shall number so rated exceed 15 per centum of the authorized strength of the Air Service. Examination will be technical as well as practical and will include maintenance and repair of airplanes, and the operation, maintenance and repair of aeronautical engines. A 50 per cent. increase in pay of grade is allowed to men holding such rating.

BALLOON MECHANICIAN [1]

Same as aviation mechanician, with the exception of theory and practise. Ex-

[1] Not necessarily flying personnel but may be and frequently are put on flying status.



Manufacturers Aircraft Association's Chart showing operating parts of an airplane.

amination covers the rigging, repair and maintenance of balloons. Methods of hydrogen production and aeronautical motors if the rating is sought in an organization operating airships.

Enlisted pilots, Aviation and Balloon Mechanicians on flying status, receive 50 per cent. increase in pay while on flying duty.

U. S. NAVAL AIR SERVICE

Following are the ratings of the flying personnel in the Naval Air Service:

NAVAL AVIATOR (N.A.)

NAVAL AVIATOR, Seaplane (N.A. (S.))

NAVAL AVIATOR, Dirigible (N.A. (D.))

KITE BALLOON PILOT (K.B.P.)

In the nomenclature used by the Navy "aviator" indicates the pilot of any power aircraft.

U. S. AERIAL MAIL SERVICE

Following are the ratings of the personnel (flying and non-flying) of the United States Aerial Mail Service:

PILOT (P.)

OFFICIAL (O.)

MECHANIC (M.)

CLERK (C.)

BRITISH ROYAL AIR FORCE

PILOT	(MAY BE OFFICER, CADET, OR SERGEANT.)
OBSERVER	(MAY BE OFFICER, CADET, OR SERGEANT.)

FRENCH AIR SERVICE

PILOT-AVIATEUR MILITAIRE	MILITARY PILOT
OBSERVATEUR	MILITARY OBSERVER
AÉROSTIER	BALLOON OBSERVER
AÉRONAUTE	DIRIGIBLE PILOT
PILOTE-BOMBARDIER	BOMBING PILOT

ROYAL ITALIAN AIR SERVICE

PILOTA DA BOMBARDMENTO	BOMBING PILOT
PILOTA DA RICOGNIZIONE	SCOUTING PILOT
PILOTA DA CACCIA	FIGHTING PILOT
PILOTA IDROVOLANTI	SEAPLANE PILOT
OSSERVATORE D'AEROPLANO	AERIAL OBSERVER

IV

CORRESPONDING ARMY AND NAVY RANKS IN THE UNITED STATES, GREAT BRITAIN, FRANCE AND ITALY

United States Army	Great Britain Army	France Army	Italy Army
	Field Marshal	Maréchal-Général	
General	General	Maréchal de France	Generale
Lieutenant General	Lieutenant General	Général de Corps d'Armée	Tenente Generale
Major General	Major General	Général de Division	Maggior Generale
Brigadier General	Brigadier General **	Général de Brigade	Brigadier Generale
Colonel	Colonel	Colonel	Colonello
Lieutenant Colonel	Lieutenant Colonel	Lieutenant-Colonel	Tenento Colonello
Major	Major	Commandant	Maggiore
Captain	Captain	Capitaine	Capitano
First Lieutenant	First Lieutenant	Lieutenant	Tenente
Second Lieutenant	Second Lieutenant	Sous-Lieutenant	Sottotenente

Navy	Royal Air Force [1]	Navy	France Navy
Admiral of the Fleet	Marshal of the Air	Admiral of the Fleet	Amiralissime
Admiral	Air Chief Marshal	Admiral	Amiral
Vice Admiral	Air Marshal	Vice Admiral	Vice-Amiral
Rear Admiral	Air Vice Marshal	Rear Admiral	Contre-Amiral
	Air Commodore	Commodore	
Captain	Group Captain	Captain — 3 years	Capitaine de Vaisseau
Commander	Wing Commander	Captain — under 3 years	
	Squadron Leader		
Lieutenant Commander	Flight Lieutenant	Lieutenant — 8 years	Capitaine de Frégate
Lieutenant	Flying Officer	Lieutenant — under 8 years	Capitaine de Corvette
	Pilot Officer		
Lieutenant Junior Grade		Sub-Lieutenant	Lieutenant de Vaisseau
Ensign			Enseigne de Vaisseau — 1 re classe
			Enseignede Vaisseau — 2 de classe
			Aspirant de Marine

** Temporary rank only.

[1] No country outside of Great Britain has distinct rank titles for the aerial forces.

NOTE: We are unable to secure Italian Navy Ranks at present time.

V

ORGANIZATION OF UNITED STATES ARMY AIR SERVICE

Director of Air Service

MAJOR GENERAL CHAS. T. MENOHER

COLONEL O. WESTOVER . . . . *Executive*
LIEUTENANT-COLONEL S. W. FITZGERALD . . . . *Assistant Executive*
MAJOR B. D. FOULOIS . . . . *Liquidation Division*
COLONEL WM. J. KENDRICK . . . . *Claims Board*
AIR ATTACHES (Foreign)
COLONEL A. L. FULLER . . . . *President, Advisory Board*
COLONEL W. F. PEARSON . . . . *Administrative Executive*
COLONEL E. A. TRUBY . . . . *Medical Division*
LIEUTENANT-COLONEL F. M. ANDREWS . . . . *Inspection Division*
LIEUTENANT-COLONEL R. B. LINCOLN . . . . *Personnel Division*
LIEUTENANT-COLONEL J. E. FICKEL . . . . *Finance Division*
CAPTAIN A. R. TRABOLD . . . . *Miscellaneous Division*

Information Group

LIEUTENANT-COLONEL H. M. HICKAM . . . . *Chief of Group*
CAPTAIN A. J. CLAYTON . . . . *Acting Assistant to Chief*
CAPTAIN J. I. MOORE . . . . *Collection Division*
LIEUTENANT C. H. DOLAN, JR. . . . . *Library Division*
LIEUTENANT T. J. ROWE . . . . *Reproduction Division*
MAJOR ERNEST JONES . . . . *Dissemination Division*
CAPTAIN A. J. CLAYTON . . . . *Special Division*

Training and Operations Group

BRIGADIER GENERAL WM. MITCHELL . . . . *Chief of Group*
COLONEL T. DEW. MILLING . . . . *Assistant to Chief*
LIEUTENANT-COLONEL W. C. SHERMAN . . . . *Training Division*
LIEUTENANT-COLONEL LESLIE MCDILL . . . . *Operations Division*
COLONEL C. DEF. CHANDLER . . . . *Balloon and Airship Division*

Supply Group

COLONEL W. E. GILLMORE . . . . *Chief of Group*
MAJOR RAYCROFT WALSH . . . . *Assistant to Chief*
COLONEL T. A. BALDWIN . . . . *Property Division*
COLONEL C. G. HALL . . . . *Procurement Division*
LIEUTENANT-COLONEL A. W. ROBINS . . . . *Requirements Division*
COLONEL C. G. HALL . . . . *Materials Disposal and Salvage Division*
COLONEL T. H. BANE . . . . *Engineering Division*

VI

OFFICERS ON AVIATION DUTY IN THE UNITED STATES NAVY DEPARTMENT

NAVAL OPERATIONS

Planning Division

CAPTAIN T. T. CRAVEN — Director of Naval Aviation.
COMMANDER W. J. GILES — Assistant Director Naval Aviation.
COMMANDER K. WHITING — Aide for Heavier-than-Air — Naval Aviator.

COMMANDER L. H. MAXFIELD — Assistant Lighter-than-Air Division — Naval Aviator.
COMMANDER W. G. CHILD — Liaison — Naval Aviator.
LIEUTENANT-COMMANDER R. E. BYRD — Naval Aviator.
LIEUTENANT J. S. FULTON, JR.—
LIEUTENANT (jg) L. B. AVERILL —
Operating Forces
LIEUTENANT-COMMANDER H. C. VAN VALZAH — Naval Aviator.
Inspection and Survey
Test Board
LIEUTENANT-COMMANDER V. C. GRIFFIN — Naval Aviator.
Communications
Pigeons
LIEUTENANT (jg) J. J. MCATEE.
Bureau of Navigation
Personnel
LIEUTENANT-COMMANDER H. B. CECIL
LIEUTENANT-COMMANDER R. M. GRIFFIN.
LIEUTENANT S. B. FRY — Naval Aviator.
LIEUTENANT (jg) Y. W. MANN.
Photography
LIEUTENANT W. L. RICHARDSON — Naval Aviator.
ENSIGN D. L. BROWN.
Recruiting
LIEUTENANT (jg) G. D. ANDERSON — Naval Aviator.
Aerology
LIEUTENANT (jg) C. M. KEYSER.
Bureau of Construction and Repair
COMMANDER J. C. HUNSAKER (CC).
LIEUTENANT-COMMANDER GARLAND FULTON (CC).
LIEUTENANT (T) FRANK M. SMITH (CC).
LIEUTENANT (jg) G. R. AREY.
LIEUTENANT (jg) CHARLES E. BAUCH — Naval Aviator (D)
LIEUTENANT (jg) WILLIAM G. BROWN (CC).
LIEUTENANT (jg) CHARLES H. CHATFIELD (CC).
LIEUTENANT (jg) WALTER S. DIEHL (CC).
LIEUTENANT (jg) CARL B. HARPER (CC).
LIEUTENANT (jg) J. J. IDE.
LIEUTENANT (jg) RAYMOND D. MACCART.
LIEUTENANT (jg) CHARLES J. MCCARTHY.
LIEUTENANT (jg) FRANK G. OSGOOD.
LIEUTENANT (jg) EDWARD W. ROUNDS — Naval Aviator.
LIEUTENANT (jg) WALTER G. WILSON (CC) — Naval Aviator.
LIEUTENANT (jg) G. V. WHITTLE (CC).
ENSIGN, THOMAS J. CONNELLEY — Naval Aviator (D).
1ST LIEUTENANT G. B. NEWMAN — Naval Aviator — U.S.M.C.
Bureau of Steam Engineering
COMMANDER A. K. ATKINS.

COMMANDER H. T. DYER.
LIEUTENANT-COMMANDER S. M. KRAUS.
LIEUTENANT H. S. ALDEN.
LIEUTENANT C. F. GOOB.
LIEUTENANT H. W. ROUGHLEY — Naval Aviator.
LIEUTENANT (jg) J. C. JENNINGS.
LIEUTENANT (jg) E. B. KOGER — Naval Aviator.
LIEUTENANT (jg) J. C. LITTLE.
ENSIGN FRANK MILLER.
Bureau of Ordnance
COMMANDER A. C. STOTT.
LIEUTENANT (T) B. P. DONNELLY.
Bureau of Supplies and Accounts
COMMANDER H. D. LAMAR (P.C.).
Bureau of Yards and Docks
COMMANDER KIRBY SMITH (CEC).

VII

UNITED STATES AERIAL MAIL OFFICIALS

OTTO PRAEGER	*2nd Assistant Postmaster General*
J. B. CORRIDON	*General Superintendent*
DR. L. T. BUSSLER	*Chief, Maintenance*
J. CLARK EDGERTON	*Chief, Flying*
JNO. L. JORDAN	*Chief, Construction*
GEO. L. CONNER	*Chief Clerk*
E. J. SCANLON	*Chief, Supply*
A. J. WILLOUGHBY	*In Charge of Radio*
CHAS. I. STANTON	*Superintendent of Eastern Division*
GEO. O. NOBLE	*Superintendent of Western Division*
EDW. McGRATH	*Assistant Superintendent of Western Division*

VIII

UNITED STATES ARMY AIR SERVICE VICTORIES

The following list contains the names, rank and number of last service formation of officers of the Air Service, American Expeditionary Forces, who in the World War brought down (destruction confirmed) five or more enemy aircraft as specified herewith. This list is the latest and most authentic compilation of American aerial victories which it has been possible to prepare after months of painstaking investigation. The number of enemy aircraft destroyed with which members of the Army Air Service are credited with in this list, does not include such victories as some of them achieved while serving as members of Allied air forces. This explanation is made for the reason that some prominent aviators with long lists of victories are absent from this list. Deceased aviators are indicated by an asterisk.

In the column "Last Formation" a number indicates the squadron number of the United States Army Air Service, while R. A. F. denotes that the officer, while a member of the United States Army Air Service, was individually attached to the Royal Air Force of Great Britain.

Name	*Rank*	*Last Formation*	*Airplanes*	*Balloons*	*Total*
Rickenbacker, Edw. V., Columbus, Ohio.	Captain	94	21	4	25
*Luke, Frank, Phoenix, Arizona.	2nd Lieut.	27	4	14	18
Vaughn, George, A., Brooklyn, N. Y.	1st Lieut.	17	12	1	13
*Kindley, Field E., Gravette, Ark.	Captain	148	12	..	12
Springs, Elliott, W., Lancaster, So. Carolina.	Captain	148	12	..	12
Landis, Reed G., Chicago, Ill.	Captain	25	9	1	10
*Putnam, David E., Brookline, Mass.	1st Lieut.	139	10	..	10
Swaab, Jacques M., Philadelphia, Pa.	Captain	22	10	..	10
*Hamilton, Lloyd A., Burlington, Vt.	1st Lieut.	17	6	3	9
Hunter, Frank O'D., Savannah, Ga.	1st Lieut.	103	9	..	9
Wright, Chester E., Cambridge, Mass.	1st Lieut.	93	8	1	9
Baer, Paul F., Fort Wayne, Ind.	1st Lieut.	103	8	..	8
Cassady, Thomas G., Spencer, Indiana.	Captain	28	8	..	8
*Clay, Henry R., Jr., Fort Worth, Texas.	1st Lieut.	148	8	..	8
*Coolidge, Hamilton, Boston, Mass.	Captain	94	5	3	8
Creech, Jesse O., Washington, D. C.	1st Lieut.	148	8	..	8
Donaldson, John Owen, Washington, D. C.	Captain	R.A.F.	8	..	8
Erwin, William P., Chicago, Illinois.	1st Lieut.	1st	8	..	8
Jones, Clinton, San Francisco, Cal.	2nd Lieut.	22	8	..	8
Meissner, James A., Brooklyn, N. Y.	Major	94	7	1	8
*White, Wilbur Wallace, New York, N. Y.	1st Lieut.	147	7	1	8
Biddle, Chas. J., Philadelphia, Pa.	1st Lieut.	13	7	..	7
Burdick, Howard, Brooklyn, N. Y.	Major	17	7	..	7
Chambers, Reed M., Memphis, Tenn.	Major	94	6	1	7
Cook, H. Weir, Toledo, Ohio.	Captain	94	3	4	7
Holden, Lansing C., New York, N. Y.	1st Lieut.	95	2	5	7
Larner, G. DeFreest, New York, N. Y.	Captain	103	7	..	7
Robertson, Wendel A., Fort Smith, Ark.	1st Lieut.	139	7	..	7

* Killed in service.

