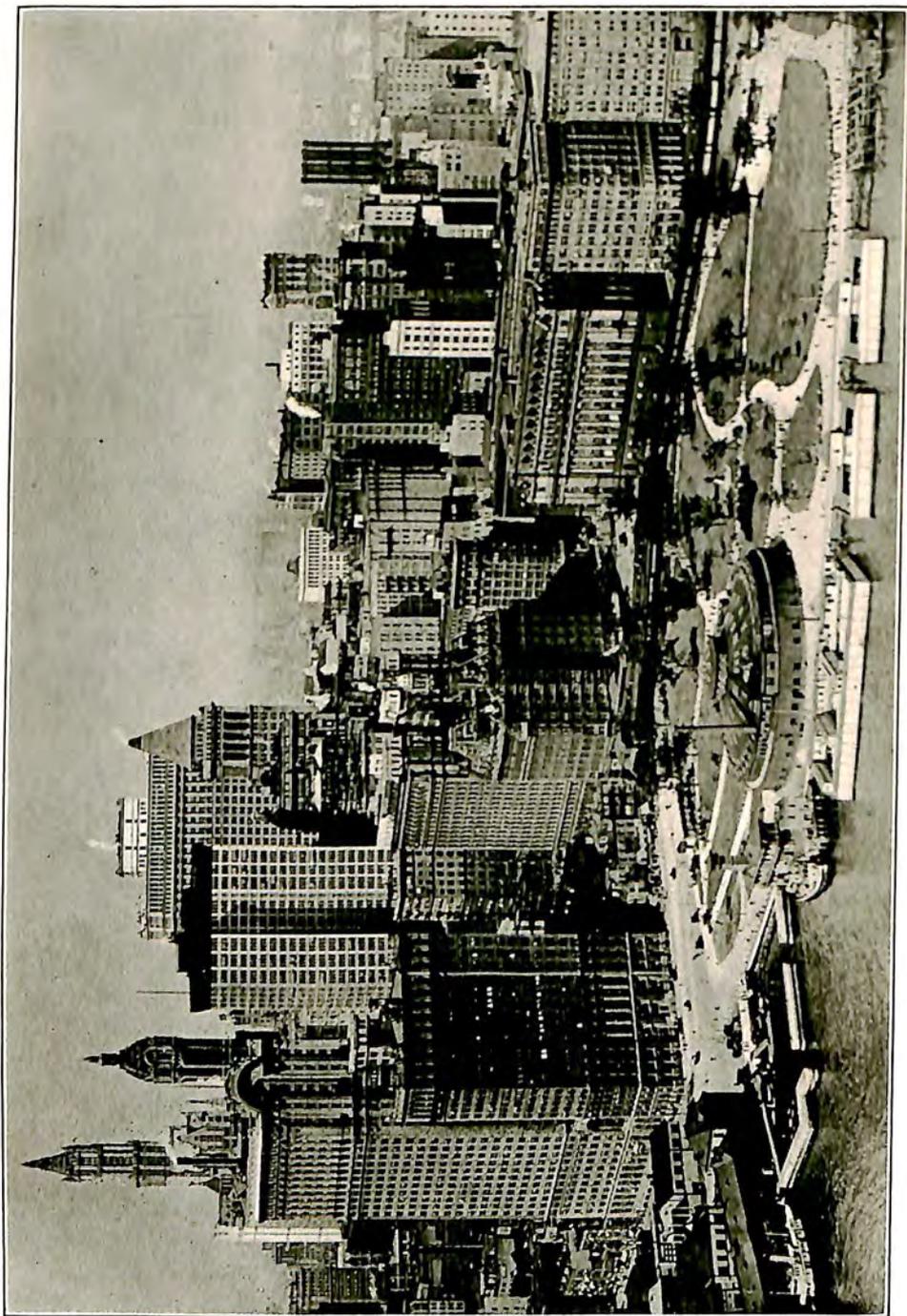


The
AIRCRAFT
YEAR BOOK

For 1921

AIRCRAFT YEAR BOOK, 1921



BATTERY PARK, NEW YORK.—This photo by U. S. Air Service is declared to be the most remarkable aerial ever taken.

AIRCRAFT YEAR BOOK



1921



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INTRODUCTION

In presenting the Aircraft Year Book for 1921, the third of the series, the editors and publishers wish to acknowledge the help provided by the various Governmental services having to do with aeronautics.

It is desired particularly to express appreciation for the assistance given by Major H. M. Hickam, Chief of the Information Group, U. S. Air Service; Lieut. Commander R. E. Byrd of the Naval Aviation; the Flying Section of the Marine Corps; officials in charge of the Air Mail; the National Advisory Committee for Aeronautics; the Forestry Service, the Coast and Geodetic Survey, the Weather Bureau, the Bureau of Fisheries, the Bureau of Standards and the Bureau of Foreign and Domestic Commerce. Chapter XIII, which deals with the technical development of aircraft, was contributed in its entirety by Commander J. C. Hunsaker, of the Bureau of Construction and Repair, U. S. Navy, who is recognized as an authority on aeronautical design.

MANUFACTURERS AIRCRAFT ASSOCIATION, INC.

New York City, January 1st, 1921.

AIRCRAFT YEAR BOOK

CHAPTER I

THE COMMERCIAL AIRPLANE TRIES ITS WINGS; NOTABLE ACHIEVEMENTS OF THE YEAR; AMERICAN AERONAUTICS ENCOUNTERS OBSTACLES; MORE THAN 15,000,000 MILES FLOWN IN THE UNITED STATES

THE year 1920 will stand unique in the history of aeronautics, particularly in the United States. In 1919 there was the acute stimulus of popular curiosity in one of the mysterious elements which won the war. But in 1920 came the readjustment and consequently the necessity for flying to demonstrate its usefulness in peace.

If established business experienced difficulty in shifting from extraordinary activity to normal levels, what a task, then, for aeronautics, peculiarly developed as a military adjunct, to challenge the age-long beliefs of time and space, and to share with the older forms of transportation the honor of greatly reducing the one and minimizing the other!

In examining the record of the last twelve months, one is impressed with the brilliant promise and the sober want. Great things have been accomplished — great first flights by the Wright Brothers were made only seventeen years ago. But whatever has been achieved has been due rather more to individual vision and courage than to general support.

This was particularly true of our own country, where the art had its birth. Here possibly the greatest opportunities were presented; and here, too, the severest handicaps were encountered. Yet in defiance of obstacles and discouragements, American aeronautics during 1920 proved itself worthy of a more liberal acceptance as a commercial factor and as a necessary element in the national defense.

If spectacular flights, such as the crossing of the Atlantic by airplane and airship, were recorded in 1919, to 1920 were reserved certain achievements which, if not so likely to astonish, were more certain to advance the art.

INTERNATIONAL PROGRESS IN AERONAUTICS

The great nations of the earth, with more or less fixedness of purpose, endeavored to progress along lines aeronautical. Belgium,

Italy, France and Great Britain quickly enacted codes based upon the International Aerial Convention, laid out aerial routes and took such other steps as seemed wise in order to develop civil transport in the air as a measure of future safety, and economic growth. And to each came very definite honors. Thus Belgium won the international balloon race and France the international airplane race for the Gordon Bennett trophies. Italy successfully completed the 10,000-mile flight from Rome to Tokio and England opened and traversed the aerial highway spanning Africa from Cairo 5,000 miles to the Cape.

In actual accomplishment it would appear at first that the United States led the world. An American excelled the altitude record made by another American in 1919 by reaching the stupendous height of 33,114 feet. The famous N.C.-4, first to fly across the Atlantic, made an 8,000-mile flight around the Atlantic and Gulf coasts and up the Mississippi river. Four Air Service planes "blazed" a new trail through the uncharted Northwest, flying 9,000 miles from New York to Nome, Alaska, and return. A squadron of F.-5-L's accompanied the Atlantic fleet on a 13,000-mile cruise through the West Indies and withstood hardships of wind and water better than many of the surface craft. In the Pulitzer race, on Thanksgiving day, the planes taking first and second places, both American designed and built and powered with American designed and built engines, set new speed records.

And, finally, at Le Mans, France, there was unveiled a monument to the memory of Wilbur and Orville Wright — a testimonial to the Americans whose patient, practical experimentation on the sand hills of Kitty Hawk, N. C., showed man how to fly and thus made all these things possible.

Within the United States and insular possessions it is estimated that 15,250,000 miles were flown during 1920, divided as follows:

Army Air Service	6,250,000
Naval Aviation	1,500,000
Aerial Mail	1,500,000
Civilian	6,000,000

It is believed that approximately 225,000 passengers were carried by the civilian machines, in addition to many tons of freight. The year witnessed the establishment of pioneer transport lines, hopeful that Congress would shortly enact an aerial code, making easier credits and more satisfactory insurance rates possible and provide otherwise for the encouragement of the art.

HANDICAPS EXPERIENCED IN AMERICA

But the true picture of the year can not be painted wholly in brilliant colors. There was a gloomier aspect which was due partly to the fact that commercial flying was new and in many respects untried and partly to the fact that the national consciousness, reacting from the war, was inclined to forget all arms and to be more or less indifferent to the early struggles of an art which, although it captivated the fancy, did not — could not — add forthwith to the wealth of the world. And in this situation some saw a reflection of the state of mind which first ridiculed, then doubted, then enthusiastically utilized the steamboat and the railroad.