Name	Rank	Last Formation	Airplanes	Balloons	Total
*RUMMEL, LESLIE J., Newark, N. J.	1st Lieut.	93	7	..	7
*SCHOEN, KARL J., Indianapolis, Ind.	1st Lieut.	139	7	..	7
SEWALL, SUMNER, Bath, Maine.	Captain	95	5	2	7
STOVALL, WILLIAM H., Stovall, Miss.	1st Lieut.	13	7	..	7
*BEANE, JAMES D., Concord, Mass.	1st Lieut.	22	6	..	6
CAMPBELL, DOUGLAS, Mount Hamilton, Cal.	Captain	94	6	..	6
CURTISS, EDWARD P., Rochester, N. Y.	Captain	95	6	..	6
GUTHRIE, MURRAY K., Mobile, Ala.	1st Lieut.	13	6	..	6
HAMMOND, LEONARD C., San Francisco, Cal.	Captain	91	6	..	6
HAYES, FRANK K., Chicago, Ill.	1st Lieut.	13	6	..	6
KNOTTS, HOWARD C., Carlinville, Ill.	2nd Lieut.	17	6	..	6
LINDSAY, ROBERT O., Madison, N. C.	1st Lieut.	139	6	..	6
MCARTHUR, JOHN K., Everett, Wash.	2nd Lieut.	27	6	..	6
PONDER, WILLIAM T., Mangum, Okla.	1st Lieut.	103	6	..	6
PORTER, KENNETH L., Dowagial, Mich.	2nd Lieut.	147	6	..	6
STENSETH, MARTINUS, Twin Valley, Minn.	Captain	28	6	..	6
TOBIN, EDGAR G., San Antonio, Texas.	Captain	103	6	..	6
VASCONCELLES, JERRY C., Denver, Colo.	Captain	27	5	1	6
BADHAM, WILLIAM T., Birmingham, Ala.	1st Lieut.	91	5	..	5
BAIR, HILBERT L., New York City, N. Y.	1st Lieut.	R.A.F.	5	..	5
BISSELL, CLAYTON L., Kane, Pa.	Captain	148	5	..	5
BROOKS, ARTHUR R., Farmingham, Mass.	Captain	139	5	..	5
BUCKLEY, HAROLD R., Agawan, Mass.	Captain	95	4	1	5
COOK, EVERETT R., San Francisco, Cal.	Captain	91	5	..	5
FURLOW, GEORGE W., Rochester, Minn.	1st Lieut.	103	5	..	5
GEORGE, HAROLD H., Niagara Falls, N. Y.	1st Lieut.	139	5	..	5
GRAY, CHAS. G., Chicago, Ill.	Captain	213	4	1	5
HAIGHT, EDWARD M., Astoria, N. Y.	1st Lieut.	139	5	..	5

* Killed in service.

Name	Rank	Last Formation	Airplanes	Balloons	Total
HEALY, JAMES A., Jersey City, N. J.	Captain	147	5	..	5
KNOWLES, JAMES, Cambridge, Mass.	1st Lieut.	95	5	..	5
LUFF, FREDERICK E., Cleveland, Ohio.	1st Lieut.	25	3	2	5
O'NEILL, RALPH A., Nogales, Ariz.	1st Lieut.	147	5	..	5
OWENS, J. SIDNEY, Baltimore County, Md.	2nd Lieut.	139	5	..	5
RALSTON, ORVILLE A., Lincoln, Nebraska.	1st Lieut.	148	5	..	5
STRAHM, VICTOR H., Evanston, Ill.	Major	91	5	..	5
SEERLEY, JOHN J., Chicago, Ill.	1st Lieut.	13	5	..	5
TODD, ROBERT M., Cincinnati, Ohio.	2nd Lieut.	17	4	1	5
*VERNON, REMINGTON, DEB., New York, N. Y.	1st Lieut.	22	3	2	5
WILLIAMS, RODNEY D., Everett, Mass.	1st Lieut.	27	0	5	5
WILLIAMS, RODNEY D., Waukesha, Wisc.	1st Lieut.	17	4	1	5

* Killed in service.

IX

HONORS AND AWARDS TO MEMBERS OF THE AIR SERVICE, AMERICAN EXPEDITIONARY FORCE

American Decorations

Medal of Honor

Luke, Frank, Jr., 2nd Lieutenant.

Distinguished Service Cross

Abernathy, Thos. J., 2nd Lieutenant; Alexander, Arthur H., 1st Lieutenant; Alexander, Sterling Campbell, 1st Lieutenant; Aldrich, Perry H., 1st Lieutenant; Allen, Gardner Philip, 1st Lieutenant; Andrew, Flynn L. A., 1st Lieutenant; Armstrong, Rodney M., 1st Lieutenant; Arthur, Bogan H., 2nd Lieutenant; Atwater, Benj. L., 1st Lieutenant; Avery, Walter L., 1st Lieutenant.

Babcock, Phillip R., 1st Lieutenant; Backus, David H., 1st Lieutenant; Badham, William T., 1st Lieutenant; Baer, Paul Frank, 1st Lieutenant; Bagby, Ralph P., 1st Lieutenant; Bartholf, Herbert B., 1st Lieutenant; Baucom, Bryne V., 2nd Lieutenant; Beane, James D., 1st Lieutenant; Beebe, David C., 2nd Lieutenant; Bellows, Franklin B., 2nd Lieutenant; Bennell, Otto E., 2nd Lieutenant; Belzer, William, 2nd Lieutenant; Bernheimer, Louis B., 1st Lieutenant; Blake, Chas. Raymond, 1st Lieutenant; Bleckley, Erwin R., 2nd Lieutenant; Bonnalie, Allan P., 1st Lieutenant; Borden, Horace L., 2nd Lieutenant; Bowers, Lloyd G., 1st Lieutenant; Bowman, Samuel A., 2nd Lieutenant; Boyd, Theodore E., 1st Lieutenant; Breese, Clinton S., 2nd Lieutenant; Brereton, Lewis H., Lieutenant-Colonel; Brewster, Hugh, 1st Lieutenant; Brooks, Arthur R., 2nd Lieutenant; Broomfield, Hugh D., 1st Lieutenant; Brotherton, William E., 2nd Lieutenant; Brown, Mitchell H., 2nd Lieutenant; Buckley, Harold R., 1st Lieutenant; Buford, Edw., Jr., 1st Lieutenant; Burger, Valentine Jos., 2nd Lieutenant; Burns, James S. D., 2nd Lieutenant; Burtt, Buron T., Jr., 1st Lieutenant.

Campbell, Douglas, 1st Lieutenant; Carroll, George C., 1st Lieutenant; Cassady, Thomas G., 1st Lieutenant; Castleman, John R., 1st Lieutenant; Chambers, Reed M., Captain; Chapman, Chas. W., 2nd Lieutenant; Clapp, Kenneth Smith, 2nd Lieutenant; Clarke, Sheldon V., 1st Lieutenant; Coleman, Wallace, 1st Lieutenant; Conover, Harvey, 1st Lieutenant; Cook, Everett R., Captain; Cook, Harvey Wier, 1st Lieutenant; Coolidge, Hamilton, 1st Lieutenant; Cousins, John W., 1st Lieutenant; Curtis, Edward P., 1st Lieutenant; Cutter, Edward B., 1st Lieutenant.

Dawson, Leo H., 1st Lieutenant; DeCastro, Ralph E., 2nd Lieutenant; Diekema, William A., 1st Lieutenant; Dillon, Raymond P., 1st Lieutenant; Dodwell, Thomas B., 2nd Lieutenant; D'Olive, Charles R., 1st Lieutenant; Douglas, Kingman, 1st Lieutenant; Dowd, Meredith L., 2nd Lieutenant; Drew, Chas. W., Captain; Dickstein, Arthur William, 1st Lieutenant.

Easterbrook, Arthur E., 1st Lieutenant; Eaton, Warren Edwin, 1st Lieutenant; Elliott, Robert P., 1st Lieutenant; Erwin, William P., 1st Lieutenant; Este, J. Dickinson, 1st Lieutenant.

Ferrenbach, Leo. C., 1st Lieutenant; Fleeson, Howard T., 2nd Lieutenant; Follette, Justin P., 1st Lieutenant; Fontaine, Hugh L., 1st Lieutenant; Ford, Christopher W., Captain; Frank, William F., 1st Lieutenant; Frost, John, 1st Lieutenant; Furlow, George Willard, 1st Lieutenant.

Gaylord, Bradley J., 1st Lieutenant; George, Harold H., 1st Lieutenant; Giroux, Ernest A., 1st Lieutenant; Goettler, Harold Ernest, 2nd Lieutenant; Goldthwathe, George A., 1st Lieutenant; Grant, Alfred A., 1st Lieutenant; Graveline, Fred C., Sergeant, 1st Class; Grey, Charles G., Captain; Gundelach, Andre H., 1st Lieutenant; Guthrie, Murray K., 1st Lieutenant.

Hall, James Norman, Captain; Hamilton, Lloyd A., 1st Lieutenant; Hammond, Leonard C., 1st Lieutenant; Hart, Percival G., 2nd Lieutenant; Hartney, Harold E., Major; Harwood, Benjamin P., 1st Lieutenant; Haslett, Elmer R., Captain; Hays, Frank K., 2nd Lieutenant; Healy, James A., Captain; Henderson, Phil A., 1st Lieutenant; Hill, Maury, Captain; Hill, Raymond C., 1st Lieutenant; Higgs, James A., Jr., 1st Lieutenant; Hitchcock, Roger W., 2nd Lieutenant; Holden, Kenneth H., 1st Lieutenant; Holden, Lansing C., Jr., 1st Lieutenant; Holland, Spesserd L., 1st Lieutenant; Hoover, William J., 1st Lieutenant; Hudson, Donald, 1st Lieutenant; Hunter, Frank O'D., 1st Lieutenant.

Irving, Livingston Gilson, 1st Lieutenant.

Jeffers, John N., 1st Lieutenant; Jervey, Thomas M., 1st Lieutenant; Jones, Arthur H., 2nd Lieutenant; Jones, Clinton, 2nd Lieutenant; Jordan, John W., 2nd Lieutenant.

Kahle, Clarence C., 1st Lieutenant; Kaye, Samuel, Jr., 1st Lieutenant; Kelty, Asher E., 1st Lieutenant; Kenney, George C., 1st Lieutenant; Kindley, Field E., 1st Lieutenant; Kinney, Clair A., 1st Lieutenant; Kinsley, Wilbert E., 2nd Lieutenant; Knowles, James, Jr., 1st Lieutenant.

Lambert, John H., 1st Lieutenant; Landen, E. C., 1st Lieutenant; Larner, Gorman De F., 1st Lieutenant; Lawson, Walter Rolls, Captain; Lee, John B., 2nd Lieutenant; Lindsay, Robert D., 1st Lieutenant; Littauer, Kenneth P., Major;

Llewellyn, Frank A., 1st Lieutenant; Lowe, William O., 2nd Lieutenant; Lowry, Francis B., 2nd Lieutenant; Luke, Frank, Jr., 2nd Lieutenant.

MacArthur, John, 2nd Lieutenant; MacBrayne, Winfred C., 1st Lieutenant; McClendon, Joel H., 1st Lieutenant; McDermott, Cleveland W., 2nd Lieutenant; McDevitt, James A., 1st Lieutenant; McDougall, Harry O., 1st Lieutenant; McKay, Elmer K., 2nd Lieutenant; McKay, James R., 1st Lieutenant; McMurry, Ora R., 1st Lieutenant; Manning, James F., Jr., 1st Lieutenant; Maughan, Russell L., 1st Lieutenant; Meissner, James A., 1st Lieutenant; Michener, John H. 1st Lieutenant; Mitchell, William, Brigadier-General; Mitchell, John, Captain; Moore, Edw. Russell, 1st Lieutenant; Morris, Edw. M., 2nd Lieutenant; Morse, Guy E., 2nd Lieutenant; Myers, Oscar B., 1st Lieutenant.

Neel, Roland H., 2nd Lieutenant; Neibling, Harlow P., 1st Lieutenant; Nicholls, Harold O., Sergeant, 1st Class; Nixon, George R., 1st Lieutenant; Norris, Sigbert A. G., 2nd Lieutenant; Norton, Fred W., 1st Lieutenant; Noyes, Stephon H., 1st Lieutenant; Nutt, Alan, 1st Lieutenant.

O'Donnell, Paul J., 2nd Lieutenant; O'Neil, Ralph A., 2nd Lieutenant; Orr, Edw., 1st Lieutenant.

Page, Richard C. M., 1st Lieutenant; Palmer, Joseph A., 2nd Lieutenant; Palmer, William W., 1st Lieutenant; Patterson, Alfred B., Jr., 1st Lieutenant; Payne, Carl C., 1st Lieutenant; Pegues, Josiah J., 1st Lieutenant; Pendell, Elmer, 1st Lieutenant; Peterson, David McK., Captain; Phelps, Glinn, 1st Lieutenant; Phillips, George R., 1st Lieutenant; Plumer, Charles W., 2nd Lieutenant; Plush, Louis C., 1st Lieutenant; Polley, Britton, 1st Lieutenant; Porter, Chas. Pullman, 2nd Lieutenant; Porter, Earl W., 2nd Lieutenant; Porter, Kenneth L., 2nd Lieutenant; Potter, William Clarkson, 1st Lieutenant; Ponder, William Thomas, 1st Lieutenant; Preston, Glen A., 2nd Lieutenant; Putnam, David E., 1st Lieutenant; Pyne, Percy Rivington, 1st Lieutenant. Quinn, John J., 1st Lieutenant.

Raible, Joseph C., Jr., 1st Lieutenant; Rancourt, John I., 1st Lieutenant; Rath, Howard G., 2nd Lieutenant; Raymond, Robert Fulton, 1st Lieutenant; Reynolds, John N., Major; Reynolds, Clearton H., Captain; Richenbacker, Edw. V., Captain; Richardson, James M., 2nd Lieutenant; Rooney, Paul N. A., 1st Lieutenant; Rorison, Harmon C., 1st Lieutenant; Ross, Cleo J., 1st Lieutenant; Rucker, Edw. W., 2nd Lieutenant; Rummell, Leslie J., 1st Lieutenant.

Schenck, Alexander P., 1st Lieutenant; Schoen, Karl J., 1st Lieutenant; Seavers, Arthur F., 1st Lieutenant; Sellers, Cecil G., 1st Lieutenant; Sewall, Sumner, 1st Lieutenant; Shelby, Richard D., 1st Lieutenant; Simon, Louis C., Jr., 1st Lieutenant; Snyder, John H., 1st Lieutenant; Spatz, Carl, Major; Springs, Elliott White, 1st Lieutenant; Steele, Richard Wilson, 2nd Lieutenant; Stevens, John H., 2nd Lieutenant; Strahm, Victor H., 1st Lieutenant; Stokes, John Y., 1st Lieutenant; Stout, Penrose V., 1st Lieutenant; Stovall, William H., 1st Lieutenant; Suiter, Wilbur C., 1st Lieutenant.

Taylor, William J. R., 1st Lieutenant; TenEyck, Walter B., Jr., 2nd Lieutenant; Thaw, William, Major; Tillman, Fred A., 2nd Lieutenant; Tittman, Harold H., 1st Lieutenant; Tobin, Edgar G., 1st Lieutenant.

Vail, William H., 1st Lieutenant; Vernam, Remington DeB., 1st Lieutenant.

Wallis, James E., Jr., Captain; Waring, William Wallace, 1st Lieutenant; Warner, Donald D., 1st Lieutenant; Way, Pennington H., 2nd Lieutenant;

Wehner, Joseph F., 1st Lieutenant; White, Wilbur Wallace, 2nd Lieutenant; Winslow, Alan F., 2nd Lieutenant; Wright, Chester E., 1st Lieutenant.

Oak Leaf Clusters Awarded with Distinguished Service Crosses

Arthur, Bogan H., 2nd Lieutenant.

Backus, David H., 1st Lieutenant; Baer, Paul Frank, 1st Lieutenant; Baucom, Bryne V., 2nd Lieutenant; Bernheimer, Louis B., 1st Lieutenant; Buckley, Harold R., 1st Lieutenant.

Campbell, Douglas, 1st Lieutenant; Cassady, Thomas G., 1st Lieutenant; Chambers, Reed M., Captain; Cook, Harvey Wier, 1st Lieutenant.

Dawson, Leo H., 1st Lieutenant.

Easterbrook, Arthur E., 1st Lieutenant; Erwin, William P., 1st Lieutenant.

Fleeson, Howard T., 2nd Lieutenant; Fontaine, Hugh L., 1st Lieutenant; Furlow, George Willard, 1st Lieutenant.

Guthrie, Murray K., 1st Lieutenant.

Holden, Lansing C., Jr., 1st Lieutenant; Hunter, Frank O'D., 1st Lieutenant.