National neglect was manifest, on the one hand, in the depleted aeronautical establishments of the Army and Navy and the shrunken industry, to which the national defense must look for men and matériel. On the surface it would appear that the government activities have covered the entire field and in a sense they have, but there is now apparent an increasing tendency to believe that greater progress will obtain if there is worked out some proper organization to centralize many of these activities and to specialize in the development of civil and commercial aeronautics. By actual count, at the close of 1920, there were twenty-one official or semi-official services, bureaus or agencies dealing with the art, each faithfully endeavoring to be of assistance. These activities are:

U. S. Army Air Service.....	Organizes and maintains air forces for the military establishment.
U. S. Navy.....	Aviation activities, scattered among various departmental bureaus, carried on for naval establishment.
U. S. Marine Corps.....	Organizes and maintains aviation units for expeditionary service.
The Aeronautical Board.....	Organized to co-ordinate Army and Navy aeronautics.
The Helium Board.....	Organized to facilitate gas development by Army, Navy and Bureau of Mines.
National Advisory Committee for Aeronautics.....	Conducts scientific investigations.
U. S. Post Office Department.....	Maintains flying corps for carriage of mails.
Forestry Service.....	Maintains Aerial Forest Patrol, in cooperation with U. S. Air Service.
Forest Products Laboratory.....	Carries on scientific research.
Bureau of Entomology.....	Utilizes aircraft in scientific crop work.
Weather Bureau.....	Carries on aerological work.
Bureau of Mines.....	Develops helium and utilizes aircraft in mine rescue work.
Coast Guard.....	Maintains flying corps for life and property saving at sea and for transportation.

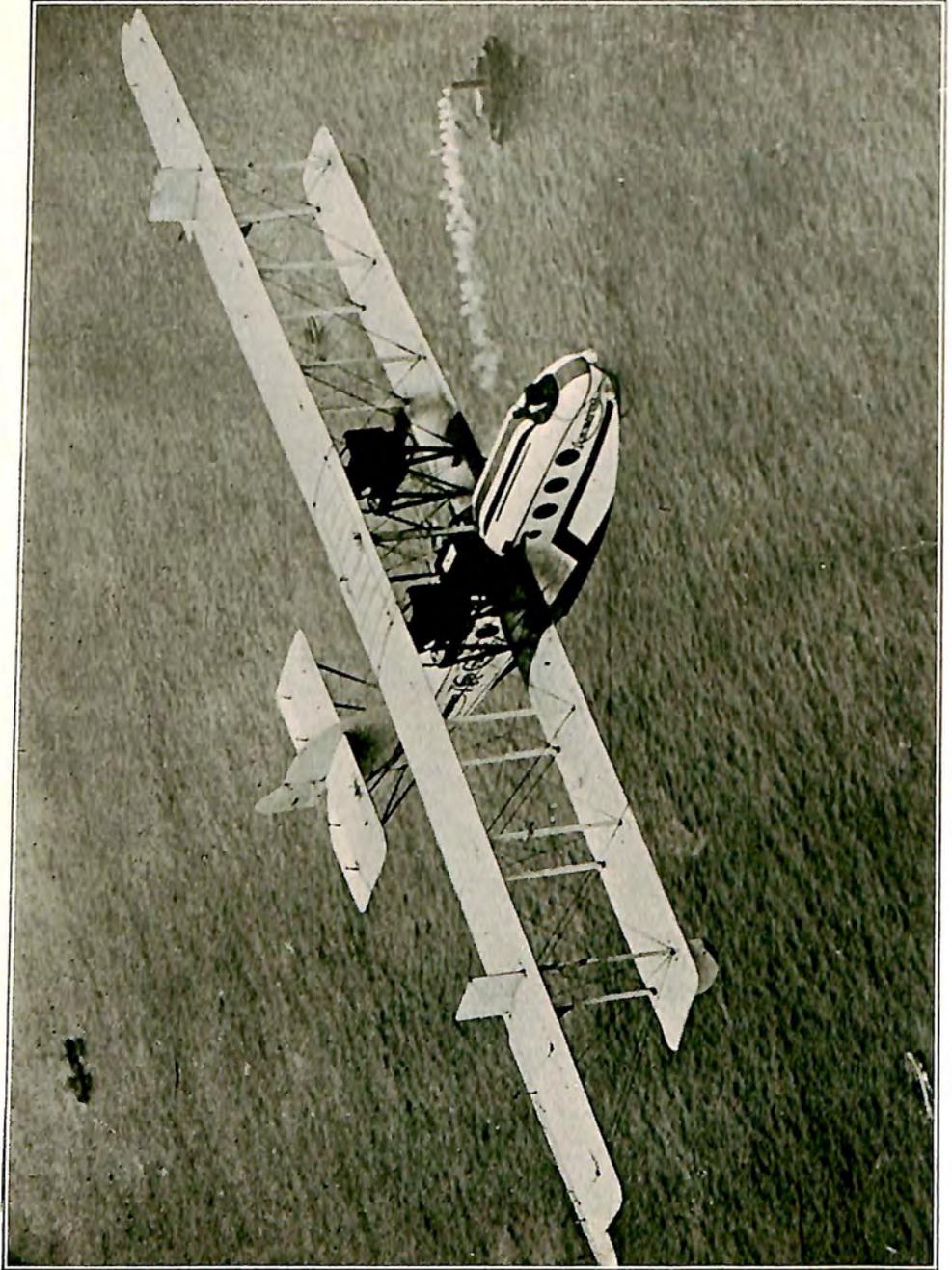
Public Health Service.....	Controls clearance from and entrance into U. S. ports of aircraft.
Coast and Geodetic Survey.....	Utilizes aircraft in correcting existing charts and making new maps.
Bureau of Fisheries.....	Developing utilization of aircraft in fish-spotting.
Bureau of Foreign and Domestic Commerce	Gathers aeronautical information abroad.
Bureau of Standards.....	Conducts aerodynamical research work.
Sub-Committee on Commercial Aviation of Economic Liaison Committee on Foreign Trade.....	Designed to co-ordinate aeronautical contact among State, War, Navy, Commerce, Post Office and other departments.
Board of Surveys and Maps.....	Promotes use of aircraft in mapping.
Interdepartmental Committee on Meteorology	Designed to prevent duplication of meteorological work by Army, Navy and Weather Bureau.

In gathering data for this Year Book the editors have been impressed with what is really a remarkable record. And it is all the more notable because of the lack of a clearly defined national policy and programme. Those whose privilege it is to aid in the development of an art which promises so much encouragement in man's constant effort to eliminate space and secure dominion over inertia, not unnaturally have ever in mind the prospect of what can be accomplished with handicaps removed.

Therefore the following chapters are written with a two-fold purpose: First, to portray truthfully what has been done, and Second, to indicate how best we may advance.



General View of Yosemite Valley. Photograph from Curtiss-Standard, first airplane to penetrate National Park.—Photo, Earl P. Cooper, Airplane and Motor Company.



Aeromarine West Indies Airways Passenger Mail Boat Between Key West and Havana, Cuba

CHAPTER II

AERIAL TRANSPORT; ONE THOUSAND AIRCRAFT PUT TO BUSINESS USES; LINES ESTABLISHED OVER THE WATER; LAND PLANES MEET NEED WHERE RAIL AND ROAD TRANSPORTATION IS INADEQUATE

ALL aeronautical activity, in the last analysis, is aerial transport, for aircraft, to be useful in commerce, must carry either people or matériel. Regarded thus, aerial transport includes, not only the transportation of passengers, but all the peacetime activities to which aircraft may be put. Among these are the Aerial Mail of two and one-half years' successful operation; the Aerial Forest Patrol, which is credited with saving a larger amount in standing timber than was appropriated for the entire Air Service; the employment of planes in newspaper, motion picture and advertising work; aerial photography in its many ramifications; map making and surveying; exploration; timber cruising; fish spotting and the saving of life and property at sea.

That part of aerial transport, which has for its chief aim the fulfillment of transportation demands not met by the railroad train or the steamship, is destined within the next few years to be the most important feature of aeronautics. Therefore it is given precedence in the present volume, although it has scarcely had time as yet to be established.

ONE THOUSAND COMMERCIAL AIRCRAFT

In the absence of any Federal system of registration it is extremely difficult to estimate closely the number of commercial aircraft in operation in the United States and Canada. It is believed that there are about one thousand, this approximate number being fixed through manufacturers' reports and data gathered by the Air Service.

The Manufacturers Aircraft Association prepared and distributed a questionnaire in an effort to obtain information from the operators of commercial planes. But due to the itinerant nature of much of the flying it has been impossible to trace and record the activities of more than one-half of the estimated number. Accepting the returns

to these questionnaires as typical, generalizations for the entire one thousand have been arrived at.

The accompanying table gives what is believed to be a fair sectional picture. It shows eighty-seven companies or individuals, of permanent location, engaged in commercial aerial transport. These are scattered all over the United States and Canada and, as far as can be learned, they operate from 365 to 425 machines of varying capacity and of both land and water types. All have terminal facilities of some sort and many possess well-equipped air ports. Still others operate from fields obtained through the interest and courtesy of municipal authorities.