Jones, Clinton, 2nd Lieutenant.

Kaye, Samuel, Jr., 1st Lieutenant; Kindley, Field E., 1st Lieutenant.

Larner, Gorman D'F., 1st Lieutenant; Luke, Frank, Jr., 2nd Lieutenant.

McMurry, Ora R., 1st Lieutenant; Meissner, James A., 1st Lieutenant.

O'Neil, Ralph A., 2nd Lieutenant.

Patterson, Alfred B., 1st Lieutenant; Peterson, David McK., Captain; Porter, Chas. Pullman, 2nd Lieutenant; Preston, Glen A., 2nd Lieutenant.

Reynolds, John N., Major; Reynolds, Clearton H., Captain; Rickenbacker, Edw. V., Captain.

Sewall, Sumner, 1st Lieutenant; Simon, Louis C., Jr., 1st Lieutenant.

Thaw, William, Major.

Wehner, Joseph F., 1st Lieutenant; White, Wilbur Wallace, 2nd Lieutenant; Wright, Chester E., 1st Lieutenant.

Distinguished Service Medal

Menoher, Chas. T., Major General; Patrick, Mason M., Major General; Mitchell, William, Brigadier General; Dunwoody, Halsey, Colonel; Milling, Thomas De W., Colonel; Chandler, Charles DeF., Colonel; Dodd, Townsend F., Colonel; Bolling, Raynal C., Colonel; Thomas, John R., Jr., Colonel; Whitehead, Henry C., Colonel; Lahm, Frank P., Colonel; Gorrell, Edgar S., Colonel; Fowler, Harold, Colonel; Sumner, Edwin Vose, Lieutenant-Colonel; Hall, Elbert J., Lieutenant-Colonel.

British Decorations

Commander of the Order of St. Michael and St. George

Mitchell, William, Brigadier-General; Kilner, Walter G., Colonel; Bonnalie, A. F., 1st Lieutenant.

Distinguished Flying Cross

Bair, H. L., 1st Lieutenant; Bissell, C., 1st Lieutenant; Burdick, H., 2nd Lieutenant; Callahan, L. K., 1st Lieutenant; Creech, Jesse Orin, 1st Lieutenant; Campbell, Merton L., 1st Lieutenant; Clay, H. R., 1st Lieutenant; Donaldson, J. O., 2nd Lieutenant; Hamilton, Lloyd A., 1st Lieutenant; Heater, C. L., 1st Lieutenant; Herbert, Thomas John, 1st Lieutenant; Ingalls, D. S., 1st Lieutenant; Keating, James A., 1st Lieutenant; Kindley, Field E., 1st Lieutenant; Knotts, Howard C., 1st Lieutenant; Landis, Reed G., 1st Lieutenant; Luff, F. E., 1st Lieutenant; Springs, Elliott W., 1st Lieutenant; Tipton, W. D., 1st Lieutenant; Vaughn, George A., 1st Lieutenant.

French Decorations

Commander of the Legion of Honor

Menoher, Chas. T., Major General; Patrick, Mason M., Major General; Mitchell, William, Brigadier General.

Officer of the Legion of Honor

Dunwoody, Halsey, Colonel; Thaw, William, Lieutenant-Colonel.

Knight of the Legion of Honor

Gorrell, Edgar S., Colonel; Butterfield, A. D., Lieutenant-Colonel; Hartney, Harold E., Lieutenant-Colonel; Brereton, Lewis H., Lieutenant-Colonel; Soubiran, Robert, Major; Biddle, Chas. J., Captain; Buford, Edward, Captain; Hall, James Norman, Captain; Morton, Captain; Rockwell, Robert, Captain; Baer, Paul Frank, 1st Lieutenant; Cassady, Thomas G., 1st Lieutenant; Miller, C. L., 1st Lieutenant; Putnam, David, 1st Lieutenant; Tillman, F. A., 1st Lieutenant; Turner, G. W. Evans, 1st Lieutenant.

Croix De Guerre (With Palm)

Ackerman, James H., 2nd Lieutenant; Atkinson, Thomas P., 1st Lieutenant; Avery, Walter L., 1st Lieutenant; Bagby, Ralph Bridges, 1st Lieutenant; Baker, Alfred B., 2nd Lieutenant; Barber, Newel, 2nd Lieutenant; Beane, James, 1st Lieutenant; Bender, Walter, 1st Lieutenant; Blake, Charles Raymond, 1st Lieutenant; Boldt, Herman St. John, 1st Lieutenant; Borchers, Frederick Wm., 2nd Lieutenant; Bradford, Alford J., 1st Lieutenant; Brereton, Lewis H., Lieutenant-Colonel; Brown, Jasper, 1st Lieutenant; Burger, Valentini, 2nd Lieutenant; Calkins, William, 1st Lieutenant; Carey, Edw. F., 2nd Lieutenant; Carl, Pitt F., 1st Lieutenant; Comey, George M., 1st Lieutenant; Cooke, Lucien H., Captain; Cotton, John, 1st Lieutenant; Cowart, William B., 1st Lieutenant; Craig, Harry, 1st Lieutenant; Davis, Richard, 2nd Lieutenant; Dixon, Frank, 2nd Lieutenant; Goodale, Alvin C., 1st Lieutenant; Guilbert, Horace Moos, 1st Lieutenant; Hall, James Goodwin, 1st Lieutenant; Harmon, Bradley Bancroft, 2nd Lieutenant; Hartney, Harold E., Lieutenant-Colonel; Healy, James A., Captain; Hirth, Frederick K., 2nd Lieutenant; Hitchcock, Roger W., 2nd Lieutenant; Hopkins, Amos, 1st Lieutenant; Joerg, Alfred N., 1st Lieutenant; Kresge, Miles W., 1st Lieutenant; Lake, Horace, 2nd Lieutenant; Lehr, Manderson, 1st Lieutenant; Lewis, David Wilber, 2nd Lieutenant; Littauer, Kenneth P., Major; Lovett, William W., Jr., 2nd Lieutenant; Lumsden, John C., 1st Lieutenant; Menoher, Chas. T., Major General; Mitchell, William, Brigadier-General; Moody, Richard W., 2nd Lieutenant; Moore, Frank M., 2nd Lieutenant; Nelson, Carlyle La Mar, 1st Lieutenant; Newell, James Milton, 2nd Lieutenant; Noonan, Thomas W., 1st Lieutenant; Noring, Ernest G., 1st Lieutenant; Page, Richard C. M., 1st Lieutenant; Penfield, Paul, 2nd Lieutenant; Ponder, William T., 1st Lieutenant; Porter, Earl, 2nd Lieutenant; Posey, John A., 2nd Lieutenant; Putnam, David, 1st Lieutenant; Reedy, Colman, 2nd Lieutenant; Rich, Dominic Wm., 1st Lieutenant; Schaeffer, Lloyd, 2nd Lieutenant; Shaffer, Harry, 2nd Lieutenant; Taylor, William H., 1st Lieutenant; Verwholt, Howard W., 1st Lieutenant; Wooten, James A., 2nd Lieutenant; Wright, Burdette S., Captain.

Croix De Guerre (With Gilt Star)

Burger, Valentine J., 2nd Lieutenant; Cassady, Thomas G., 1st Lieutenant; Coleman, Thomas F., 2nd Lieutenant; Conover, Harvey, 1st Lieutenant; Hill, Raymond C., 1st Lieutenant; MacCormick, Russel, 1st Lieutenant; McCormick, Russell C., 1st Lieutenant; Plummer, Charles W., 2nd Lieutenant; Ponder, William T., 1st Lieutenant; Rancourt, John I., 1st Lieutenant; Schauffler, William G., Major.

Croix De Guerre (With Silver Star)

Evans, Floyd E., 1st Lieutenant; Green, Adwin M., 1st Lieutenant; Green, Paul M., 1st Lieutenant; Merrill, Harold W., 1st Lieutenant; Rhodes, Carlyle, 1st Lieutenant.

Croix De Guerre (With Bronze Star)

Chambers, Reed, Captain; Grier, Alexander, 2nd Lieutenant; Hill, Robert E., 1st Lieutenant; Lindsey, Leon M., 1st Lieutenant; Llewellyn, Frank Albert, 1st Lieutenant; Noel, Roland Hall, 2nd Lieutenant; Noyes, Stephen H., 1st Lieutenant; Osgood, James, Captain; Rotharmel, Kennets, 2nd Lieutenant; Snook, Walter B., Captain; Thompson, Clifton, 2nd Lieutenant; Tompkins, Clarence B., 1st Lieutenant; Baker, James C., Sergeant.

Croix De Guerre

Abernathy, T. J., 2nd Lieutenant; Allport, E. H., 2nd Lieutenant; Baer, P. F., 1st Lieutenant; Barneby, W. V., 1st Lieutenant; Baucham, J. H., 2nd Lieutenant; Biddle, Charles J., Captain; Bird, L. S., 2nd Lieutenant; Butler, W. O., Captain; Campbell, D., 1st Lieutenant; Chapman, C. W., 2nd Lieutenant; Connelly, J. A., Sergeant; Coyle, A. J., 1st Lieutenant; Culbert, K. P., 2nd Lieutenant; Fleet, C. C., 1st Lieutenant; Ford, C. W., 1st Lieutenant; Garside, R., 1st Lieutenant; Giroux, E., 1st Lieutenant; Hall, J. N., Captain; Howell, S. I., 1st Lieutenant; Hunter, F. O'D., 1st Lieutenant; Jones, A. H., 1st Lieutenant; Jones, H., Sergeant; Jones, H., 1st Lieutenant; Jones, M., 1st Lieutenant; Kerwood, C. W., Sergeant; Kingsolving, C., 1st Lieutenant; Kyle, G. M., 1st Lieutenant; Larner, G. DeF., 1st Lieutenant; Lehr, M., Sergeant; Meissner, J. A., 1st Lieutenant; Merrick, C. I., 1st Lieutenant; Meyers, P., 2nd Lieutenant; Moore, R. L., 1st Lieutenant; Murphy, L. M., 1st Lieutenant; O'Neill, R. A., 1st Lieutenant; Ovington, C. L., 1st Lieutenant; Peterson, D. McK., Captain; Pollock, G., Corporal; Porter, C. P., 2nd Lieutenant; Porter, K. L., 2nd Lieutenant; Powell, C. R., 1st Lieutenant; Raible, J. C., Jr., 1st Lieutenant; Rand, R. R., Sergeant; Rheno, W. D., Corporal; Rickenbacker, E. V., Captain; Royce, R., Major; Sedgwick, M. A., 2nd Lieutenant; Seymour, M., 1st Lieutenant; Simon, K. C., Jr., 1st Lieutenant; Sinclaire, R., Sergeant; Stone, D., Corporal; Thaw, William, Major; Turnure, G. E., 1st Lieutenant; Urband, E. M., 1st Lieutenant; Wallace, J. E., 1st Lieutenant; Wass, W., Corporal; Wilcox, C. H., 1st Lieutenant; Winslow, A., 2nd Lieutenant; Wilson, J. V., 1st Lieutenant; Woodward, H., Corporal; Marr, Kenneth, Major.

Medaille Militaire

Connelly, J. A., Sergeant.

Fourragere

Thaw, William, Lieutenant-Colonel; Soubiran, R., Major; Hill, Dudley, Captain; Bridgman, R. C., Captain; Rockwell, Robert, Captain; Jones, Henry, 1st

Lieutenant; Dolan, Chas. H., Jr., 1st Lieutenant; Dugan, William E., 1st Lieutenant.

Italian Decorations

Gold Medal of Valor

Coleman, De Witt, 1st Lieutenant.

Silver Medal of Valor

Hartney, Harold E., Lieutenant-Colonel; Bahl, James L., 1st Lieutenant.

Officer of the Crown of Italy

Glendinning, Robert, Major.

Knight of the Crown of Italy

Fleishman, Charles M., Captain; Maquire, Frank H., Captain; Bongiorno, Philip, Captain; Spalding, Albert, 1st Lieutenant; Kiel, O. B., Captain (M. C.) (Attached).

Italian War Cross

La Guardia, Fiorello H., Major; Bahl, James L., 1st Lieutenant; Baldwin, Raymond P., 1st Lieutenant; Beach, Arthur H., 1st Lieutenant; Bevin, Allen W., 1st Lieutenant; Bogart, Gilbert P., 1st Lieutenant; Clement, Arthur F., 1st Lieutenant; Cochran, William G., 2nd Lieutenant; Coleman, De Witt, 1st Lieutenant; Collins, Kenneth G., 1st Lieutenant; Craig, Alexander M., 1st Lieutenant; Dodds, Herbert C., 1st Lieutenant; Donnan, Edmund A., 1st Lieutenant; Downs, Norton, Jr., 1st Lieutenant; Farquhar, Arthur D., 1st Lieutenant; Finkenstaedt, Harry S., 1st Lieutenant; Fitch, Willis S., 1st Lieutenant; Frost, Donald G., 1st Lieutenant; Frost, William O., 1st Lieutenant; Galehouse, Ira W., 1st Lieutenant; Hanley, James P., 1st Lieutenant; Hart, Spencer L., 2nd Lieutenant; Hering, George C., 1st Lieutenant; Hoggson, Wallace, 1st Lieutenant; Johnson, Gosta, N., 1st Lieutenant; Kennedy, James H., 2nd Lieutenant; Kiley, LeRoy D., 1st Lieutenant; Krueger, Herman F., 1st Lieutenant; MacGilvary, Paton, 1st Lieutenant; Mitchell, Oble H., 1st Lieutenant; Park, John, 1st Lieutenant; Potthoff, William H., 1st Lieutenant; Russell, Aubrey G., 1st Lieutenant; Shelton, William D., 1st Lieutenant; Sweetser, Norman, 1st Lieutenant; Terry, Norman, 2nd Lieutenant; Watchorn, Emery E., 1st Lieutenant; Weyenhauser, Frederick K., 1st Lieutenant; Wheeler, George W., 1st Lieutenant; Wilson, Alfred S., 1st Lieutenant; Wilson, Warren S., 1st Lieutenant.

Rumanian Decorations

Crown of Rumania

Rea, William, 2nd Lieutenant; Shaw, Alfred P., 2nd Lieutenant.

Star of Rumania with Arms

Powell, Lyle S., Captain.

Belgian Decorations

Order King Leopold of Belgium

Menoher, Chas. T., Major General.

Knight of the Crown of Belgium

Wright, Burdette S., Captain.

NAVAL AWARDS

A complete list of awards for bravery and conspicuous service in Naval Aviation has not yet been announced. A preliminary list, as given to the press, stated that the Congressional Medal had been given to Lieutenant Talbot, and Gunnery Sergeant Robinson, attached to the First Marine Aviation Force in France.

X

GROUND COURSES AND FLYING SCHOOLS

(A) GROUND COURSES

COLLEGES, UNIVERSITIES AND SCHOOLS IN THE UNITED STATES, OFFERING PRACTICAL OR THEORETICAL COURSES IN AERONAUTICS

Name	*Address*
ACADEMY OF APPLIED AERONAUTICS	Irving Park Boulevard and Western Avenue, Chicago, Illinois.
CASTLE GIRLS SCHOOL	Tarrytown-on-Hudson, New York.
UNIVERSITY OF COLORADO	Boulder, Colorado.
KANSAS STATE AGRICULTURAL COLLEGE	Manhattan, Kansas.
MASSACHUSETTS INSTITUTE OF TECHNOLOGY	Boston, Massachusetts.
UNIVERSITY OF MICHIGAN	Ann Arbor, Michigan.
PENNSYLVANIA STATE COLLEGE	State College, Pennsylvania.
UNIVERSITY OF PENNSYLVANIA	Philadelphia, Pennsylvania.
PURDUE UNIVERSITY	Lafayette, Indiana.
THROOP COLLEGE OF TECHNOLOGY	Pasadena, California.
TUFTS COLLEGE	Tufts, Massachusetts.