By far the greater mileage was recorded in short demonstration flights of from 10 to 15 minutes, for which an average fee of \$12.50 was charged. There was an increasing demand for transportation between cities and toward the close of the year considerable flying of this nature was being done, the average charge for such service being 65 cents a mile.

On practically all inter-city flights, baggage or freight was carried, the quantity limited only by the capacity of the craft, reports showing an aggregate of 41,390 pounds.

During the flying season, which varied according to the region, these eighty-seven organizations carried 115,163 passengers and flew a total of 3,136,550 miles.

Accidents there were, and forced landings, but, according to the signed reports, in all the 3,000,000 miles flown, not a single person lost his life. Altogether, there were 222 forced landings and 88 accidents without fatalities. There have been fatal accidents in other instances, but so far as records show, most — if not actually all — of them happened in the course of stunt or exhibition performances, or under circumstances indicating that undue risk had been taken. It should be emphasized that, in the commercial business reported, not a fatal accident occurred, a fact in itself indicative of the comparative safety of travel through the air.

THE GYPSY FLYERS

Before proceeding further with the analysis it is well to review the progress of aerial transport in its application to the ordinary course of business. The first spring after the signing of the Armistice, thousands who had been engaged in military aeronautics, either in operation or production, turned to commerce. There was the airplane — new, mysterious — for the sight of which hundreds of thousands were eager. The first pilots to be released from the service were quick to take advantage of this popular curiosity. And so there sprang into full-fledged being, a new race — the gypsy

flyers. Equipped, for the most part, with Army or Navy training planes, they flew from point to point, picking up a gradually increasing trade, some of them realizing considerable profit. At first they operated from cow pasture to town lot and then, when local interest abated, flew on to other communities. Some of these men, more ambitious than cautious, came to grief — and carried others with them — leaving behind fear and misunderstanding. Many, however, leased or purchased terminals, and some assumed incorporate responsibility, and thus established themselves as pioneers. It is to them that the art owes much.

In the late winter of 1918 it was a distinction to have had a close-up view of an airplane. By the summer of 1919 a few hundreds of civilians, here and there, had experienced the sensation of flying. At the close of 1920, these hundreds had multiplied into thousands, many of whom flew no longer for "thrill," but for business or the sheer pleasure of dominion which powerful motion and exalted height alone can give. But gypsy flying continues and will continue so long as there are fairs or small-town expositions to attract curious folk from remote districts and consequently provide business for the alert and wandering pilot.

This accounts for the inability to trace all commercial activity and is the basis for estimating that, during 1920, the one thousand machines believed to be in actual use, carried some 225,000 passengers and flew about 6,000,000 miles.

PROOF OF FLIGHT IN THE TRANSITION PERIOD

The transition period between itinerant and permanent flying has been particularly interesting, inasmuch as one experiment has led naturally to another and both have combined to produce further activity along practical lines. Thus the gratification of pleasure instincts through the patronage of "joy rides" or "excursions" has led to the establishment of aerial transport lines with increasing patronage between cities. And the ever-present desire of modern business for advertising has afforded opportunity for aircraft to demonstrate also their package or freight-carrying capabilities.

Typical instances of the former are the success of the Aeromarine Sightseeing and Navigation Co.; the Aeromarine-West Indies Airways, Inc.; the America Trans-Oceanic Co.; and Aero Limited, all on the Atlantic coast, and the Mercury Aviation Co., of Los Angeles.

The most convincing demonstrations of aerial utility were made either in sparsely settled regions where rail or road transportation was inadequate, or in more congested areas where the pressure of demand offset the sharp competition of established modes of convey-

ance. The experiences of the three big Atlantic coast companies, dealt with more fully later on, indicate the excellent opportunities for aircraft in centers of population. In the middle west, southwest and Pacific regions specific examples also may be cited.

On one occasion, when the railroad schedules were interrupted, the President of an oil company, with headquarters at Tulsa, used a Curtiss "*Oriole*" for a two-thousand-mile inspection trip in Texas and Oklahoma. By train or motor this would have required at least a fortnight, with many inconveniences. But by air it was accomplished in two days. As a result of this experience zone maps for aerial service are to be found in all the oil company offices; and inspection tours by airplane are becoming the rule rather than the exception.

Again, a grain company in Nebraska found itself in a desperate situation when a sleet and wind storm halted wire communication. Negotiations were pending in Wyoming, Montana and Idaho, on the immediate completion of which (due to the state of the market) depended profit or severe loss. The company chartered a Curtiss "*Oriole*," visited all the points desired and by this quick move was able to close every deal successfully.

A rice grower in California made a hurried trip by air. His idea was transportation, but as he passed over his fields the whir of the propeller startled wild ducks which rose in clouds from the grain crop on which they had been feeding. The idea of utilizing the airplane to patrol his property occurred to the planter. And now thousands of acres of rice lands are protected by flyers.

AIRCRAFT UNIQUE IN ADVERTISING

In advertising, aircraft are unique. They are not only the publicity medium — they are also the means of moving the goods. They are not alone the means of attracting attention, they carry the very individual or article which it is desired to advertise. The aircraft companies incidentally advertise themselves even while they operate and when employed to advertise other activities, they must, perforce, continue advertising themselves.

What hint of the quick transportation of perishable foodstuffs is contained in the performance of an Aero Limited boat which flew to New York from Florida in sixteen hours with a cargo of grapefruit at a time of year when that delicacy was rare to even the choice menus of the north?

And the traveling salesman who took a sample case in an Aero-marine flying boat up the Hudson, thus getting the jump (or the hop) on his competitors, surely was the first of a long line of "flying drummers."

Ice cream has risen in popularity and in fact since prohibition was enacted. And it was the airplane that did it! Who ever heard of shipping frozen food hundreds of miles in the middle of summer without the aid of salt or ice? A Dayton Wright "*Aerial Coupe*" did the trick, flying high amid the cool winds between Cleveland and Washington with a special container of cream which later had the place of honor at a banquet of the Retail Ice Cream Dealers' Association.

Mention of Washington calls attention to the Air Service, which is by no means insensible to the benefits to be obtained from letting the people see what an Army plane and flyer can do. The Air Service has probably obtained more constructive publicity out of a certain Glenn L. Martin twelve-passenger transport, which is in constant demand for the quick transfer of high officers, than out of many squadrons of strictly military types of machines.

Aerial advertising has a double appeal. Today it is the airplane that is seen by all eyes on earth. Tomorrow, when many more thousands are flying and thinking of ordinary travel in the vernacular of three dimensions, that which is on the earth will be seen by all in the air. Today we have "flying billboards"—aircraft with signs on wings and fuselage. Tomorrow we certainly shall have signs on roofs and highways and—who knows?—hillsides and pastures sown to advertise some commodity. And when that tomorrow comes who will deny the possibility of the family group at ease on the furnished or gardened housetop watching the sky parade, even as we now sit on the front porch and watch the ceaseless stream of motor cars?

Alfred Decker & Cohn of Chicago; the William J. Wrigley, Jr., Co.; the Brandram-Henderson Co. of Montreal; the Simmons Hardware Co.; and the Dayton Co., dry goods house of Minneapolis, have established "stables" of Curtiss aircraft which serve the double purpose of advertising and transportation of salesmen and packages for urgent delivery. The Vivadou Co., filling an order for Mrs. Wilson, astonished even Washington, accustomed as it is to aircraft, by delivering the goods from New York almost to the gates of the White House in a Gallaudet "*Liberty Tourist*."

POLITICS, RELIGION AND TRAVEL

Aircraft have sometimes combined the three functions of publicity, passenger and cargo carrying. In the last national campaign the Republican, Democratic, Farm-Labor and Prohibition parties and the Non-Partisan League all utilized airplanes. "Vote for ——" was the legend painted on them—the candidates ranging from a citizen of Queens Borough, New York, who aspired to be sheriff, to

Harding and Cox. Some of the candidates themselves traveled by air, while from every plane were dropped circulars appealing for support.

Religion, too, has taken to wing, not as symbolic of that state which it may sometime achieve, but as a practical matter of present day business, as Edward Hungerford wrote in *Harper's Magazine*:

"I rode over Portland, Oregon, in a propaganda airplane. It belonged to a new-old religious cult, the Apostolic Faith, which is gaining both members and money — and is exerting the last to gain the first. It has printing presses, motor cars, motor trucks, and the airplane in which I rode. This last is called the 'Sky Pilot' and has the cross and crown painted on the under surface of the plane. Literally it carries the gospel to the far corners of Oregon; the Dominie is a war-graduate aviator and speaks with the force which comes from real experience."

In reviewing aerial transport in 1920 or forecasting its future, the influence of beauty is seen to be ever present. Only those who have flown can fully appreciate the grandeur and novelty of travel at a height of three to four thousand feet. Earth, ocean, air, are seen in new and more charming aspects and under conditions which invite the feeling of mental dominion and power even while impressing the traveler with a sense of his own physical impotence.

This was particularly true of operations on the Pacific Coast, and more especially over the National Parks. The gray harbor and green hills of San Francisco, the golden-blue mosaic of Los Angeles and San Diego, the rough picturesqueness of Seattle's mountains and sea can never be seen in such loveliness as from the air.

Three flights were peculiarly commanding. The Earl P. Cooper Airplane and Motor Co. of San Francisco sent a Curtiss-Standard training plane into Yosemite Valley. It has been but a dozen years or so since the only transportation to the park was by stage 90 miles from Raymond, the end of the railway spur. The trip required two or three days. Then the motor car was admitted and later a new railway carried the tourist to within ten miles of the reservation. And now the airplane! The pilot was Dan Davison, and to reach the valley he had to attain an altitude of 11,000 feet, descending steeply to a diminutive sward beside the roaring Merced river. It was truly a historic entry.

Lake Tahoe, perhaps the most beautiful water in the Sierra available to vacationists, is now accessible by air. It was thought to be so high that no seaplane could operate on it, yet, late in 1920, Charles T. Stoffer, with a passenger, took off his Curtiss Wright-engined pontoon machine from the river at Sacramento, soared 11,500 feet over the divide and came to rest on the calm waters of Tahoe.

What is more, he did a thriving business in scenic flights and at the end of the season flew back to the valley.

Herbert Munter, of the Aerial Tours Co., Kent, Wash., was the first to "discover" Mount Rainier from the air. In his three-place Boeing — christened the "*Mount Rainier*" on that trip, by the way — he reached an altitude of 16,000 feet and circled low over the summit, which towers almost 15,000 feet, far above its white-crested neighbors in the Cascades and Siskiyoues. It was a superb sight, the fame of which has since attracted many aerial tourists.

"It gave us a peculiar feeling," wrote Mr. Munter, "to look over one side of the plane, into the very fountain head of the Rainier glaciers, but a few hundred feet beneath us, and then, looking over the other side, to see Paradise Inn, nestled thousands of feet below in beautiful Paradise Valley."

THE EASTERN TRANSPORT COMPANIES

The aerial transport companies operating along the Atlantic coast have found that, with the exception of such resorts as Atlantic City, which claims thousands of strangers each season, something more interesting than short flights must be offered in order to justify permanent existence.

It has been indicated that most of the commercial flying in the United States dates from the spring of 1919. There is, however, one notable exception, the America Trans-Oceanic Company, which was formed in 1916, when Glenn H. Curtiss, Rodman Wanamaker and others were working on the flying boat "*America*" in the hope of crossing the Atlantic. Immediately on its formation the company established seaplane stations at Port Washington, L. I., and Palm Beach, Fla. During 1916 operation was carried on for pleasure and sport purposes, but the demand was not sufficient to warrant great expansion, even if the war had not intervened.

Soon after the signing of the Armistice, the America Trans-Oceanic Co., many of whose flyers had served in Naval Aviation with distinction, took over a number of Curtiss H.S. and H.-16 flying boats, the former being rebuilt into five and six place commercial craft and the latter into fourteen or sixteen place long-distance carriers. Curtiss "*Seagulls*" and the M.F. type were used on the shorter trips. Since the fall of 1918 continuous service, according to the season, has been maintained between Florida coast towns and points in the West Indies, such as Havana, Nassau and Bimini; and between New York and Atlantic City, Newport, Bar Harbor, New London, Boston, Saratoga Springs, Lake George, Albany and Norfolk. It is the proud record of the company, during the five years of its operations, covering a total distance of approximately 300,000

miles, and the carriage of from 4,000 to 5,000 passengers, that not a single accident has happened to either its passengers, pilots or mechanics.

On July 26, 1919, the Aero Limited was formed, being one of the first, if not actually the first company organized on a corporate basis after the close of the war. The company at once established a regular transport line between New York and Atlantic City, operating two three-place Aeromarine boats powered with the Wright engine. The experience thus gained—it is more than 100 miles each way—enabled the company to enlarge and to add six passenger rebuilt H.S. boats to its equipment.

In the fall of 1919, Aero Limited flew south and for three months operated out of Miami, carrying during this time a total of 2,200 passengers an aggregate distance of 100,000 miles. Forty round trips to Nassau, Bahamas, 210 nautical miles east of Miami, many special charter flights to Havana and more than 100 flights to Bimini were included. During this time Aero Limited carried the first United States and British mail from American to British West Indian ports, located sponge beds and schools of fish, gave assistance to Federal agents endeavoring to block smuggling, and provided the "stage" for an aerial wedding.

In the spring of 1920 Aero Limited transferred its activities to the North, operating air lines, especially on charter trips, between New York and many Atlantic Coast, Hudson River and Chesapeake Bay points. During the four months of this season 2,176 passengers were carried, of whom 747 were booked in August.

Aero Limited is believed to have been the first to open general passenger offices. The agents in charge consequently had opportunity for original observations. They report, for instance, that more than 70 per cent of the passengers carried on the short demonstration flights were women. Many brought their children with them, one even carrying an eight-months' old babe. The remaining 30 per cent were men who frequently came along because they had to.

But it was different when long trips were concerned. Here the women hesitated and the men were eager. The women flew for the novelty; the men wanted a reason, and if business required them to go from one point to another, and transportation was quickest by air, not one hesitated or thought of the expense or possible risk. One case was of a man who desired to get north, as quickly as possible. As he had never been up a trial flight was offered, but this he refused: "My interest," he said, "is in getting to New York and nothing more." And they flew him there.

WATER AIR PORTS AVAILABLE

The significance of successful commercial flying over the water must be apparent. In a seaplane, wherever there is water, there, too, is a possible place to alight. But not so with a land plane, the operation of which in regular service has been seriously retarded by the absence of proper terminals.

The growing patronage of flying boat lines impelled a study of the immediate equipment needs. Chief of these, it was felt, was for a carrier capable of making long sustained flights and of such capacity as to cut to a minimum the per capita cost of operation. The Aeromarine Plane & Motor Co., which later acquired practically all the Navy surplus, was the first to appreciate the possibilities of the F.-5-L. This flying boat of distinctly American origin, powered with two 400 h.p. Liberty engines, had proven its remarkable endurance during the war and it was possible to utilize every flying and seaworthy quality, at the same time installing all the comforts and conveniences required by the paying traveler. The entire hull was enclosed and two mahogany fitted cabins built, fore and aft, in which were placed upholstered chairs for eleven passengers, in addition to the crew of three. Protected from wind and weather, electric lights affording illumination after night had thrown into obscurity the view through the ports at each chair, the passengers received the assurance of ease and security unsurpassed, it is believed, by any other mode of transportation.

The first of these boats was launched at Keyport June 22, 1920, and was christened the "*Aeromarine Navy Cruiser*" by Governor Edwards of New Jersey. It was taken over at once by the Aeromarine Sightseeing and Navigation Co., and placed in the suburban excursion service around New York. Trips were made regularly up to October 1 to Southampton, L. I., Atlantic City, Newport, Spring Lake, N. J., etc. During the International Yacht Races the "*Aeromarine Navy Cruisers*" carried passengers over this greatest of marine sporting events when spectators on surface craft were inconvenienced by inclement weather or handicapped by limited vision. Altogether, in these excursion services, some 800 persons were transported.

The approach of winter, which impelled the usual migration of many northerners to the south, impelled the Aeromarine Sightseeing and Navigation Co. to consider a similar course. But in the meantime another large company had been organized for transport service between Florida and the West Indies and a merger was effected under the name of Aeromarine West Indies Airways, Inc. Mail contracts were obtained from the American and Cuban governments

and on October 23, two "*Aeromarine Navy Cruisers*"—the "*Santa Maria*" and the "*Pinta*" taking their names from Columbus caravels—were dedicated at the Columbia Yacht Club, New York City, and within the hour were winging their way to Key West, the company's terminal in the United States.

This flight down the Atlantic Coast was of romantic interest, for the first stop out of New York was made on the island of Roanoke, off the North Carolina coast. Here on the sand hills of Kitty Hawk, Wilbur and Orville Wright made the first flights in the history of the world, and here rested, on their maiden voyage, the first units of the first extensive overseas American air fleet.

The Aeromarine West Indies Airways, Inc., is successfully operating daily between Key West and Havana. Travelers arriving at the peninsular terminus need no longer wait eight hours for the Cuba boat and then spend the night on the turbulent channel. They step from parlor car to parlor flying boat and an hour and a quarter later are on the quay at Havana. An increasing preference for the air route is manifest.

PROPHETICAL OF THE FUTURE

These experiences are typical of what has been attempted and prophetic of what should be accomplished as limitations are diminished and the art demonstrates its further usefulness.

The year cannot be looked upon as phenomenal; neither can it be viewed as a disappointment. And in reviewing the record one is impressed with the analogy which this first year of commercial aeronautics bears to the first twelve months of our recent war. Something of the same imagination which burned in 1917 at the thought of launching clouds of fighting machines upon the enemy, again kindled, in the spring of 1920, at the contemplation of peaceful heavens filled with wingéd argosies.

And, just as what we *did* accomplish in war—the production of nearly 15,000 aircraft in eighteen months—would have been impossible without aiming high and expecting much, persevering against odds and ultimately achieving, so, too, the preservation of any part of the industry and the first commercial trials would have been unlikely had there not been faith and persistency attributable only, in the absence of great, immediate rewards, to the fascination which the new art holds for those engaged in it.