COURSE CONTEMPLATED

GEORGIA SCHOOL OF TECHNOLOGY	Atlanta, Georgia.
UNIVERSITY OF ILLINOIS	Champlain, Illinois.
IOWA STATE COLLEGE	Ames, Iowa.
OHIO STATE UNIVERSITY	Columbus, Ohio.
STATE UNIVERSITY OF OKLAHOMA	Norman, Oklahoma.
OREGON AGRICULTURAL COLLEGE	Corvallis, Oregon.
SHEFFIELD SCIENTIFIC SCHOOL OF YALE UNIVERSITY	New Haven, Connecticut.

(B) CIVILIAN FLYING SCHOOLS

The following civilian flying schools are maintained by members of the Manufacturers Aircraft Association. Full information may be had by addressing the plants named:

Name	*Address*
AEROMARINE PLANE & MOTOR CO. Flying boat school at Keyport.	Keyport, New Jersey.
BOEING AIRPLANE COMPANY	Seattle, Washington.
CURTISS AEROPLANE & MOTOR CORPORATION	Garden City, New York.

Roosevelt Field at
Mineola, Long Island, New York;
Atlantic City, New Jersey;
Newport News, Virginia;
Miami, Florida.

Instruction is offered in land and water-machine flying.

Name	*Address*
DAYTON-WRIGHT AIRPLANE COMPANY	Dayton, Ohio.
GALLAUDET AIRCRAFT CORPORATION Gallaudet Aviation School, Inc. East Greenwich, Rhode Island.	30 East 42nd Street, New York, New York.
GLENN L. MARTIN COMPANY	Cleveland, Ohio.
WEST VIRGINIA AIRCRAFT COMPANY Schools at Princeton, New Jersey, and Daytona, Florida.	Wheeling, West Virginia.

The Goodyear Tire & Rubber Company, Akron, Ohio, maintains a school for balloons and dirigibles.

XI
UNITED STATES AERIAL MAIL STATISTICS

(A) PERFORMANCE AND COST
NEW YORK–WASHINGTON ROUTE

	MAY 15 TO SEPT. 30 1918	OCT. 1 TO DEC. 31 1918	JAN. 1 TO MAR. 31 1919	APR. 1 TO JUN. 30 1919	TOTALS AND AVERAGES 1918–19
[1] Total cost operation	$42,800.69	$33,815.90	$41,267.03	$42,304.70	$160,188.32
[2] Cost per mile, average	.64	[3] .93	[3] 1.25	.87	.87
Cost per ton-mile	....	....	....	....	....
Cost per flying hour	46.88	49.68	89.64	66.07	63.06
Cost per mile overhead	.18	.33	.42	.27	.28
Cost per mile, flying	.17	.19	.28	.20	.20
Cost per mile, maintenance	.29	.41	.55	.40	.39
Pounds mail carried	66,586.	51,420.	51,125.	48,942.	218,073.
Miles flown	66,374.	36,175.	32,955.	48,530.	184,034.
Time in air	890h 5m	508h 12m	460h 24m	669h 57m	2,528h 38m
Average speed, miles per hour	75.	71.	72.	72.	72.
Miles per gallon gasoline	4.72	4.65	3.35	3.60	4.08
Number trips possible	477.	316.	311.	270.	1,374.
Number trips made	449.	302.	261.	256.	1,268.
Per cent. performance	94.	96.	84.	95.	92.
Forced landings	25.	21.	30.	28.	104.
Mechanical troubles	13.	9.	12.	7.	41.
Weather	12.	12.	18.	21.	63.
Other causes	0.	0.	0.	0.	0.
Falls, total number	0.	1.	0.	1.	[4] 2.
Fatal	0.	1.	0.	0.	1.
Wounded	0.	0.	0.	1.	1.
Number planes operated	18.	18.	19.	[5] 35.	22.

[1] Costs include: Gas, grease and oil, office force, operation of motorcycles and trucks; rent, light, fuel, power, telephone and water; miscellaneous, pilots, mechanics and helpers, repairs and accessories, interest on investment, departmental overhead charge.

[2] Obtained by dividing miles flown into total cost of operation.

[3] Increased average cost per mile on quarters October 1st to December 31st, 1918, and January 1st to March 31st, 1919, is due to laying out fields, experimental work, etc.

[4] Of these, one was a fatality which resulted from an applicant endeavoring to demonstrate his ability to fly one of the air mail 'planes.

[5] Number of planes operated April 1st to June 30th, 1919, include 'planes on New York-Cleveland run, working out a schedule, etc. Route was not established officially until July 1st, 1919.

CHICAGO-CLEVELAND ROUTE

	May 15 to May 31, 1919	June 1 to June 30, 1919	Totals and Averages
[1] Total cost operation	$7,514.15	$12,304.87	$19,819.02
Cost per mile, average	.71	.57	.61
Cost per ton-mile	....	....	....
Cost per flying hour	55.36	50.40	52.88
Cost per mile, overhead	.17	.17	.17
Cost per mile, flying	.21	.20	.20
Cost per mile, maintenance	.33	.20	.24
Pounds mail carried	9,933.	20,003.	29,936.
Miles flown	10,653.	21,689.	32,342.
Time in air	135h 44m	224h 55m	360h 39m
Average speed miles per hour	78.	96.	87.
Miles per gallon gasoline	2.89	2.22	2.56
Number trips possible	48.	51.	99.
Number trips made	46.	49.	95.
Per cent. performance	96.	96.	96.
Forced landings	0.	0.	0.
Mechanical troubles	0.	0.	0.
Weather	0.	0.	0.
Other causes	0.	0.	0.
Falls, total number	1.	0.	1.
Fatal	1.	0.	1.
Wounded	0.	0.	0.
Number planes operated	14.	16.	15.

[1] Costs include: Gas, Grease and Oil, Office Force, Operation of Motorcycles and Trucks; Rent, Light, Fuel, Power, Telephone and Water; Miscellaneous, Pilots, Mechanics and Helpers, Repairs and Accessories, Interest on Investment, Departmental Overhead Charge.

(B) ITEMIZATION OF COSTS

	NEW YORK-WASHINGTON				CLEVELAND-CHICAGO	
	From May 15, 1918 to Dec. 31, 1918		From May 15, 1918 to June 30, 1919		From May 15, 1919 to June 30, 1919	
	Total	Average per mile	Total	Average per mile	Total	Average per mile
Gasoline	$6,772.65	.066	$13,704.15	.074	$3,423.99	.195
Grease and oil	1,499.46	.014	3,284.19	.018	461.71	.014
Office force	2,344.50	.022	7,413.14	.041	1,522.87	.47
Motorcycles and trucks	4,565.69	.044	10,218.40	.055	728.88	.023
Rent, Fuel, Light, Power, Telephone, Water	2,751.19	.026	5,652.55	.031	562.80	.017
Miscellaneous	5,524.31	.053	17,148.64	.093	2,429.21	.075
Pilots	9,808.83	.095	19,932.17	.108	2,679.45	.082
Mechanics and helpers	15,063.47	.146	32,221.61	.175	2,839.53	.087
Repairs and accessories	14,041,41	.136	22,824.33	.124	2,534.01	.078
Interest on investment	7,285.30	.071	14,182.96	.077	1,267.50	.039
Departmental overhead charge	6,959.78	.067	13,606.18	.074	1,369.07	.043
Total	76,616.59	.74	$160,188.32	.87	$19,819.02	.61

Aerial Mail Pilots

Applications for appointment as aerial mail pilots may be made to the Second Assistant Postmaster General, Mail Service, Post Office Department, Washington, District of Columbia.

Qualifications should be stated in detail with special reference to cross-country flying, aerial navigation, radio work and total number of hours' air experience. Five hundred hours in the air are considered desirable. Each application should be accompanied by three letters of recommendation from persons familiar with the qualifications set forth.

Salaries are $2000 per annum, with automatic increases of $200 for every additional 30 hours of flying up to and including the $2800 grade. Promotions up to and including the $3600 grade, will be based on special qualifications revealed in the pilot's service, such as unusually meritorious work, executive ability, exceptional knowledge of aerial navigation, skilfulness in radio telegraphy or telephony, aeronautical instrumentation, etc.

Aerial Postage Rates

The use of distinctive aerial mail stamps are no longer necessary and mail matter for despatch by airplane is treated in the same manner as other first-class mail and subject to the same rates of postage and conditions except that no article may be despatched by airplane which exceeds 30 inches in length and girth combined. Senders may arrange with postmasters to have letters despatched by aerial mail. The main function of the Aerial Mail Service is to advance the greatest quantities of mails between such selected points as may warrant the operation of this special service.

When the aerial mail was first established, special stamps were issued and the rate was 24 cents per ounce. Then a reduction to 16 cents was made and finally the rate became 6 cents, with the use of either airplane stamps or regular ones with "Aerial Mail" conspicuously marked on the envelope. On July 18th, 1919, the standard domestic rate of 2 cents an ounce was put into force.

A special delivery stamp, now as always, insures still greater expedition of letters at the point of delivery.

XII
GOVERNMENT ORGANIZATIONS COOPERATING IN DEVELOPMENT OF AERONAUTICS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

D BUILDING, 4½ STREET AND MISSOURI AVENUE, WASHINGTON, DISTRICT OF COLUMBIA

Dr. Charles D. Walcott.................................Chairman
Dr. S. W. Stratton.................................Secretary
Dr. Joseph S. Ames..............Chairman, Executive Committee
George W. Lewis.................................Executive Officer
John F. Victory...Assistant Secretary and Special Disbursing Agent

Col. Thurman H. Bane, U. S. A.
Capt. T. T. Craven, U. S. N.
Dr. William F. Durand
Dr. John F. Hayford
Dr. Charles F. Marvin
Maj. Gen. Charles T. Menoher, U. S. A.
Dr. Michael I. Pupin
Rear Admiral D. W. Taylor, U. S. N.

The National Advisory Committee for Aeronautics was appointed by the President, pursuant to act of Congress approved March 3rd, 1915 (naval appropriation act, public No. 273, Sixty-third Congress). Its membership consists of two officers of the Smithsonian Institution, the United States Weather Bureau, and the United States Bureau of Standards, together with five additional persons acquainted with the needs of aeronautical science, or skilled in aeronautical engineering or its allied sciences. All the members, as such, serve without compensation.

The duties of the committee, as provided by Congress, are to supervise and direct the scientific study of the problems of flight, with a view to their practical solution, and to determine the problems which should be experimentally attacked, and to discuss their solution and their application to practical questions.

Under the rules and regulations formulated by the committee and approved by the President, technical subcommittees have been established whose general duties are to aid in determining the problems in their respective branches of the aeronautical field to be scientifically attacked, bringing to bear the knowledge derived from experimental investigations conducted in all parts of the world, and to endeavor to coordinate the research and experimental work involved in the study of problems agreed upon. These subcommittees are composed in part of specially appointed representatives of the Army and Navy Air Services.

Under the law the committee holds itself at the service of any department or agency of the Government interested in aeronautics for the furnishing of information or assistance in regard to scientific or technical matters relating to aeronautics, and in particular for the investigation and study of problems in this field with a view to their practical solution.

The committee may also exercise its functions for any individual, firm, association, or corporation within the United States, provided that such individual, firm, association, or corporation defray the actual cost involved.

The committee directly conducts scientific research and experiment in aeronautics at its research laboratory and associated buildings at Langley Field, Virginia, a section of which has been set aside by the War Department for its use. A clear distinction exists between scientific research in aeronautics as conducted by the committee and engineering research or development as conducted by other agencies.

Aeronautical information is being gathered by the committee in England, France and Italy and plans are being made for similar work in Germany and Austria.

XIII

PERMANENT AIRDROMES (AIRPLANE HARBORS) AND SEAPLANE STATIONS IN THE UNITED STATES AND DEPENDENCIES, AND MEXICO.

(Total to January 1st, 1919, 115)

The following list gives the location, name and size of permanent airdromes (airplane harbors) and seaplane stations in the United States and dependencies, and Mexico. The letter, or group of letters, following the name of states and territories, and the number preceding the name of localities are the recognition marks, as adopted by the Army Air Service, which are to be permanently displayed on the airdromes listed.

The list includes in particular:

(1) Army Flying Fields (active and inactive);
(2) Naval Air Stations;
(3) Aerial Mail Fields;
(4) Municipal Airdromes; and
(5) Commercial Airdromes.

AIRDROMES (PERMANENT AIRPLANE HARBORS) AND SEAPLANE STATIONS IN THE UNITED STATES AND DEPENDENCIES

	City	*Name of Field*	*Type*	*Remarks*
		ALABAMA (AL)		
63	Montgomery	Taylor Field	Army	
		ARIZONA (AR)		
49	Tucson		Municipal	
		ARKANSAS (ARK)		
	Lonoke	Eberts Field	Army	
		CALIFORNIA (CA)		
59	Redwood City	Redwood City Aviation School	Commercial	208 acres, near San Francisco
23	Riverside	March Field	Army	
92	Sacramento	Mather Field	Army	
1	San Diego	Rockwell Field	Army	
	(North Island)	Naval Air Station	Navy	Seaplanes *and* Airplanes
	San Pedro	Chaplin Field	Commercial	
26	Santa Barbara	Loughhead Seaplane Station	Commercial	*Seaplanes only*
4	Venice	T. H. Ince Flying Field	Commercial	400′ x 1200′
		T. H. Ince Seaplane Station	Commercial	*Seaplanes only*
		CANAL ZONE (CZ)		
	Balboa	Fort Amador	Army	
	Coco Solo (Colon Harbor)	Naval Air Station	Navy	*Seaplanes only*
	Cristobal	France Field	Army	
		DISTRICT OF COLUMBIA (DC)		
	Anacostia	Aerial Defense Station	Navy	*Seaplanes only*
	Washington	Bolling Field	Army	
		FLORIDA (FLA)		
	Arcadia	Carlstrom Field	Army	
		Dorr Field	Army	
	Key West	Naval Air Station	Navy	*Seaplanes only*
	Miami	Chapman Field	Army	

	City	*Name of Field*	*Type*	*Remarks*
		FLORIDA (FLA) (*Continued*)		
	Miami	Marine Corps Field	Navy	
	Pensacola	Naval Air Station	Navy	*Seaplanes only*
		GEORGIA (GA)		
46	Americus	Souther Field	Army	
73	Macon	Fair Grounds	Municipal	Triangle shaped 1,000′
121	Waycross		Municipal	
		HAWAIIAN ISLES (HI)		
	Honolulu	Luke Field	Army	At Ford's Island
		IDAHO		
	Coeur d'Alene		Municipal	160 acres
		ILLINOIS		
32	Belleville	Scott Field	Army	2000′ x 1200′
189	Chicago	Grant Park Field	Air Mail	60 acres; on Lake Shore Front
		Ashburn Field	Commercial	Ae. C. of Illinois
	Rantoul	Chanute Field	Army	
145	Rock Island	Framing Field	Commercial	
		INDIANA (IN)		
18	Evansville	Evansville Aero Club Field	Commercial	
82	Kokomo	Kokomo Aviation Company Field	Commercial	3960′ x 2640′
64	New Castle	Rose City Aviation Company	Commercial	1750′ x 1200′
97	Wabash	Service Aviation Training and Transportation Company	Commercial	50 acres
		IOWA (IA)		
50	Des Moines	Herring Field	Commercial	
		KANSAS (KS)		
	Fort Riley	Camp Funston	Army	
32	Wichita	Strattford Field	Municipal	2400′ x 1200′; Good
		LOUISIANA (L)		
15	Lake Charles	Gerstner Field	Army	
		MARYLAND (MD)		
	Aberdeen	Aberdeen Proving Grounds	Army	

	City	Name of Field	Type	Remarks
		MARYLAND (MD) (*Continued*)		
	College Park	Air Mail Field	Post Office	50 acres. On B. & O. R. R., 7½ mi. N.E. Washington, D.C., Post Office
		MASSACHUSETTS (MS)		
	Bedford	Curtiss Flying Field	Commercial	Curtiss Aero Corp'n.
	Taunton	King Flying Field	Municipal	1288′ x 774′
		MICHIGAN (MI)		
21	Battle Creek	Camp Custer	Army	
31	Detroit		Municipal	5280′ x 2640′
		Morrow Field	Army	
		Packard Aviation Field	Commercial	Good
48	Mount Clemens	Selfridge Field	Army	
		MINNESOTA (M)		
56	Minneapolis	Twin Cities Field	Air Mail	100 Good acres (900′ x 1125′) 5 mi. from P.O.
		Curtiss Air Port	Commercial	2000′ x 800′
		MISSISSIPPI (MP)		
	West Point	Payne Field	Army	
		MISSOURI (MO)		
	Kansas City		Municipal	2000′ square
		MISSOURI (MO)		
	Saint Louis	Forrest Park	Air Mail	100 acres (825′ x 525′) 3 mi SW of P.O.
		MONTANA (MA)		
	Billings		Municipal	In preparation
		NEBRASKA (NE)		
68	Omaha	Ak-Sar-Ben Field	Air Mail	80 acres, 3½ mi. SE of Post Office
		NEVADA (NA)		
	Battle Mountain		Municipal	
		NEW JERSEY (NJ)		
10	Atlantic City	Air Port	Commercial	About 3500′ x 3600′ Curtiss Flying Station
7	Cape May	Naval Air Station	Navy	*Seaplanes only*

	City	Name of Field	Type	Remarks
		NEW JERSEY (N.J) (Continued)		
107	Hasbrouk Heights	Witteman-Lewis Field	Commercial	800 acres, 1 x ⅞ mi. Witteman-Lewis Aircraft Corp.
54	Keyport	Aeromarine Field	Commercial	1800′ x 400′—Aeromarine Plane & Motor Co.
77	Newark	Heller Field	Air Mail	47 acres, 4 mi. NE of Post Office adjoining Golf Links

NEW YORK

(N for Western half of State and Y for Eastern half.)