COMMERCIAL AIRCRAFT OPERATING COMPANIES IN THE UNITED STATES AND CANADA

	Name of Company	Address	Aircraft	Air Port Facilities	Charge Short Flight	Charge Pas.-mile Inter-city Flight	Passengers Carried	Freight Carried	Miles Flown
1	Aerial Tours Co.	Seattle, Wash.	1 B.B.-L † 1 J.N.-4	Field (rented) and hangars at Kent, Wash.	\$15.00	\$1.00	1,700	0	31,500
2	Aeromarine Sight-seeing & Navigation Co. (merged with Aeromarine West Indies	86th St. & Riverside Drive, N. Y. City.	2 F.-5-L Navy Cruiser Flying Boats; † 2 50-B.-2 Flying Boats	Terminal at 86th St. & Hudson River.		.83	800	0	7,000 (est.)
3	Aeromarine West Indies Airways, Inc.	Key West, Fla.	6 F.-5-L Navy † Cruisers (14 passenger)	Terminals in harbors at Key West & Palm Beach, Fla.; Havana, Cuba; Bimini and Nassau.		\$75 bet. Key West and Hav.	300		7,200
4	Aero Limited	20 W. 34th St., N. Y. City.	15 5-passenger H.S.-2-L Flying Boats	Air ports (owned) at Flushing and Miami.	10.00 to 25.00	.60	4,376	1,500 lbs.	200,000
5	Air Service, Inc.	536 Broad St., Newark, N. J.	1 Canadian J.N.-4 OX5 motor	Field 1500 x 3000' (leased); 1 hangar under construction.	10.00	.85	1,473		13,800
6	Air Transport & Photographic Co.	302 Sloan Bldg., Cleveland, O.	1 Canadian J.N.	Field (leased); test hangar; hangar for 10 machines and repair shop.					unknown
7	America Transoceanic Co.	505 Fifth Ave., N. Y. City.	1 H.-16; 1 H.S.; 3 Seagulls; 1 F Boat.	Pt. Washington, L. I.; Palm Beach and Miami, Fla.; Bimini & Nassau, Bahamas	10.00 to 15.00	.46	4,000		80,000 (est.)
8	Augusta Aircraft Co., Inc.	Augusta, Ga.	2 J.N.-4-D's.	Field (owned); hangar and supply depot.		1.00	1,000		15,000
9	Beaty Aviation Co.	Dallas, Tex.	2 J.N.-4-C's.	Field (owned) at East Dallas, end Gaston Ave., Dallas, Tex.; shop and repairs.	10.00	.40	515		6,120
10	E. B. Bridges	Anderson, Ind.	1 J.N.-4-H.†	Field (rented) 32 acres; tent hangar, supply depot.	15.00	\$50.00 (an hour)	278		8,100
11	Canadian Aerial Services, Ltd.	Hempstead & St. Lawrence Blvd., near Montreal, Canada.	1 504-K 1 J.N.-4-C	1 hangar at Hempstead for 2 machines; 1 hangar at St. Lawrence Blvd. for 1 machine. Fields at both (rented).	10.00	.75	445	240	9,280
12	Canadian Aircraft Co., Ltd.	Winnipeg, Canada	3 504-K's; 2 Canadian J.N.-4's.	Field with hangar and shop at St. Charles, Winnipeg.	10.00	1.00	1,500	600	12,000 (est.)
13	Cassell Motor Co.	Santa Fe, N. M.	1 J.-1.†	Field (owned) with 1-shp hangar, equipped with repair shop, gas and oil facilities.	12.50	1.00 per min.	200	200 lbs.	10,000
14	Chattanooga Auto Co. (Aerial Depot)	Chattanooga, Tenn.	3 Canadian J.N.'s 2 J.N.-4-D's; 1 J.-1; 1 Oriole K.-6.	Field (leased), hangar, supply shop.	15.00	.75			

COMMERCIAL AIRCRAFT OPERATING COMPANIES IN THE UNITED STATES AND CANADA—Continued

	Name of Company	Address	Aircraft	Air Port Facilities	Charge Short Flight	Charge Pas.-mile Inter-city Flight	Passengers Carried	Freight Carried	Miles Flown
15	Checkerboard Airplane Service	Forest Park, Ill.	7 Canadian and American J.N.'s and J.-1's.	Field (owned), 1 hangar, 8-plane capacity, service depot complete.	\$10.00	\$.50 to .70 p. mi.	2,000 (est.)		25,000 (est.)
16	Chenoweth Aviation Co.	Richmond, Ind.	1 J.N.	Field (owned), with hangar for 3, shop and supply depot.	10.00 to 15.00		300		3,500 (est.)
17	Chester R. Clark Aerial Service Co.	1563 Franklin St., Oakland, Calif.	2 OXX6 J.-1's; 1 float.	2 fields (owned); 2 hangars (one under construction).	1.00 per min.	1.00 per min.	1,476		15,000 (est.)
18	Cincinnati Aircraft Co.	Duck Creek Rd., Cincinnati, O.	2 Canadian J.N.'s.	Field (owned) 2680 x 2900 ft.; hangar 50 x 125 ft.	15.00		400		4,000 (est.)
19	Colorado Aviation Corp.	Glenwood Springs, Colo.	1 J.-1 1 monoplane *	1 field (leased).	12.50	.50	1,500		28,000
20	Concord Aircraft Co.	65 N. Main St., Concord, N. H.	1 Canadian J.N. 1 504-K.	1 field (rented) with hangar, shop, office.	10.00	.80	500		10,000
21	Connecticut Aerial Navigation Co.	886 Main St., Bridgeport, Conn.	Seagulls M.F. Boat.	Seaplane base (leased) with hangar and storage facilities, etc. Black Rock Harbor, Bridgeport; landing field 3 mi. east of Bridgeport.	1.00 per min.	1.00	582		7,000
22	Curtiss Aeroplane & Motor Corp. (Main Company)	Mitchel Field, Mineola, L. I., New York.	Orioles, J.N.'s, J.-1's, Seagulls, Eagles.	Field (owned) mile square near Mineola; hangars, supplies, etc.	15.00	1.00	1,000		25,180
23	Curtiss Aeroplane & Motor Corp. (Western Branch)	30 N. Michigan Blvd., Chicago, Ill.	Orioles, Seagulls, J.N.-4-D's, Canadian J.N.'s, J.-2's, Eagles.	2 fields (leased) at (1) Sheridan Rd., north of Waukegan; (2) Roosevelt Field at Des Plaines River.	10.00		125		1,600
24	Curtiss Eastern Airplane Corp.	130 S. 15th St., Philadelphia, Pa.	4 Orioles; 1 Seagull 2 J.N.-4-D's.	Landing field with 2 large hangars, repair shop, office, etc., at Pine Valley, N. J.	\$10.00 to 15.00	\$.75	1,000		102,000
25	Curtiss Exhibition Co.	Kenilworth Field, Buffalo, N. Y.	2 Orioles; Canadian J.N.; 4 J.N.'s; 2 K.-6 J.-1's; 1 OX J.-1.	1 field (rented) n. e. of Buffalo, with 2 hangars, shop, etc.	15.00	1.00	1,035		18,000
26	Curtiss Flying Station	Atlantic City, N. J.	1 C.-6 Seagull 1 K.-6 Seagulls 2 J.N.'s 1 K.-6 Oriole	Seaplane base at inlet and airport (both owned); 1 seaplane hangar, 200 x 100; 2 field hangars 8-machine capacity, shop, etc.	15.00	1.50	2,700		30,000

COMMERCIAL AIRCRAFT OPERATING COMPANIES IN THE UNITED STATES AND CANADA—Continued

Name of Company	Address	Aircraft	Air Port Facilities	Charge Short Flight	Charge Pas.-mile Inter-city Flight	Passengers Carried	Freight Carried	Miles Flown
27 Curtiss-Humphreys Airplane Co.	Denver, Colo.	5 Orioles 3 J.-1's	Field (leased), hangars, shops.	\$12.50	\$1.00	3,500		35,000 (est.)
28 Curtiss-Indiana Co.	Kokomo, Ind.	20 to 30 planes; J.N.-4-D, Canadian J.N., J.-1, Orioles, Bomber.**	80 acre field (leased), ¼ mile s. e. Kokomo, with hangars, shops, etc.	15.00	.50 to .75	12,000 (total)		500,000
29 Curtiss Iowa Aircraft Corp.	Fort Dodge, Ia.	4 Orioles 6 J.N.'s	63 acre field (owned) Ft. Dodge; 160 acre field (leased) Des Moines; hangars, shops, service stations both fields.	10.00				
30 Curtiss-New York Aircraft Corp.	319 Main St., Buffalo, N. Y., & 505 Fifth Ave., N. Y. City	16 planes; Seagulls, Orioles, J.N.'s, J.-1's.	Fields (owned) N. Y. City (Mineola, L. I.) and Buffalo, N. Y.					
31 Curtiss Northwest Airplane Co.	707 Metropolitan Bank Bldg., Minneapolis, Minn.	6 J.N.-4-D's, 6 J.-1's, 3 Orioles.	Field (owned) 880 x 440 yds., bet. Minneapolis & St. Paul; cor. Snelling & Larpenteur Aves.; 2 hangars for 8 ships & 4 ships respectively; 2 shops.			3,000	800	250,000
32 Curtiss Southwest Airplane Co.	Tulsa, Okla. Ft. Worth, Tex. Dallas, Tex. Houston, Tex.	3 K.-6 J.-1's 2 K.-6 Orioles 5 OX5 J.-1's 6 J.N.-4-D's 4 Canadian J.N.'s	Terminals at Tulsa & Ft. Worth, 160 acres ea. with hangars, shops, supply depots (both owned); fields (leased) with supply depots at Dallas and Houston.	10.00	.80 to 1.00	1,500 (est.)	8,400 (est.)	25,000 (est.)
33 Earl P. Cooper Airplane & Motor Co.	San Francisco, Calif.	3 Orioles; 2 J.-1's; 1 J.N.-4-D.	Field (leased).	10.00	1.00	944		40,500
34 Earl S. Daugherty	Long Beach, Calif.	1 J.N.-4-D; 1 Cand. J.N.; 1 tractor.***	Field (owned) with 3 hangars and supply depot.	10.00	.75	4,300		45,000 (est.)
35 Dayton Wright Co.	Dayton, O.	1 K.T. 1 O.W.	Field (owned) with hangars, supply depot, shops, etc., at Moraine City, Dayton, O.			250		10,800
36 DeLuxe Air Service, Inc.	Deal, N. J.	4 Canadian J.N.'s	Fields (rented) at Deal & Spring Lake, N. J.; hangar and shop at Deal.	10.00 to 15.00	.75	500		20,000
37 Dixie Flying Corp.	Birmingham, Ala.	J.N.'s	Field (owned), hangar, etc.			400		4,500 (est.)
38 Eastern Aircraft Corp.	340 First St., Boston, Mass.	J.N.-4's	Fields (rented) at Boston & Springfield; latter station fully equipped.	10.00	1.00			30,000 (est.)

COMMERCIAL AIRCRAFT OPERATING COMPANIES IN THE UNITED STATES AND CANADA — *Continued*

<i>Name of Company</i>	<i>Address</i>	<i>Aircraft</i>	<i>Air Port Facilities</i>	<i>Charge Short Flight</i>	<i>Charge Pas.-mile Inter-city Flight</i>	<i>Passengers Carried</i>	<i>Freight Carried</i>	<i>Miles Flown</i>
39 Finger Lakes Air Service, Inc.	Auburn, N. Y.	1 H.S.-2 Flying Boat				235		2,000 (est.)
40 Ft. Wayne Aviation Co.	Ft. Wayne, Ind.	2 J.-1's	Field (owned) 80 acres, with hangars, supplies, etc.	\$15.00	\$.80	150		1,500 (est.)
41 L. D. Frint Aeronautical Co.	Milwaukee, Wisc.	1 J.N.-4-D 1 Canadian J.N.	Field (rented) and large hangar.	10.00	.75	500		15,000 (est.)
42 Valentine Gephart, Inc.	Kansas City, Mo.	16 planes; J.N.-4's, J.-1's.**	Field (owned) 100 acres, hangar 100 x 200 ft., shops, etc.	10.00 to 15.00	1.00			420,000 (est.)
43 Goodyear Tire & Rubber Co.	Akron, O.	1 Pony Blimp, 3 place.	Airship stations (owned) at Akron, Los Angeles & Avalon, Catalina Islands.			400 (est.) (at Los Angeles)		6,000 (at Los Angeles) (est.)
44 Green Bay Aero Club	Green Bay, Wisc.	1 J.N.	Field (owned) and hangar with supply depot.	10.00		500		5,000 (est.)
45 Gulf States Aircraft Co.	Shreveport, La.	4 planes: J.-2's and J.N.'s.	Use State Fair Grounds, Shreveport, La	10.00	.75	1,000		20,000 (est.)
46 Fred'k. H. Harris	Brattleboro, Vt.	1 J.N.-4-D.	Uses Fair Field one mile north of Brattleboro.	15.00	1.00	100		2,000
47 Heddon Aviation Co.	Dowagiac, Mich.	2 Canadian J.N.'s 1 Swallow. ^o	Field (leased), 40 acres, with hangar and supply depot.	10.00				6,500
48 Holbrook & MacLeod	Hanna, Atlanta, Ga.	1 J.N.-4.	Field (leased) at Hanna, Atlanta, Ga.	10.00	.75	1,200		40,000
49 Hubbard Air Transport Co.	Seattle, Wash., & Victoria, B. C.	2 B.-1 Flying Boats.	Harbor terminals at Seattle and Victoria.			25		1,700
50 Jaquith Flying Station, Inc.	317 Guarantee Trust Bldg., Atlantic City, N. J.	2 Model 50-B Flying Boats.	Platform, office, etc., at Madison Ave. and Boardwalk.	15.00	1.50	1,500		30,000
51 O. K. Jeffery Airplane Co.	Wilcox Bldg., Portland, Ore.	504-K and J.-1's.†	Field and hangars (owned) at The Dalles and Bend, Ore.	10.00	1.00	50		500
52 LaCrosse Aerial Co.	LaCrosse, Wisc.	1 J.N.4-D.	Tent hangar (owned).	10.00	.75	1,500		15,000 (est.)
53 LaGrande Aircraft Co.	LaGrande, Ore.	3 J.-1's.†	Fields (rented) at LaGrande, The Dalles and Bend, Ore. Permanent station at LaGrande.	10.00	.45			
54 Leschi Aerial Taxi Co.	Seattle, Wash.	Model C Twin float seaplane.	Harbor terminal at Seattle.	15.00		600		9,000

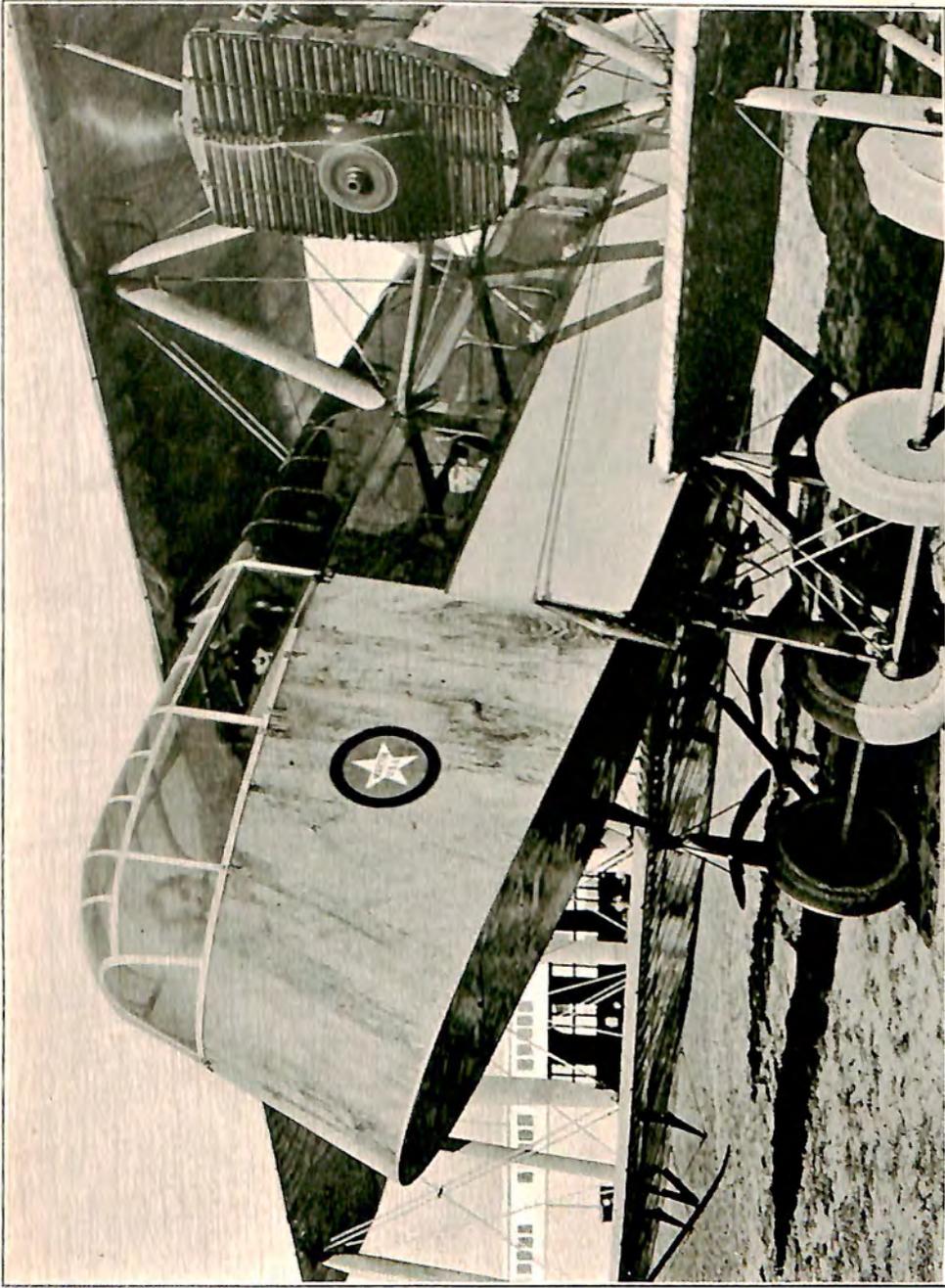
COMMERCIAL AIRCRAFT OPERATING COMPANIES IN THE UNITED STATES AND CANADA—Continued