(L for Long Island)

* Aerodromes situated on Long Island are listed under New York City and Long Island.

	City	Name of Field	Type	Remarks
Y-52	Albany	Quentin Roosevelt Field	Municipal	300′ x 600′
	Lake Placid		Commercial	Excellent Field
N-30	Lockport	Curtiss Field	Commercial	
	Newdorp, Staten Island Aerial Coast Defense Station		Army	1230′ x 800′
	LONG ISLAND			
L-6	Amityville	Sperry Station	Commercial	*Seaplanes only*
	Baldwin	Ordnance Field	Commercial	1500′ x 600′ x 200′ Ordnance Engineering Corporation
	Belmont Park	Air Mail Field	Post Office	
	Central Park	Ace Flying Field	Commercial	1800′ x 600′ Aircraft Engr. Corp.
		L. W. F. Flying Field (L. W. F. Engineering Company)	Commercial	3 mi. W of Farmingdale
	Commack	Brindley Field	Army	
	Copaigue	Sperry Field	Commercial	2000′ x 1000′ good. Lawrence Sperry Aircraft Corp.
	Garden City	Mitchel Field	Army	393 acres
L-4	Hempstead	Roosevelt Field	Army	
	Mineola	Hazelhurst Field	Army	50 acres
	Port Washington	Seaplane Station	Commercial	*Seaplanes only*
L-5	Rockaway	Naval Air Station	Navy	*Seaplanes only*

	City	*Name of Field*	*Type*	*Remarks*
	Wantaugh	Lufberry Field	Commercial	600′ x 600′
	Rochester		Municipal	1800′ x 1800′. In preparation
		NORTH CAROLINA (NC)		
	Fayetteville	(Camp Bragg) Pope Field	Army	
		OHIO (O)		
151	Bryan	Air Mail Field	Post Office	
127	Cleveland	Woodland Hills Park	Municipal	1100′ x 500′. Used by Air Mail service. 5 mi. SE of Cleveland Post Office
127	Cleveland	Glenn Martin Field	Commercial	L shaped 3000′ x 300′ E-W and 1300′ x 200′ N-S. 8 mi. NE of Cleveland
42	Dayton	McCook Field	Army	
	(Fairfield)	Wilbur Wright Field	Army	
		South Field	Commercial	2300′ x 2125′ Dayton Wright Airplane Co.
	Warren	Packard Park	Commercial	
		OKLAHOMA (OK)		
	Fort Sill	Post Field	Army	
	Tulsa	Curtiss Southwest Airplane Co.	Commercial	1800′ x 2300′
		PENNSYLVANIA (P)		
	Bellefonte	Air Mail Field	Postal	40 acres 1¼ mi. W of Bellefonte Post Office
	Essington	Essington Aviation School	Commercial	*Seaplanes only* On the Potomac
	(Bustleton)	Air Mail Field	Post Office	45 acres, 1 mi. from Bustleton Sta. on the Holmesburg branch of the Penn. R. R. 14 mi. from Phila. City Post Of-Office
	Scranton		Municipal	

City	Name of Field	Type	Remarks
	PHILIPPINE ISLANDS (PI)		
Cavite	Aerial Coast Defense Station	Army	
	TENNESSEE (TN)		
Bristol		Municipal	
Millington	Park Field	Army	
	TEXAS (TX)		
Benbrook	Carruthers Field	Army	
Everman	Barron Field	Army	
Ft. Worth	Hicks Field	Army	
	Taliaferro Field	Army	
	TEXAS (TX) Continued		
Houston	Ellington Field	Army	
San Antonio	Kelly Field No. 2	Army	
Waco	Rich Field	Army	
Wichita Falls	Call Field	Army	
	VIRGINIA (VA)		
Hampton	Langley Field	Army	
	Naval Air Station	Navy	*Seaplanes only*
	WASHINGTON (WSH)		
Spokane	North West Airplane Company	Commercial	5000′ x 3000′
	WISCONSIN (W)		
Eau Claire	Eau Claire Aero Corp.	Commercial	2000′ x 2000′
46 La Crosse		Municipal	
33 Milwaukee	Milwaukee Air Port	Municipal	
	WYOMING (WY)		
Cheyenne	Fort D. A. Russell	Army	600 yards x 700 yards
	MEXICO		
Mexico City	Valbuena Airdrome	Army	

(The British Air Attaché reports that no permanent airdromes are to be listed as yet from Canada.)

XIV

EMERGENCY LANDING FIELDS IN THE UNITED STATES

Following is a list of emergency landing fields in the United States which have been inspected and classified, or which are known to be in accordance with tentative designations given in the list; or are in actual course of preparation. In many instances work is being prosecuted on municipal and other airdromes.

The emergency list totals approximately 1,000. These fields are to be regarded as merely the first step in the establishment of air harbors. Contrasted with the 115 permanent fields or seaplane stations they become an incentive to the immediate establishment of a nation-wide system of aerial stations and terminals.

The numbers at the left-hand side of this landing field list are those which have been assigned by the Army Air Service in connection with the national system of city numbering: under this system all municipalities of 2.000 population or over have been assigned numbers in accordance with a definite geographical program. The work of numbering cities of all the states in the Union has not as yet been completed.

Every state is being given a letter symbol. Anniston, Alabama, is thus known to the air tourist as AL-72, and so on.

LANDING FIELDS

ALABAMA (AL)

No.	*City*	*Name of Field*	*Type*	*Remarks*
	Albany		Emergency	
	Andulusia		Emergency	
72	Anniston	Camp McClellan	Emergency	
22	Athens		Emergency	
13	Bay Minette		Emergency	
38	Birmingham	Fair Grounds	Emergency	
34	Brewton		Emergency	
	Centerville		Emergency	
8	Demopolis		Emergency	
82	Enterprise		Emergency	
98	Eufaula		Emergency	
6	Eutaw		Emergency	
	Fayette		Emergency	
4	Florence		Emergency	
70	Gadsden		Emergency	
47	Huntsville		Emergency	
91	Hurtsboro		Emergency	
25	Jasper		Emergency	
2	Mobile		Emergency	1825′ x 850′
93	Ozark		Emergency	
	Snelling			
10	Thomsville		Emergency	
4	Tuscumbia		Emergency	
	Vernon		Emergency	

ARIZONA (AR)

No.	*City*	*Name of Field*	*Type*	*Remarks*
87	Douglas	Parade Ground	Emergency	
29	Flagstaff		Emergency	
	Grand Canyon		Emergency	
55	Holbrook		Emergency	
4	Kingman		Emergency	
33	Maricopa		Emergency	
28	Phoenix		Emergency	
18	Prescott		Permanent	
49	Tucson			
1	Yuma		Emergency	
71	Wilcox		Emergency	

ARKANSAS (ARK)

No.	*City*	*Name of Field*	*Type*	*Remarks*
	Arkadelphia		Emergency	About 40 acre meadow
	Batesville		Emergency	
	Berryville		Emergency	
	Brinkley		Emergency	
	Buffalo Creek		Emergency	
	Danville		Emergency	
	Dardanelle		Emergency	
	DeWitt		Emergency	
	El Dorado		Emergency	
	Fayetteville	Race Track	Emergency	
	Forest City		Emergency	
	Fort Smith		Emergency	160 acre field: Country Club, Golf Course
	Harrison	Race Track	Emergency	
	Hazen		Emergency	
	Helena		Emergency	
	Hope		Emergency	
	Hot Springs	Country Club	Emergency	Golf Links
	Jonesboro			50 acre rectangle
	Little Rock		Emergency	
	Marked Tree		Emergency	345′ x 900′
	Newport		Emergency	
	New Boston		Emergency	
	Pine Bluff		Emergency	
	Prescott		Emergency	
	Stuttgart		Emergency	
	Texarkana	Country Club	Emergency	
	Warren		Emergency	
	Wynne		Emergency	320′ x 645′; 40 acres

CALIFORNIA (CA)

No.	*City*	*Name of Field*	*Type*	*Remarks*
73	Alameda			3000′ x 3000′, dangerous, swampy
	Arcadia	Ross	Emergency	Army Balloon School
40	Bakersfield		Emergency	1200′ x 600′
	Bay Point		Emergency	400′ x 1000′
	Beaumont		Emergency	400′ x 1000′
71	Berkeley		Emergency	10 acre field: not good
	Bloomington		Emergency	2000′ x 2000′
	Blythe		Emergency	
	Brawley		Emergency	

No.	City	Name of Field	Type	Remarks
	Calexico		Emergency	
	Calipatria	Calipatria	Emergency	800′ x 1000′
	Chinese		Emergency	
	Chino		Emergency	900′ x 1500′
112	Chico		Emergency	
105	Colusa		Emergency	800′ x 2000′
20	Corona		Emergency	500′ x 1500′
	Cottonwood		Emergency	
	Daggett		Emergency	500′ x 700′
	Dominegoni		Emergency	1500′ x 2500′
3	El Centro		Emergency	
115	Eureka		Emergency	
	Fallbrook		Emergency	300′ x 900′
55	Fresno		Emergency	600′ x 1500′
	Gridley		Emergency	
	Hemet		Emergency	1000′ x 500′
15	Hollister		Emergency	1500′ x 3000′
	Lancaster		Emergency	1200′ x 700′; Good
54	Madera		Emergency	
108	Marysville		Emergency	1800′ x 6000′
	Maxwell		Emergency	
	Mecca		Emergency	
64	Merced		Emergency	1500′ x 2000′
82	Modesto		Emergency	2000′ x 1500′
	Mojave		Emergency	1000′ x 600′
	Needles		Emergency	
	Newman	Canal	Emergency	4000′ x 1000′
74	Oakland	Chevrolet Motor Car Co.	Emergency	
106	Oroville		Emergency	
	Palmdale		Emergency	
30	Pasadena	Altedena Country Club	Emergency	800′ x 1500′
87	Petaluma		Emergency	
41	Portersville	Wilko Mentz		2640′ x 3960′
	Quincy		Emergency	
114	Red Bluff		Emergency	
	Redding		Emergency	3000′ x 500′
36	San Bernardino		Emergency	1000′ x 1500′
	San Fernando		Emergency	2000′ x 1200′
68	San Francisco	Marine Exposition Grounds (Ft. Mason)	Emergency	200′ x 800′
	San Francisco	Presidio of California	Emergency	2000′ x 600′
	San Francisco		Government	Supplies at hand
	San Francisco	Naval Air Station	Government	Projected
62	San Jose	Field No. 1	Emergency	1 mi. square, smooth
		Field No. 2	Emergency	Small

No.	City	Name of Field	Type	Remarks
		CALIFORNIA (CA) (*Continued*)		
	Spadra		Emergency	800′ x 3000′
83	Stockton	Pounds Aviation Field	Emergency	About 1500′ x 500′; race track
	Temecula		Emergency	1500′ x 1000′
4	Venice		Emergency	400′ x 1200′
99	Woodland		Emergency	
	Woodlawn		Emergency	6000′ x 3600′
		COLORADO (COL)		
	Aguilar		Emergency	
43	Aspin			Good Field
33	Buena Vista			Good Field
	Burlington			Good Field
37	Colorado Springs		Emergency	
59	Denver	Chessman Park	Emergency	City Park Race Track
	Denver	Curtiss-Humphreys		Good
	Flagler			Good
46	Glenwood Springs			Good
40	Grand Junction			Good
	Limon			Good
18	Pueblo		Emergency	
	Red Cliff			Good
26	Salida			Good
7	Trinidad		Emergency	
		CONNECTICUT (CO)		
30	Ansonia		Emergency	200′ x 200′
88	Hartford	Goodwin Park	Emergency	150′ to 300′ x 600′
51	Meriden		Emergency	
52	Middletown	Connecticut Industrial School for Girls	Emergency	500′ x 600′
35	New London	Mitchel	Emergency	Next to New London Ball Field
	Pawcatuck		Emergency	
61	Plainville		Emergency	400′ x 1200′
		DELAWARE (DEL)		
	Middletown	Harry C. Drayton	Emergency	2200′ x 900′
	Newark		Emergency	
	Wilmington		Emergency	
		FLORIDA (FLA)		
	Avon Park		Emergency	
	Baldwin		Emergency	
	Bartow		Emergency	
	Bonifay		Emergency	660′ x 900′

No.	City	Name of Field	Type	Remarks
	Bradentown		Emergency	
	Brooksville		Emergency	
	Daytonia	Beach	Emergency	
	De Funiak Springs		Emergency	825′ x 825′
	De Land	College Arm Golf Course	Emergency	200′ x 1000′
	De Land	College Arm Hotel	Emergency	
	Eustis		Emergency	
	Fort Meade		Emergency	
	Fort Myers		Emergency	
	Fort Pierce		Emergency	
	Gainesville	Oval	Emergency	
	Gladcrest		Emergency	
	Glendale		Emergency	
	Hobe Sound		Emergency	
	Immokalee		Emergency	
	Jacksonville	Camp Johnson	Emergency	Rifle range
	Kissimmee		Emergency	1350′ x 850′; L shaped
	Lakeland		Emergency	
	Lake City		Emergency	1800′ x 500′
	Leesburg		Emergency	
	Live Oak		Emergency	1150′ x 1000′; L shaped
	Marianna		Emergency	1350′ x 1350′
	Moorshaven		Emergency	
	North Labelle		Emergency	
	Ocala		Emergency	
	Ocecchobee		Emergency	
	Orlando	Fair Grounds	Emergency	
	Ormond		Emergency	
	Pensacola	Navy Blimp School	Emergency	400′ x 600′; supplies
	St. Augustine		Emergency	
	St. Cloud		Emergency	
	Sanford		Emergency	
	Seabreeze		Emergency	Beach
	Sarasota		Emergency	
	Tallahassee		Emergency	1200′ x 500′
		GEORGIA (GA)		
53	Albany	Curtiss	Emergency	Triangle shaped
76	Ashburn		Emergency	
81	Athens	C. C. Golf Links	Emergency	
40	Atlanta	Candler		Country Club
122	Augusta	Camp Hancock		Parade Grounds
	Belleville		Emergency	
16	Blakely		Emergency	250′ x 150′
36	Buena Vista		Emergency	