	Name of Company	Address	Aircraft	Air Port Facilities	Charge Short Flight	Charge Pas.-mile Inter-city Flight	Passengers Carried	Freight Carried	Flown Miles
55	David B. Lindsay	Marion, Ind.	3 Curtiss J.N.-4-D's.	Field (rented), with temporary hangar, etc., ½ mile so. of Marion.	\$15.00	\$.75	927		12,400
56	Floyd J. Logan Aviation Co.	Cleveland, Ohio.	2 Canadian J.N.'s. 1 J.N.-4-D. 1 J.-1.	Field (leased) on Linndale Rd near Cleveland; 3 canvas hangars for 10, phone, shop, supply, etc.	15.00	1.00	100		10,000
57	Lynchburg Air Service Corp.	Lynchburg, Va.	2 J.N.-4-D's, Orioles, J.-1's.	2 fields (rented) near Lynchburg; one hangar and shop.	15.00		200		3,500 (est.)
58	A. G. McMann	Bettendorf, Ia.	1 J.N.-4-D.	Field (owned) east of Bettendorf with hangar and shop.	15.00		500		5,000 (est.)
59	Martin-Sweet Motor Co.	Denver, Colo.	3 J.-1's.†	Field (owned), 40 acres, with 3 plane hangar and shop.	\$15.00		1,000		20,000
60	Mercury Aviation Co.	Hollywood, Calif.	7 J.N.-4-D's, 2 J.-1's,† 2 J.L. mono-planes.	3 fields (leased); 2 at Hollywood, 1 Pasadena; 3 hangars at Hollywood, 1 Pasadena; repair shops.	5.00		15,000 (total)		475,000
61	Morrow Aircraft Corp	Charlotte, N. C.	1 Oriole, 1 J.N.-4-D, 1 Canadian J.N.	Field (owned) at Charlotte, N. C.	15.00		500		7,500
62	National Airway Service Co.	217 Walsh Bldg., Akron, O.	2 J.N.-4's.	Field (rented) at Akron, O., with hangars, repair shops and supply depot.	10.00				
63	New York Aircraft Exhibition Corp.	Troy, N. Y.	1 Canadian J.N.	Field (rented) at Troy, N. Y.	15.00		300		5,000
64	Northwest Aircraft Corp.	Newell, S. Dak.	1 J.-1.	Field (owned), hangar and shop; 30'x 50'.	10.00	\$.50	100		8,000
65	Ohio Flying School & Transport Co.	53 Central Office Bldg., Akron, O.	5 J.N.-4's.	Field (owned) 8 mi. n.e. of Akron, 80 acres; hangars, supply depot, shops.	15.00	1.00	586		3,450
66	Oregon, Washington & Idaho Airplane Co.	Portland, Ore.	3 Orioles 2 Seagulls 4 F Boats 5 J.N.-4-D's; 1 J.-1.	Terminals at Portland, Astoria, Seaside, Vancouver, Marshfield, Salem, Eugene, The Dalles; 12 hangars, shops, offices, etc.; Portland hangar accommodates 18 airplanes	10.00		3,852	25,000	74,000
67	Orlando Aerial Co.	Orlando, Fla.	2 J.N.-4-D's.	Field (owned) 2 mi. west of Orlando.	15.00				
68	Osgood & Stickney	Springfield, Vt.	2 J.-1's 1 J.N.-4-D.	Field (rented) with hangar and supplies at Springfield.	15.00		3,000		4,500 (est.)
69	Rankin Aviation Co.	Walla Walla, Wash.	1 J.N.-4, OX motor; 1 J.-1, OX motor.	Emergency field at Walla Walla.	1.00 min.	.50	862		30,000 (est.)
70	Foster Russell Aviation Co.	Spokane, Wash.	1 Oriole; 1 J.N.-4-D, 1 J.-1.	2 fields (leased), one at Spokane and other at Walla Walla.	10.00	.50	1,500		

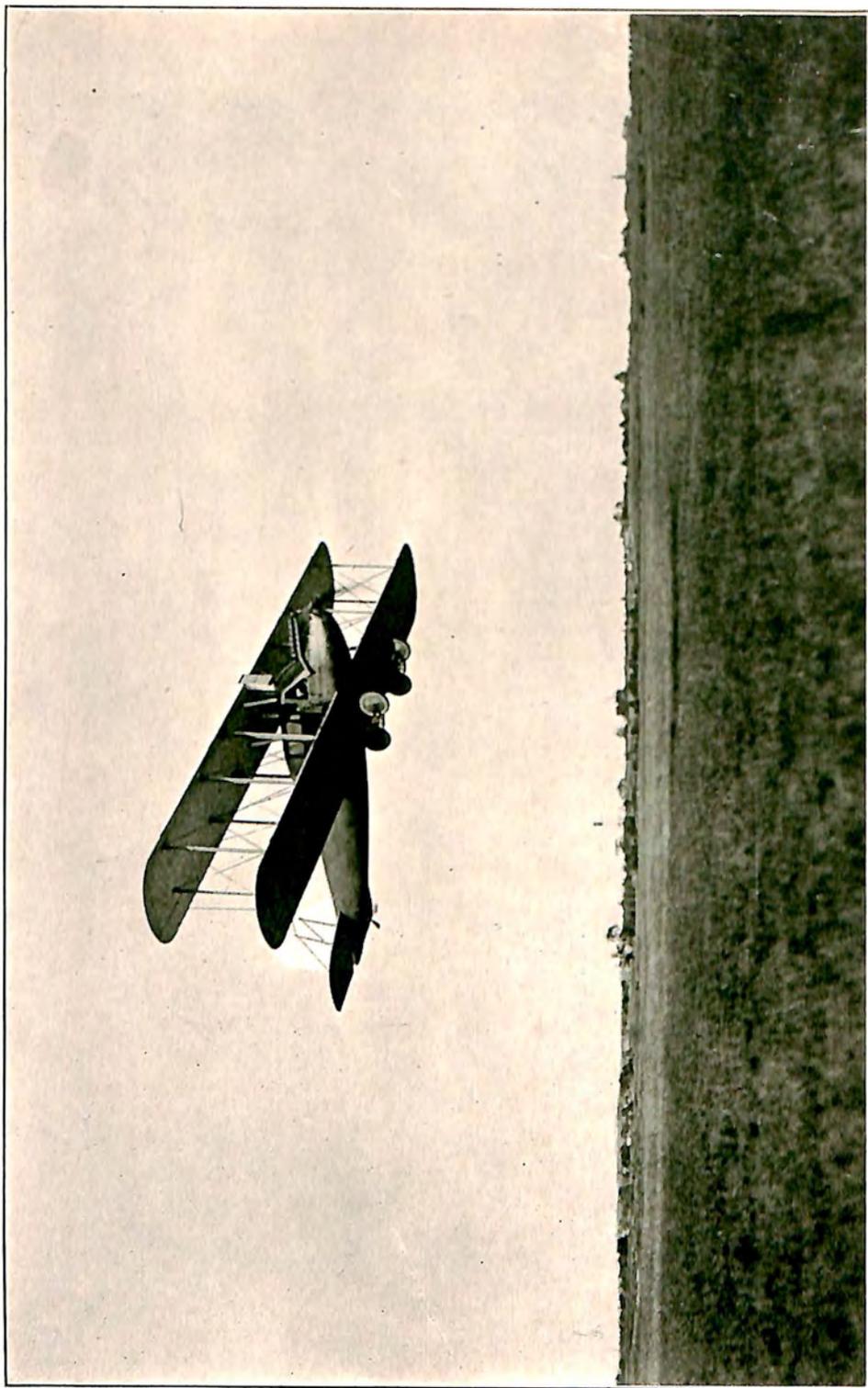
COMMERCIAL AIRCRAFT OPERATING COMPANIES IN THE UNITED STATES AND CANADA—Continued