No.	City	Name of Field	Type	Remarks
		GEORGIA (GA) *(Continued)*		
29	Canton		Emergency	
9	Columbus	Race Track	Emergency	
63	Cordale		Emergency	
	Cumberland Island		Emergency	Beach
37	Dawson		Emergency	
109	Douglas		Emergency	
	Ellaville		Emergency	1200′ x 1200′
90	Fitzgerald		Emergency	1500′ x 900′
60	Fort Valley		Emergency	Triangle shaped
	Gracewood		Emergency	
43	Griffin		Emergency	1200′ x 600′
	Helena		Emergency	
83	Hawkinsville		Emergency	1200′ x 750′
2	LaFayette		Emergency	
107	McRae		Emergency	
73	Macon	Camp Wheeler	Emergency	Parade Grounds
31	Marietta	C. C. Golf Links	Emergency	
61	Marshallville		Emergency	600′ x 1200′
98	Milliedgeville	Golf Course	Emergency	450′ x 1500′
62	Montezuma	Curtiss	Emergency	1200′ x 1500′
65	Moultrie	Golf Course	Emergency	1800′ x 750′
	Oglethorpe		Emergency	1200′ x 900′
	Omaha		Emergency	
	Plains		Emergency	450′ x 1200′
23	Richland		Emergency	
4	Rome		Emergency	
131	Savannah	Daffin Park	Emergency	470′ x 1200′
26	Shellman		Emergency	1200′ x 750′
	Sugar Valley		Emergency	900′ x 700′
128	Sylvania		Emergency	
64	Sylvester		Emergency	470′ x 1200′
45	Thomaston		Emergency	900′ x 600′
84	Tifton		Emergency	300′ x 900′
93	Valdosta	Race Track	Emergency	300′ x 900′
116	Vidialia		Emergency	
123	Waynesboro		Emergency	
	Wrens		Emergency	
		IDAHO (ID)		
	Athol		Emergency	
	Belmont		Emergency	
	Coeur d'Alene		Municipal	160 acres
	Corbin		Emergency	
	Garwood		Emergency	
	Hayser		Emergency	
	Moscow		Emergency	2500′ x 5000′
	Rathdrum		Emergency	

No.	City	Name of Field	Type	Remarks
	Twin Lakes		Emergency	
		ILLINOIS (IL)		
118	Abington		Emergency	1500′ x 1800′
136	Aledo		Emergency	900′ x 400′
49	Alton		Emergency	5280′ x 300′
169	Aurora		Emergency	1200′ x 600′
	Avena		Emergency	5280′ x 2640′
	Beckemeyer		Emergency	Large
203	Belvidere		Emergency	80 acres
	Blandenville	Poor Farm	Emergency	80 acres
110	Bloomington	Country Club		
36	Breese	Race Track	Emergency	½ mile
	Brownstown		Emergency	1200′ x 900′
	Caberry		Emergency	500′ x 2500′
63	Carlinville		Emergency	1100′ x 1300′
37	Carlyle		Emergency	1200′ x 400′
62	Carrollton		Emergency	1200′ x 600′
7	Cartersville	Dr. Farrill	Emergency	600′ x 1200′
56	Casey		Emergency	1300′ x 1300′
	Cedar Point		Emergency	
38	Centralia		Emergency	500′ x 1800′
98	Champaign	Country Club	Emergency	
75	Charleston		Emergency	2640′ x 1320′
	Chatsworth	Haberborn Farm	Emergency	
189	Chicago	Jackson Park	Emergency	
96	Clinton		Emergency	1500′ x 1200′
	Corina		Emergency	1200′ x 1200′
	Damianville		Emergency	
101	Danville	Old Soldiers' Home	Emergency	
90	Decatur		Emergency	
	Delavan	Ross	Emergency	1800′ x 1800′
	Dennison		Emergency	60 acres
	Dow		Emergency	1000′ x 1000′
	Dupe		Emergency	1500′ x 1500′
19	Du Quoin		Emergency	
61	Effingham		Emergency	1200′ x 1600′
193	Elgin	Hornbeck Farm	Emergency	1000′ x 1200′
	Elmwood		Emergency	300′ x 100′
	Fallon		Emergency	2000′ x 2000′
28	Fairfield		Emergency	1600′ x 1600′
	Fieldon		Emergency	50 acres square
	Freeburg		Emergency	1800′ x 900′
123	Galesburg	Galesburg Driving Park	Emergency	Oval ½ mile track
	Galesburg	Schilo Farm	Emergency	
	Galesburg	Bar Country Club	Emergency	
69	Girard		Emergency	200′ x 1200′

No.	*City*	*Name of Field*	*Type*	*Remarks*
		ILLINOIS (*Continued*)		
	Goreville		Emergency	
	Gorham		Emergency	
	Greenup		Emergency	
51	Greenville		Emergency	1300′ x 1300′
	Harvel		Emergency	
103	Havana		Emergency	2500′ x 1500′
	Hettick		Emergency	1320′ x 1320′
44	Highland		Emergency	1200′ x 1000′
	Hinkley		Emergency	
54	Jerseyville		Emergency	1800′ x 2000′
158	Joliet		Emergency	
133	Kankakee	State Insane Asylum	Emergency	2000′ x 2000′
	Keenes		Emergency	
	Kempton		Emergency	700′ x 500′
149	La Salle		Emergency	800′ x 400′
	Le Harpe		Emergency	1400′ x 1400′
	Le Roy		Emergency	2000′ x 2000′
95	Lincoln		Emergency	1320′ x 1320′
59	Litchfield		Emergency	1300′ x 2000′
	Lora		Emergency	
106	Macomb		Emergency	600′ x 800′
	Malta		Emergency	1200′ x 1200′
76	Marshall		Emergency	40 acres
35	Mascoutah		Emergency	2000′ x 2000′
74	Matoon		Emergency	
156	Mendota		Emergency	1500′ x 1500′
	Meredosia		Emergency	1300′ x 600′
3	Metropolis		Emergency	
122	Monmouth		Emergency	80 acres near Country Club
97	Monticello		Emergency	1000′ x 1000′
	Montrose		Emergency	
151	Morris	Baseball Park	Emergency	800′ x 100′
	Morrisonville		Emergency	2000′ x 2000′
57	Mount Olive		Emergency	
89	Mount Sterling	Fair Grounds	Emergency	1500′ x 1500′
24	Mount Vernon		Emergency	
5	Murphysboro		Emergency	2500′ x 1600′
	New Baden		Emergency	1300′ x 1300′
	New Memphis		Emergency	1300′ x 1300′
53	Newton		Emergency	500′ x 750′
	Odin		Emergency	1320′ x 1320′
	Odon		Emergency	350′ x 200′
46	Olney		Emergency	
141	Ottawa	King	Emergency	800′ x 800′
71	Pana		Emergency	1300′ x 1300′
119	Peoria	Peoria Driving Park	Emergency	1 mi. oval

No.	City	Name of Field	Type	Remarks
	Peoria	Fair Grounds	Emergency	3960′ long
	Percy		Emergency	1500′ x 900′; Alfalfa field
	Pierron		Emergency	1500′ x 400′
18	Pinkneyville		Emergency	1500′ x 800′
128	Pontiac	Poor Farm	Emergency	1800′ x 1800′
147	Princeton		Emergency	1800′ x 1800′
	Ramsey		Emergency	2000′ x 1200′
	Robinson		Emergency	600′ x 600′
202	Rockford	Drill Grounds	Emergency	2500′ x 2500′
145	Rock Island	Framing	Emergency	
68	Rood House		Emergency	1200′ x 1200′
	Roseville		Emergency	1200′ x 1500′
	Sadorus		Emergency	300′ x 900′
	Saint Elmo		Emergency	2500′ x 1000′
	Saint Jacob		Emergency	1200′ x 600′
39	Salem		Emergency	1800′ x 1200′
	Sandoval		Emergency	3000′ x 3000′
73	Shelbyville		Emergency	1500′ x 1600′
	Shumway		Emergency	
17	Sparta	Fair Grounds	Emergency	
84	Springfield	Fair Grounds	Emergency	Mile track
38	Staunton		Emergency	
130	Streater	Country Club	Emergency	300′ x 300′; golf course
80	Sullivan	County Poor Farm	Emergency	1800′ x 1800′
	Sumner		Emergency	
	Swanwick		Emergency	
	Tallula		Emergency	2000′ x 2000′
	Tamarosa		Emergency	1000′ x 1400′
	Trenton		Emergency	1500′ x 1000′
	Troy		Emergency	
99	Urbana		Emergency	
52	Vandalia		Emergency	1300′ x 1300′
	Wagoner		Emergency	1800′ x 1800′
121	Watseka		Emergency	3500′ x 2000′
211	Waukegan		Emergency	
	Wedron		Emergency	
173	Wheaton		Emergency	40 acres; sq.
	Winchester		Emergency	900′ x 600′
	Woodlawn		Emergency	
		INDIANA (IN)		
73	Attica		Emergency	1800′ x 1250′
	Boswell		Emergency	800′ x 900′
51	Brazil		Emergency	
118	Butler		Emergency	375′ x 900′
	Effingham		Emergency	
106	Fort Wayne		Emergency	

No.	City	Name of Field	Type	Remarks
		INDIANA (IN) (Continued)		
	Fowler		Emergency	
74	Frankfort		Emergency	2000′ x 1500′
59	Indianapolis	Speedway		
	Hamilton		Emergency	
	Ireland		Emergency	1200′ x 600′
107	Knox	Scholling's Farm	Emergency	1800′ x 1800′
				3960′ x 2640′
81	Lafayette		Emergency	
95	Logansport		Emergency	450′ x 750′
7	Loogootee		Emergency	750′ x 900′
17	Mount Vernon		Emergency	
78	Muncie		Emergency	
	New Harmony		Emergency	750′ x 450′
	New Richmond		Emergency	1200′ x 3000′
5	Petersburg		Emergency	300′ x 900′
62	Richmond		Emergency	1200′ x 1200′
124	South Bend	Notre Dame University	Emergency	Meadow
	Schereville		Emergency	
38	Spencer		Emergency	
27	Sullivan		Emergency	7500′ x 1200′
42	Terre Haute		Emergency	1600′ x 800′
1	Vincennes		Emergency	
6	Washington		Emergency	
		IOWA (IA)		
40	Atlantic		Emergency	900′ x 1500′
	Blairsburg		Emergency	40 acres
	Bonaparte		Emergency	600′ x 600′
123	Charles City		Emergency	
111	Clarion City		Emergency	20 acres
54	Davenport		Permanent	Good; Oval
	Donnelson	Race Track	Emergency	
	Dow City		Emergency	
	Lowden		Emergency	
122	Mason City		Emergency	
135	Northwood		Emergency	
126	Osage		Emergency	
34	Oskaloosa		Emergency	1200′ x 900′
43	Pella		Emergency	900′ x 600′
	Rockford		Emergency	
92	Rockwell City		Emergency	20 acres
91	Sac City		Emergency	1200′ x 600′
	Shell Rock		Emergency	
90	Sioux City		Emergency	
	Stanwood		Emergency	
98	Waterloo		Emergency	

KANSAS (KS)

No.	City	Name of Field	Type	Remarks
72	Abiline		Emergency	
5	Arkansas City		Emergency	
98	Belleville		Emergency	800′ x 1500′; Oval
	Cottonwood Falls		Emergency	1300′ x 1300′
35	Dodge City		Emergency	1300′ x 1300′
58	Emporia		Emergency	
88	Fort Leavenworth		Emergency	
23	Fredonia	Fair Grounds	Emergency	
84	Goodland		Emergency	2400′ x 2400′
	Hiawatha	Race Track	Emergency	700′ x 1000′ Good, oval, inside ½ mile track
46	Iola		Emergency	1700′ x 1400′
	Kensington		Emergency	
89	Leavenworth		Emergency	2000′ x 800′
	Leavenworth		Government	
71	Lincoln		Emergency	1300′ x 1300′
51	McPherson	Darrow	Emergency	1500′ x 500′; good
96	Mankato		Emergency	2500′ x 1800′; L shaped, good
99	Marysville		Emergency	1700′ x 850′; L shaped, good
97	Norton		Emergency	1400′ x 1400′; good
76	Olathe	Polo Grounds	Emergency	
19	Parsons		Emergency	
	Phillipsburg		Emergency	1000′ x 1300′; good
	Scott City		Emergency	1000′ x 2000′
100	Seneca		Emergency	600′ x 1500′
	Smith Center		Emergency	1700′ x 1100′; good
74	Topeka		Emergency	2600′ x 1700′
	Washington		Emergency	1320′ x 1000′; good
32	Wichita	Stratford	Municipal	2400′ x 1200′; good

KENTUCKY (KY)

No.	City	Name of Field	Type	Remarks
	Corydon		Emergency	
	Georgetown		Emergency	
	Louisville		Emergency	1800′ x 400′
	Midway		Emergency	

No.	City	Name of Field	Type	Remarks
		KENTUCKY (KY) (*Continued*)		
	Morganfield		Emergency	
	Paducah		Emergency	
	West Point	Godman Field	Emergency	
	Winge		Emergency	
		LOUISIANA (LA)		
	Alexandria	Camp Beauregard	Emergency	Army Post
	Baton Rouge		Emergency	
31	Crowley		Emergency	
	Harrisonburg		Emergency	
	Kinder		Emergency	
56	Lake Providence		Emergency	
	Matchitoches		Emergency	
6	Minden		Emergency	
32	Monroe		Emergency	
79	New Orleans	Race Track	Emergency	Oval
39	Opelousas		Emergency	
2	Shreveport	Fair Grounds	Emergency	Race track
	Tallulah		Emergency	
		MAINE (ME)		
38	Augusta		Emergency	
34	Lewiston		Emergency	
82	Old Town	Bachelder's Field	Emergency	500′ x 2000′
16	Portland		Emergency	
		MARYLAND (MD)		
27	Baltimore	Pimlico Race Track	Emergency	
	Baltimore	Clifton Park	Emergency	
	Camp Meade		Emergency	
	Chase		Emergency	
	Elk Mill		Emergency	2100′ x 400′ about 75 acres
40	Havre de Grace		Emergency	
18	Laurel		Emergency	
42	Northeast		Emergency	
	Sparrows Point		Emergency	
		MASSACHUSETTS (MS)		
	Ashburnham		Emergency	
	Boston	Franklin	Emergency	
	Beverly		Emergency	
	Boxford		Emergency	
	Cambridge		Emergency	
	Deerfield		Emergency	
	Essex	Race Track	Emergency	
	Falmouth		Emergency	
	Grafton		Emergency	
	Hamilton		Emergency	
	Hudson		Emergency	
	Marlboro		Emergency	

No.	City	Name of Field	Type	Remarks
	New Bedford	Fort Redman	Emergency	Drillground; 700′ x 600′
	Northampton		Emergency	
	Newberryport		Emergency	
	Orange		Emergency	
	Pitsfield		Emergency	
	Princeton		Emergency	
	Readville	Race Track	Emergency	
	Springfield	Mollwaine	Emergency	2000′ x 2000′
	So. Framingham		Emergency	
	Upton		Emergency	
	Worcester	Race Track	Emergency	
	Weyland		Emergency	
		MICHIGAN (MI)		
11	Adrian		Emergency	
23	Albion	Finley	Emergency	250′ x 400′
	Almot		Emergency	700′ x 700′
26	Ann Arbor	University of Michigan	Emergency	1050′ x 750′
87	Bad Axe	Fair Grounds	Emergency	
21	Battle Creek	Camp Custer	Emergency	
	Battle Creek		Emergency	(1 other good field)
84	Bay City	Race Track	Emergency	
1	Buchannon		Emergency	
81	Caro		Emergency	
	Cass City		Emergency	
	Chelsea		Emergency	
	Crosswell		Emergency	
	Dearborne		Emergency	
	Decatur		Emergency	
	Delhi Mills		Emergency	
	Dexter		Emergency	
5	Dowagiac		Emergency	
70	Flint		Emergency	
	Fowler		Emergency	
	Fowlerville	Fair Grounds	Emergency	
	Glenwood		Emergency	
65	Grand Haven	Spring Lake Country Club	Emergency	
59	Grand Rapids	Grand Rapids Country Club	Emergency	
		West Mich. State Fair Grounds	Emergency	
9	Hillsdale	Fair Grounds Race Track	Emergency	½ mile track
	Imlay City	Race Track	Emergency	10 acres
24	Jackson	Sparks	Emergency	Good
53	Lansing	Golf Club	Emergency	

No.	City	Name of Field	Type	Remarks
		MICHIGAN (MI) (Continued)		
	Lansing	McPherson Farm	Emergency	
	Lansing	Mich. Agricultural College	Emergency	
	Lansing	Race Track	Emergency	
71	Lapeer	County Farm Hospital	Emergency	1500′ x 1500′
19	Lawton		Emergency	
	Manchester	Spaferdy	Emergency	825′ x 1155′
	Mayville		Emergency	660′ x 960′
83	Midland		Emergency	
	Milea		Emergency	
82	Mount Pleasant	Cemetery	Emergency	
2	Niles		Emergency	
34	Plymouth		Emergency	
	Pointe aux		Emergency	
	Barques		Emergency	
	Redwood City		Emergency	1000′ x 400′
	Saint Charles		Emergency	
	Sandusky		Emergency	
	Standish	Fair Grounds	Emergency	
	Stockbridge		Emergency	300′ x 650′
	Wayne		Emergency	
	Yale		Emergency	
27	Ypsilanti			1000′ x 1000′; L-shaped
		MINNESOTA (M)		
46	Appleton		Emergency	Good
67	Breckenridge		Emergency	Good
	Cannon Junction		Emergency	Good
	Clare City		Emergency	Good
	Crow River		Emergency	Fairly good
	Daktoa		Emergency	
	Dresbach		Emergency	
78	Duluth	Superior Country Club	Emergency	300′ x 975′; golf links
4	Fairmont		Emergency	Good
40	Fort Snelling	Parade Grounds	Emergency	1200′ x 1200′
	Golden		Emergency	
	Graceville		Emergency	
37	Hastings		Emergency	
27	Lake City		Emergency	
	Maple		Emergency	
	Mayer		Emergency	
	Maynard		Emergency	
	Milan		Emergency	
	Minnesota City		Emergency	
43	Montevideo		Emergency	
	New Germany		Emergency	

No.	City	Name of Field	Type	Remarks
	Parker		Emergency	
	Pine Creek		Emergency	
33	Red Wing		Emergency	
49	Valley		Emergency	
28	Wabasha		Emergency	
	Wacona		Emergency	Good
	Wayzata		Emergency	
	Wheaton		Emergency	Good
	White Rock		Emergency	Good
47	Willmar		Emergency	Good
18	Winona		Emergency	1200′ x 600′
	MISSISSIPPI (MP)			
	Artesia		Emergency	
	Belzoni		Emergency	300′ x 1200′
	Biloxi		Emergency	300′ x 1200′
	Canton	Race Track	Emergency	
	Charleston		Emergency	3000′ x 900′
	Como		Emergency	
	Clarksdale	Clark	Emergency	
	Granada		Emergency	
	Corinth		Emergency	
	Greenville		Emergency	
	Jackson	Davis Stock Farm	Emergency	
	Kosciusko		Emergency	
	Holly Springs		Emergency	
	Madison Station		Emergency	Good
	Meridian		Emergency	
	Newton		Emergency	
	Tupelo		Emergency	Good; 1500′ x 1200′; Marked with "T"
	Tutweiler		Emergency	
	Vicksburg		Emergency	
	Senatobia	Race Track	Emergency	
	MISSOURI (MO)			
	Bogard		Emergency	
39	Booneville		Emergency	
112	Bowling Green		Emergency	2600′ x 2600′
68	California		Emergency	1700′ x 1700′
33	Cape Girardeau		Emergency	2000′ x 600′
98	Centralia		Emergency	3000′ x 2000′
31	Chaffee		Emergency	
120	Chillicothe		Emergency	900′ x 1200′
11	Dexter		Emergency	1260′ x 1300′
90	Fayette		Emergency	800′ x 400′
57	Festus	Burgess	Emergency	2600′ x 800′
43	Flat River	Columbia Park	Oval	1800′ x 600′

No.	*City*	*Name of Field*	*Type*	*Remarks*
		MISSOURI (MO) *(Continued)*		
119	Hamilton		Emergency	1500′ x 1500′
86	Higginsville		Emergency	1600′ x 800′
84	Independence		Emergency	1300′ x 1300′
	Ironton		Emergency	
69	Jefferson City		Emergency	
	Jonesboro		Emergency	1300′ x 1300′
83	Kansas City	Overland Park	Emergency	2000′ x 1100′
83	Kansas City	Swope Park	Emergency	1500′ x 500′
	Keota		Emergency	1200′ x 600′
	Leasburg		Emergency	1500′ x 1000′
36	Lebanon		Emergency	1300′ x 1300′
88	Marshall		Emergency	850′ x 850′
9	Monett		Emergency	
	Monroe City		Emergency	45 acre square field
	New Florence		Emergency	650′ x 1000′
	New Haven		Emergency	500′ x 100′
	New London		Emergency	
110	Paris		Emergency	3960′ x 2640′
5	Poplar Bluffs		Emergency	2000′ x 600′
	Richland		Emergency	3000′ x 2600′
42	Rollo		Emergency	2500′ x 2500′
53	Saint Genevieve		Emergency	
117	Saint Joseph		Emergency	
67	Sedalia	Fair Grounds	Emergency	900′ x 900′
	Senneca		Emergency	2000′ x 1000′
30	Springfield		Emergency	
	Sturgeon		Emergency	1000′ x 1000′
	Sullivan		Emergency	
61	Washington		Emergency	
	Wentsville		Emergency	1200′ x 1200′
		MONTANA (MA)		
	Arlee		Emergency	
	Bigtimber		Emergency	Very good
	Bozeman		Emergency	
	Bridger Creek		Emergency	
	Columbus		Emergency	
	Dixon	Bison Range	Emergency	
	Drummond		Emergency	
	Elliston		Emergency	
	Garrison		Emergency	
	Glendive		Emergency	
	Helena	Fort Harrison	Government	
	Heron		Emergency	
	Kalispell		Emergency	
	Laurel		Emergency	
	Livingston		Emergency	

No.	City.	Name of Field	Type	Remarks
	Manhattan		Emergency	
	Miles City	Fort Keogh	Government	
	Mission		Emergency	
	Missoula		Emergency	1800′ x 1800′; L-shaped
	Missoula	Fort Missoula	Government	
	Missoula		Emergency	2000′ x 2000′; Good
	Paradise		Emergency	
	Park City		Emergency	
	Perma		Emergency	
	Plains		Emergency	
	Reid Point		Emergency	
	Thompson Falls		Emergency	1000′ x 1300′
	Townsend		Emergency	
	Winston		Emergency	
		NEBRASKA (NE)		
	Central City		Emergency	2000′ x 2000′
	Fort Crook	Parade Ground	Government	
61	Loup City		Emergency	2000′ x 1000′
47	Nebraska City	Schreiter's Pasture		1290′ x 800′
50	North Platte		Emergency	Excellent
	Ogallala		Emergency	Good
68	Omaha	Florence	Emergency	Balloon Field
52	Saint Paul		Emergency	3960′ x 2648′
49	Sidney		Emergency	Large, good
57	Wahoo		Emergency	
42	York		Emergency	1200′ x 1500′
		NEVADA (NA)		
	Carson City		Emergency	
	Elko		Emergency	
	Fallon	Lake Bed	Emergency	10560′ x 7920′; Good
	Lovelock		Emergency	
	Montello	Lake Bed	Emergency	
	Reno		Emergency	2000′ x 350′
	Winnemucca		Emergency	
		NEW HAMPSHIRE (NH)		
	Deming	Drill Grounds		
69	Lancaster	Halton's Meadow	Emergency	700′ x 1000′
29	Portsmouth		Emergency	
		NEW JERSEY (NJ)		
38	Asbury Park	Asbury Park Aviation	Emergency	1200′ x 600′
10	Atlantic City	Atlantic City Country Club	Emergency	
	Lakehurst	Army and Navy Balloon Base	Emergency	Building
	Pine Valley	Curtiss Flying Field	Emergency	3600′ x 4200′
44	Princeton		Emergency	

No.	City	Name of Field	Type	Remarks
		NEW MEXICO (NM)		
	Albuquerque			Flying School
	Chapelle		Emergency	
	Carlsbad		Emergency	
	Clayton		Emergency	
	Columbus		Emergency	
	Des Moines		Emergency	
	Gallup		Emergency	
	Las Vegas		Emergency	
	Deming	Drill Grounds	Emergency	
	Lordsburg		Permanent	
	Onava		Emergency	
	Optimo		Emergency	
	Santa Fe		Emergency	
	Shoemaker		Emergency	
	Tucumcari		Emergency	
	Wagon Mound		Emergency	
		NEW YORK (N = Western half of State) (Y = Eastern half of State)		
	Au Sable Forks		Emergency	
L-8	Babylon, L. I.	H. J. Damm	Emergency	
Y-37	Binghamton	De Forest Street	Emergency	1200′ x 600′
	Birdsell		Emergency	300′ x 1200′
	Brooklyn	Parade Ground	Emergency	600′ x 1800′
N-19	Buffalo	Cranberry Lake	Emergency	
	Coney Island		Emergency	
N-7	Dunkirk		Emergency	
Y-33	Glen Falls		Emergency	
Y-22	Goshen		Emergency	
Y-43	Ithaca	Thomas Morse	Emergency	1200′ x 120′
	Jay		Emergency	
	Keeseville		Emergency	
	Liberty		Emergency	700′ x 1100′
Y-76	Little Falls	Smith's Field	Emergency	700′ x 700′; Excellent
	Lowville		Emergency	
	Millerton		Emergency	1800′ x 350′
	Montauk Point		Emergency	
Y-1	New York City	Gallatin No. 1	Emergency	
Y-71	Oneida	Oneida Aviation	Emergency	300′ x 60′
	Orchard		Emergency	
N-41	Oswego		Emergency	
	Pierce Field		Emergency	
Y-97	Plattsburg	Plattsburg Barracks	Emergency	Good
	Plum Island		Emergency	
Y-19	Port Jervis	Cuddebecks	Emergency	600′ x 500′
Y-32	Poughkeepsie	Poughkeepsie Race Track	Emergency	600′ x 150′

No.	*City*	*Name of Field*	*Type*	*Remarks*
	Pulaski		Emergency	
X-34	Rochester		Municipal	1800′ x 1800′: in preparation
Y-93	Saranac Lake		Emergency	
Y-63	Schenectady		Emergency	In Preparation
	Sheepshead Bay	Motordrome	Emergency	
	Silver Creek		Emergency	
Y-55	Syracuse	Bethka	Emergency	1200′ x 400′
Y-12	Tarrytown		Emergency	
	Union		Emergency	
Y-74	Utica	Utica Aviation	Emergency	1500′ x 900′
Y-54	Waterloo	Thomas	Emergency	600′ x 600′
X-6	Westfield		Emergency	
Y-6	Yonkers	Yonkers Golf Field	Emergency	300′ x 75′
		NORTH CAROLINA (NC)		
	Fayetteville		Emergency	Large
	Goldsboro	Race Track	Emergency	150′ x 750′
			Emergency	150′ x 600′
	Greensboro		Emergency	
	Hobgood		Emergency	2400′ x 1800′
	Hoffman		Emergency	
	Pinehurst	Golf links; Race track	Emergency	
	Raleigh		Emergency	4500′ x 750′
	Weldon		Emergency	750′ x 150′
	Wilmington	Country Club	Emergency	75′ x 1350′
	Winston-Salem		Emergency	35 acres
		NORTH DAKOTA (ND)		
14	Bismarck	Reservation	Government	
11	Dickinson		Emergency	
	Eagles Nest		Emergency	
	Eldridge		Emergency	
18	Fargo		Emergency	3960′ x 3960′
	Fort Benj. Harrison		Emergency	Army Post
	Fort Lincoln		Emergency	Army Post, abandoned
13	Glen Ullin		Emergency	
28	Grand Forks		Emergency	2000′ x 3000′
	Hobart		Emergency	
15	Jamestown		Emergency	
	Judson		Emergency	
8	Mandan		Emergency	
	Sedalia		Emergency	
	Sims		Emergency	
	Sunny		Emergency	
	Sweet Briar		Emergency	
16	Valley City		Emergency	

No.	City	Name of Field	Type	Remarks
		OHIO (O)		
126	Akron	Portage Country Club	Emergency	
142	Bowling Green		Emergency	
	Cedar Point		Emergency	
1	Cincinnati	Phoenix Country Club	Emergency	
		Hamilton Country Club	Emergency	
127	Cleveland	Cleveland Aero Club	Emergency	
49	Columbus		Emergency	
66	Coshocton		Emergency	1200′ x 1800′
89	Lima		Emergency	450′ x 1500′
101	Mansfield		Emergency	1400′ x 800′
	Minerva		Emergency	1800′ x 1800′
58	Newark		Emergency	1400′ x 1400′
	New London		Emergency	2100′ x 1500′
63	Piqua		Emergency	
154	Sandusky		Emergency	
168	Toledo	Bay View Yacht Club	Emergency	1200′ x 1500′
		OKLAHOMA (OK)		
	Ada	Norr's Meadow	Emergency	300′ x 1000′
	Ardmore		Emergency	100 acres
	Atoka		Emergency	
	Blackwell	Race Track	Emergency	450′ x 1350′
	Blanchard	Davis Field	Emergency	1000′ x 500′
	Bristow		Emergency	
	Chandler	Rifle Range	Emergency	1800′ x 750′
	Chattanooga		Emergency	
	Cheyenne		Emergency	600′ x 1200′
	Chickasha		Emergency	
	Clarimore		Emergency	½ mile track
	Cleveland		Emergency	1200′ x 200′
	Clinton		Emergency	700′ x 250′
	Cordell	Moslander	Emergency	½ mile x ¼ mile
	Cranfield		Emergency	
	Cushing		Emergency	
	Devol		Emergency	
	Drumright	Cook's Aviation	Emergency	900′ x 300′
	Duncan		Emergency	
	Durant		Emergency	
	Elk City	Race Track		½ mile
	Enid	Dargue		175 yds. sq.
			Emergency	800′ x 1000′
	Fairview	Race Track	Emergency	450′ x 1350′
	Fredrick		Emergency	
	Guthrie	Curtis Farm	Emergency	32 acres
	Hartshorne		Emergency	1000′ x 600′
	Hennessy		Emergency	600′ x 900′

No.	*City*	*Name of Field*	*Type*	*Remarks*
	Henryetta	West Henryetta Field	Emergency	80 acres 2640′ x 1320′
	Hobart	Raymond Goodson Landing	Emergency	4000′ x 600′
	Holdenville	Race Track	Emergency	1320′ x 1320′
	Hugo		Emergency	
	Kingfisher		Emergency	225′ x 900′
	Lexington		Emergency	
	McAlester	Fair Ground	Emergency	
	McLoud	McCray	Emergency	600′ x 100′
	Macomb		Emergency	1200′ x 1200′
	Mangum	Boggs	Emergency	300′ x 600′
	Marlow		Emergency	
	Mountain Park		Emergency	950′ x 225′
	Muskogee	Fair Grounds	Emergency	1800′ x 800′
	Newkirk	Ward's Pasture	Emergency	160 acres
	Norman	Smith Pasture	Emergency	2500′ x 1500′
	Nowata		Emergency	
	Oklahoma City	Aviation Field	Emergency	1200′ x 450′
		Westwood	Emergency	1000′ x 1500′
	Okmulgee	Russell	Emergency	Good
	Pauls Valley		Emergency	100 Acres
	Pawnee		Emergency	600′ x 600′
	Ponca City	Ball Park		1200′ x 1200′
	Prague		Emergency	
	Purcell		Emergency	50 acres
	Repley		Emergency	800′ x 300′
	Sapulpa		Emergency	
	Shawnee		Emergency	750′ x 1320′
	Shawnee	Santa Fe	Emergency	180 acres
	Stillwater	College	Emergency	1200′ x 1500′
	Stroud		Emergency	
	Tishomingo	Fair Grounds	Emergency	400′ x 1000′: race track
	Tulsa	Curtiss S. W. Airplane Co.	Commercial	1800′ x 2300′
	Vinita		Emergency	1800′ long
	Walter		Emergency	2400′ x 1800′
	Watonga		Emergency	
	Waurika		Emergency	
	Wayonka		Emergency	300′ x 150′
	Woodward		Emergency	1000′ x 300′
		OREGON (ORE)		
	Albany	Seth T. French	Emergency	1400′ x 1400′
	Ashland		Emergency	
	Arlington		Emergency	800′ x 1800′
	Columbia River (Mouth of)	Naval Air Sta.	Government	Projected

No.	City	Name of Field	Type	Remarks
		OREGON (ORE) (Continued)		
	Cottage Grove		Emergency	
	Dallas	Laereole Landing	Emergency	450′ x 890′
	Corvallis		Emergency	
	Eugene	Eugene Landing	Emergency	1500′ x 2000′; Good
	Grant's Pass	Grant's Pass Aviation	Emergency	660′ x 2640′
	Grenada		Emergency	
	Imbeler		Emergency	2600′ x 2500′
	Medford		Emergency	
	Penleton		Emergency	600′ x 2000′
	Portland	Eastmoreland	Emergency	1500′ x 200′
	Roseburg		Emergency	
	Salem		Emergency	
	The Dalles		Emergency	800′ x 1500′
		PENNSYLVANIA (P)		
58	Altoona	Driving Park and Fair Grounds	Emergency	Half-mile track
37	Chester		Emergency	
141	Clearfield	Race Track	Emergency	One-half mile
142	Du Bois	Beaver Meadows	Emergency	450′ x 1200′
125	Easton		Emergency	1800′ x 800′
	Everett		Emergency	2000′ x 1000′
29	Gettysburg		Emergency	
53	Harrisburg		Emergency	
83	Johnstown		Emergency	2000′ x 2000′
57	Huntingdon		Emergency	
50	Lebanon		Emergency	1200′ x 1200′
56	Lewistown	Race Track	Emergency	
	Ligonier		Emergency	
51	Middletown		Government	
	Milford		Emergency	
	Mount Union		Emergency	2100′ x 600′
	Penllyn	Penllyn Polo	Emergency	300′ x 1200′
40	Philadelphia	Speedway Flying	Emergency	1000′ x 300′
	Philadelphia		Government	
11	Pittsburgh		Emergency	Golf Course
49	Reading		Emergency	1500′ x 1500′
	Rodring Springs		Emergency	1200′ x 900′
	Scranton	Clark's Summit	Municipal	
130	Stroudsburg		Emergency	
20	Uniontown	Race Track	Emergency	One mile
163	WilkesBarre	Suburban Park	Emergency	
		RHODE ISLAND (RI)		
16	Apponaug		Emergency	Good
	Bradford		Emergency	
	Collingwood	Race Track	Emergency	
12	East Greenwich		Emergency	

No.	City	Name of Field	Type	Remarks
2	Narragansett Bay	Naval Air Station	Government	Projected
7	Newport	Polo Club	Emergency	
27	Providence	Race Track	Emergency	Good
	Shannock		Emergency	
	Slocum		Emergency	
	Weed River Junction		Emergency	
42	Woonsocket	Race Track	Emergency	300′ x 1200′

SOUTH CAROLINA (SC)

No.	City	Name of Field	Type	Remarks
	Aiken	Race Track	Emergency	One mile
	Sumter		Emergency	
	Bamberg		Emergency	
	Tillman		Emergency	
	Bennettsville	Bennettsville Flying	Emergency	1800′ x 525′; L-shaped
	Camden		Emergency	
	Camp Jackson	Emerson	Government	
	Charleston	Charleston Country Club	Emergency	Golf Club
	Charleston	Naval Air Station	Government	Projected
	Chesterfield		Emergency	
	Columbia		Emergency	
	Charleston	Hampton Park	Emergency	

SOUTH DAKOTA (SD)

No.	City	Name of Field	Type	Remarks
54	Aberdeen		Emergency	
46	Redfield		Emergency	400′ x 500′
24	Sioux Falls	Lyons	Emergency	500′ x 1000′

PHILIPPINE ISLANDS (PI)

No.	City	Name of Field	Type	Remarks
	Cavite	Naval Air Station	Government	Projected
	Camp Stotsch-berg		Government	
	Fort Mills		Government	
	Paranque		Government	

TENNESSEE (TN)

No.	City	Name of Field	Type	Remarks
	Alexandria		Emergency	1000 x 5500′
	Chattanooga		Emergency	
	Davis		Emergency	
	Fayetteville		Emergency	107 acres
	Huntington		Emergency	1500′ x 3000′
	Huntington		Emergency	1200′ x 1000′
	Jackson		Emergency	2000′ x 2000′
	Knoxville	Cherokee Country Club	Emergency	Half-mile track
	Knoxville	Race Track	Emergency	½ mile
	Lexington		Emergency	
	Memphis	No. Memphis Driving Park	Emergency	1 mile Race Track; Good
	Nashville	Old Country Club	Emergency	1000′ x 2000′

No.	City	Name of Field	Type	Remarks
		TENNESSEE (TN) (*Continued*)		
	Nashville	E. L. Hampton	Emergency	2000′ x 4000′
	Nashville	Reedy	Emergency	82 acres (Mr. Bush)
	Somerville		Emergency	1000′ x 3000′
	Sugar Tree		Emergency	
	Union City	Race Track	Emergency	1050′ x 225′
	Woodbury		Emergency	500′ x 2000′
		TEXAS (TX)		
	Abott		Emergency	
	Alpine		Emergency	Very good; quadrant shaped
	Austin	Penn	Emergency	
	Barstow		Emergency	Fairly good
	Beaumont		Emergency	500′ x 900′; ½ mile west of the heart of city
	Beeville		Emergency	Exceptionally fine field
	Belcherville		Emergency	Very smooth
	Benchley		Emergency	
	Big Springs		Emergency	Marked by white circle
	Bonhan		Emergency	
	Bowie		Emergency	
	Brownwood		Emergency	
	Bryan	College Station	Emergency	1000′ x 1500′
	Cactus		Emergency	L-shaped
	Cameron		Emergency	3000′ x 8000′
	Canadian		Emergency	
	Childress	Race Track	Emergency	
	Chillicothe		Emergency	Excellent
	Cisco		Emergency	
	Clarendon		Emergency	
	Corpus Christie	Ft. Scully	Emergency	
	Cotulla		Emergency	
	Crowell		Emergency	
	Cuero		Emergency	
	Danbury		Emergency	
	Dectur		Emergency	
	Del Rio		Emergency	
	Denison		Emergency	Field marked with a pile of white washed rocks
	Desdemona	S. E. Davis' Farm	Emergency	1200 yds. sq

No.	*City*	*Name of Field*	*Type*	*Remarks*
	Eagle Lake		Emergency	
	Electra		Emergency	
	El Paso	Ft. Bliss Parade Ground	Emergency	
	Fairbanks		Emergency	
	Flatonia		Emergency	
	Ft. Clark	Parade Ground	Emergency	
	Ft. Stockton	Drill and Parade Ground	Emergency	
	Fredericksburg		Emergency	
	Gainsville		Emergency	Rectangular
	Galveston	Ft. Crockett Parade Grounds	Emergency	
	Giddings		Emergency	
	Haskell		Emergency	Good
	Hempstead		Emergency	Very good
	Henrietta		Emergency	
	Hollis		Emergency	
	Hondo		Emergency	1200′ x 800′; Very good
	Hot Wells		Emergency	
	Huntsville		Emergency	4000′ x 1000′
	Iowa Park		Emergency	
	Jolly		Emergency	
	Katy		Emergency	
	Laredo		Emergency	
	Leaque City		Emergency	
	Lexington		Emergency	
	Liberty		Emergency	1500′ x 600′
	Lubbock		Emergency	
	McKinney		Emergency	
	Marathon		Emergency	
	Marfa		Emergency	
	Marlin		Emergency	
	Marshall		Emergency	
	Momard		Emergency	1200′ x 500′
	Memphis		Emergency	Cotton Patch
	Midland		Emergency	
	Milford		Emergency	Marked
	Mineola		Emergency	
	Moulton		Emergency	Excellent pasture
	New Boston		Emergency	Very excellent
	Newcastle		Emergency	
	Nocona		Emergency	
	Odessa		Emergency	
	Ozona		Emergency	Excellent; 2000′ x 1500′
	Palestine		Emergency	450′ x 4000′; Rectangular

No.	City	Name of Field	Type	Remarks
		TEXAS (TX) (*Continued*)		
	Paris		Emergency	
	Pearland		Emergency	
	Pecass-2		Emergency	
	Port Arthur	Naval Air Station	Emergency	Navy Balloon Fld.
	Quannah		Emergency	
	Ringold		Emergency	
	St. Joe		Emergency	
	Saltillo		Emergency	
	San Angelo	Penrose B. Metcalfe	Emergency	2500′ x 2500′
	San Antonio	Brooks	Government	Army Balloon Fld.
	San Marcos		Emergency	
	Seymour		Emergency	
	Sherman		Emergency	
	Shumld		Emergency	
	Sierra Blanca		Emergency	Unlimited space
	South Houston	San Leon	Emergency	Near Ellington Fld.
	Spoffard		Emergency	Very good
	Stanford		Emergency	
	Stanton		Emergency	Excellent
	Sulphur Springs		Emergency	200 acres
	Sweetwater		Emergency	320 Acres; Rectangular in shape
	Temple		Emergency	
	Texarkana	Country Club	Emergency	50 acres
	Texarkana		Emergency	75 acres
	Texline		Emergency	
	Thorndale		Emergency	
	Toyah		Emergency	
	Tyler		Emergency	½ mile track
	Uvalie		Emergency	1000′ long; L-shaped
	Van Horne		Emergency	
	Vernon		Emergency	
	Victoria		Emergency	2500′ x 2500′
	Washburn		Emergency	Large
	Waxahachie		Emergency	
	Wellington		Emergency	
	Wharton		Emergency	
	Whitesboro		Emergency	
		UTAH (U)		
U-46	Salt Lake City		Emergency	
U-52	Ogden		Emergency	
U-64	Salduro		Emergency	
2	Bennington		Emergency	

No.	City	Name of Field	Type	Remarks
		VERMONT (VT)		
2	Bennington		Emergency	
52	Montpelier	Race Track	Emergency	
17	Windsor		Emergency	1800′ x 400′; Marked "T"
		VIRGINIA (VA)		
	Blacksburg		Emergency	1600′ x 700′
4	Franklin		Emergency	Very good: 200 x 300 yds.
8	Lawrenceville		Emergency	
37	Lynchburg	Y. M. C. A. Island	Emergency	700′ x 150′
22	Norfolk	Parade Grounds	Emergency	
	Oldfield		Emergency	
29	Petersburg		Emergency	1880′ x 800′; Triangle
41	Richmond	Fair Grounds	Emergency	At Fulton, suburb of Richmond: 2 miles by ½ mile
	Riverton		Emergency	
	Sandy Point		Emergency	
10	Suffolk		Emergency	Good
	Urbana		Emergency	Good; 250 x 450 yd.
39	Williamsburg		Emergency	Good; 1800′ x 500′
	Yorktown	Naval Air Station	Government	Naval Balloon Fld.
		WISCONSIN (W)		
	Barnum		Emergency	
	Bay City		Emergency	Good cross country fld.
27	Boscobel		Emergency	
	Byrds Creek		Emergency	
	Cochrane		Emergency	Fairly good
	Cross Plains		Emergency	Good
	De Sota		Emergency	
	Diamond Bluff		Emergency	
	Ferryville		Emergency	
	Hager City		Emergency	Good cross country field
	Johnson Creek		Emergency	Good
29	Lakemills		Emergency	
	Lone Rock		Emergency	Good
28	Madison		Emergency	
	Madden Rock		Emergency	Good
	Mazamanie		Emergency	Fairly good
33	Milwaukee	Milwaukee Country Club	Emergency	Fair

No.	*City*	*Name of Field*	*Type*	*Remarks*
		WISCONSIN (W) *(Continued)*		
	Milwaukee	Milwaukee Air Port	Emergency	Excellent
	North Cross		Emergency	
31	Oconomowoc		Emergency	Good
	Pepin		Emergency	Excellent
	Purdy		Emergency	Fairly good
	Quincy		Emergency	Good
	Spring Green		Emergency	Excellent
	Stockholm		Emergency	Good
22	Waukesha		Emergency	Large fld. east of city
	Waukesha		Emergency	Large L-shaped one mile west of city; excellent
		WASHINGTON (WSH)		
	Bellingham	Municipal Golf Links	Emergency	
	Chehalis		Emergency	Good 2000′ x 2000′
	Ellensburg		Emergency	Good 1500′ x 1800′
	Greenacres		Emergency	Good
	Irvin		Emergency	Good
	Millwood		Emergency	Good
	Opportunity		Emergency	Good
	Parkwater		Emergency	Good
	Pasco		Emergency	1500′ x 4000′
	Ritzville		Emergency	1000′ x 2000′
	Seattle	Municipal Golf Links	Emergency	250′ x 2500
	Tacoma	Speedway	Emergency	Oval enclosed by 7 mile track
	Walla Walla		Emergency	4000 x 3000′
	Yakima		Emergency	2000′ x 2500′
		WYOMING (WY)		
	Cheyenne	Ft. D. A. Russell	Government	600 yds. x 700 yds.
	Green River		Emergency	
	Rawlins		Emergency	
		MEXICO (MX)		
	Tampico	Salinas Caraco Oil Fld.	Emergency	2¾ miles by 8 miles; south of Tampico; fairly good
	Vera Cruz		Emergency	

XV
AIRCRAFT INSURANCE

Through the failure of the United States Government to formulate a definite policy with regard to aeronautical development, the establishment of landing fields, the inspection of aircraft, and the licensing of pilots, the writing of aircraft insurance in this country has been very seriously embarrassed.

At the present the following kinds of insurance are written:

Fire (Floater form);

Collision (Meaning damage to plane);

Liability (Meaning injury to individuals other than passengers);

Property Damage (Meaning damage to property other than the plane);

Life and Accident Insurance for passengers in aircraft, covering specific flights.

The above forms of insurance are written by two classes of companies; one group known as casualty companies and the other as fire companies. There are seven American companies in the so-called fire group writing various forms of aviation insurance, and two in the casualty group. One of the casualty companies is in position to write what is called full coverage, covering fire, collision, property damage and public liability, also accident and life insurance.

Writers of aircraft insurance are of the opinion that a fair system of rates and an adequate extension of insurance protection can not be brought about until the Federal Government accepts the responsibility with which it is confronted by proper supervision of pilots, establishment of adequate landing fields, elimination of stunt flying for exhibition purposes, and concentration of aeronautical activities under one department of the Government in Washington.

THE END