	Name of Company	Address	Aircraft	Air Port Facilities	Charge Short Flight	Charge Pas.-mile Inter-city Flight	Passengers Carried	Freight Carried	Miles Flown
71	Saginaw Aviation Co.	Saginaw, Mich.	1 J.N.-4-D, 2 J.-1's.	Field (leased), Saginaw East Side, 1 mi. from city; hangars, shop, supplies.	\$12.50	\$.50	1,450		15,000 (est.)
72	Santa Maria Aviation Co.	Santa Maria, Calif.	3 J.-1's.	Field (leased), at Santa Maria, Cal., ½ mile square; 1 hangar.	15.00				
73	Security Aircraft Co.	Minneapolis, Minn.	Orioles; J.N.'s; J.-1's; 504-K's.	Field (owned), Minneapolis; hangars, shops, etc.	15.00	1.00	3,000		12,000
74	Service Aviation Training & Transportation Co., Inc.	Wabash, Ind.	11 Canadian J.N.'s.	Field (owned) at Wabash, Ind.; hangar 120'x 65', shop, etc.	10.00 to 15.00	.75	9,355		90,000 (est.)
75	Miss Neta Snook	828 Wilson Ave., Ames, Iowa.	1 J.N. biplane.	Air terminal at Ames, Ia.; hangar, supply station.	10.00 to 15.00		882	480	2,900
76	Starkey Battery Co.	Muskogee, Okla.	2 under construction.	Field (owned) west of Muskogee.	10.00		2		20 (est.)
77	Southern Aeroplane Co.	11 S. Church St., Charlotte, N. C.	3 F.-40 & F.-46.	Terminal at Charlotte, N. C., and Fairmont, W. Va. (one owned, one leased); hangar and supplies at Charlotte.	15.00	1.00	1,249	1,100	20,000
78	Southern Wyoming Aircraft Co.	Cheyenne, Wyo.	1 J.-1.	Use municipal field, all supplies available.	15.00	2.00	500		15,000
79	Syracuse Aero Corp.	239 Union Bldg., Syracuse, N. Y.	3 J.N.-4-D's.	Field (rented) n.e. of city; hangar for 6 planes, service station.	15.00	.75			
80	Tahoe Aviation Co. W. S. Stoddard Aviation Co.	Lake Tahoe, Calif. Honolulu, T. H.	1 N-9 seaplane,† 1 J.N.-4-D.	Fields (owned) at Lake Tahoe and Honolulu; hangars and runway (under construction) at Honolulu.	10.00		130	2,000	2,000 (est.)
81	U. S. Aircraft Corp.	1803 3rd Ave., Spokane, Wash.	4 J.-1's.	Field (owned) with 8-plane hangar, supplies, etc.; 1 min. from city.	10.00	1.00	551		11,000
82	Utah Airplane Co., Inc.	343 S. Main St., Salt Lake City, Utah.	1 Oriole.	Field (rented), Salt Lake City.	12.50 to 15.00	.75	275	150	8,000
83	Vancouver Island Aerial Service	Comox Harbor, B. C.	1 J.N.-4-D converted to seaplane.	Use harbor floating-hangar and shop.	10.00 to 15.00	.75	283	600	11,000
84	Walter T. Varney, Aeroplanes	832 Post St., San Francisco, Calif.	6 J.-1's; 2 J.N.-4-D's; 1 Tourer.°°	Field (owned) at Redwood City, Cal., 2 mi. x ½ mi.; hangars and supply depot.			800		45,500



The Glenn L. Martin Twelve-passenger Commercial Plane.



Curtiss Ten-passenger Liberty-motored "Eagle"—"The Aerial Pullman."

COMMERCIAL AIRCRAFT OPERATING COMPANIES IN THE UNITED STATES AND CANADA—Continued

	Name of Company	Address	Aircraft	Air Port Facilities	Charge Short Flight	Charge Pas.-mile Inter-city Flight	Passengers Carried	Freight Carried	Miles Flown
85	Waterloo Aero Transportation Co.	Waterloo, Ind.	1 Canadian J.N.	Field (rented), 1-plane hangar, shop.	\$10.00	\$.75	350		3,500 (est.)
86	Western Aeroplane & Motor Corp.	Casper, Wyo.	1 J.N.-4; 2 Orioles; 2 J.-1's.	Field (leased); hangar for 5 planes, complete shops, etc.	10.00 to 15.00	1.00	500	800	4,000
87	Yakima Aviation Co.	Yakima, Wash.	1 J.N.-4-D; 1 J.-1.	Field (owned), at 3rd St., So. Yakima, Wash.; 1 hangar, shop, etc.	15.00	1.00	2,520		12,000
88	Zenith Aviation Co., Inc.	Santa Barbara, Calif.	2 Canadian J.N.-4's.	Field (leased) with hangars, supplies, shop, etc., at Ocean Blvd.; seaplane landing dock.	5.00	.50	1,400		20,000
	Total		365 to 425	128	\$12.50 (av.)	\$.65 (av.)	115,163	41,390 lbs.	3,136,550

KEY TO AIRCRAFT AND ENGINE TYPES

50 and 50-B-2, three-place flying boats, Aeromarine engine; F-5-L Navy Cruiser, fourteen-place flying boats, Liberty engine; built by Aeromarine Plane and Motor Company, Keyport, N. J.

B.B.-L., three-place land plane, Hall-Scott engine; B.-1, two or three-place flying boat; C, twin float seaplane; built by Boeing Airplane Company, Seattle, Wash.

J.N.'s of the various types, two-place land planes; Oriole, three-place land plane; Seagull, three-place flying boat; F. and M.F., two and three-place flying boats; Eagle, ten-place land plane; H.S. and H.-16, six to sixteen-place flying boats; OX, K and C engines; Liberty engines in larger types; built by Curtiss Aeroplane and Motor Corporation, Garden City, L. I., New York.

K.T., two-place land plane; O.W., three-place land plane, Liberty engine; built by Dayton Wright Company, Dayton, O.

J.1 and J.-2, two and three-place land planes built by Standard Aircraft Corporation, Elizabeth, N. J., and rebuilt by Curtiss Aeroplane and Motor Corporation or others.

† indicates Wright engine built by Wright Aeronautical Corporation, Paterson, N. J.

‡ indicates Liberty engine built by Packard Motor Car Company, Detroit, Mich.

§ indicates engine built by Hall-Scott Motor Car Company, Berkeley, Calif.

F.40 and F.46, French Farman; J.L. monoplane, German Junker; 504-K, British-Avro; * Lark monoplane; ** French Breguet; *** Daugherty tractor; ° Laird landplane; °° British Bristol.

The operating companies report a total of 222 forced landings and 88 accidents.

(The above is based upon statements made to the Manufacturers Aircraft Association, Inc., in response to questionnaires sent to all known operators of aircraft. No opportunity has been available to determine the accuracy of the information and no responsibility is taken for the data except for the care with which the figures and facts are reported and the manner in which the summary is presented.)

CHAPTER III

MAIL AIRCRAFT FLY 8,000 MILES DAILY; LINES LINK UNITED STATES WITH CANADA AND CUBA; TIME BETWEEN ATLANTIC AND PACIFIC REDUCED BY 42 HOURS; MANY EXTENSIONS PLANNED

THE United States Air Mail, which started with the New York-Washington route May 15th, 1918, now operates daily between New York and San Francisco, St. Louis, Minneapolis and St. Paul, and New York and Washington, a total of 3,460 miles.

Private aircraft companies are transporting the mails by contract between Seattle and Victoria, B. C., and between Key West and Havana, Cuba, a combined distance of 174 miles.

Thirty-five or more cargo-laden Air Mail planes are actually in the air each day, flying a grand total, in round trips, of approximately 8,000 miles.

The Post Office Department has recommended to Congress the extension of Government-operated routes between Boston and Detroit, by way of Buffalo; between Chicago and Los Angeles, by way of Kansas City; between St. Paul, Minneapolis and Seattle, and between St. Louis and New Orleans by way of Memphis, these routes aggregating 4,770 miles, one way.

Contracts have been let for mail transport services from Pittsburgh to St. Louis by way of Columbus, Cincinnati and Indianapolis; from New York to Atlanta, by way of Washington, Raleigh and Columbia; from New York to Chicago by way of Harrisburg, Pittsburgh and Fort Wayne; and from Cleveland to Detroit. These contract routes, with a total mileage of 2,260, were expected to be in operation by the Spring of 1921.

If the plans under contemplation go through, the United States should witness, late in 1921, the operation of a gigantic Air Mail system with terminals in most of the larger cities, and with aircraft flying more than 20,000 miles every day.

The first eight months of the Air Mail Service, between May 15 and December 30, 1918, 119,006 pounds or 4,760,240 letters were carried. The next twelve months, or during the calendar year of 1919, 471,762 pounds, or 18,870,480 letters were transported by mail

planes. The extension of the transcontinental system, operating from Coast to Coast early in September, 1920, so added to the quantities of mail flown between terminals that an approximate total of 2,800,000 pounds or 103,000,000 letters were transported during the twelve months of 1920.

HOW IT SAVES TIME AND MONEY

The longest Air Mail route at present is that between New York and San Francisco, operated in relays by way of Cleveland, Chicago, Omaha, Cheyenne, Salt Lake City and Reno. From 400 to 1,000 pounds, or from 16,000 to 40,000 letters are carried each way daily between each division point.

By co-operating with the railroads and making train connections, the Air Mail advances mail east and west from 24 to 42 hours. About 16,000 letters are advanced daily into San Francisco and New York by 42 hours and approximately 40,000 letters are advanced daily between these terminals by 24 hours. The saving in time over trains on this cross-country route is about three days, when actual delivery is considered.

The Aeromarine and West Indies Airways, Inc., flying the 90 miles between Key West and Havana differs in its operation, though it saves even more time when distances are compared. Aeromarine flying cruisers leave Key West immediately on the arrival of the northern trains and land the mail in Havana in one hour and thirty minutes. On account of boat schedules it formerly required a night and almost a half day.

Many days, sometimes a fortnight, can be saved in the movement of American-Asiatic mail by the operation of Edward Hubbard's Boeing seaplanes, 84 miles each way, between Seattle and Victoria, B. C. Transpacific steamers clearing from the Canadian port make far better time to the Orient than those from San Francisco. Heretofore all of the Seattle-Vancouver mail was carried by a Puget Sound steamer. Frequently the trains from New York arrived late in Seattle and the consignments of letters missed the ferry and consequently had to lay over for the next sailing to the Orient. The seaplanes, unlike the surface boats, wait for the mail, cut down the time between terminals to about one hour and make the desired connections.

QUICKENING OF COMMUNICATIONS

One can scarcely grasp the tremendous significance of the Air Mail in its relations to world communications until the mind runs back for a moment through the development of the postal service.

On first learning to write, man's foremost desire was to get his message delivered as quickly as possible. Thus in the ancient civilizations of Africa and Asia, runners carried clay tablets from city to city, and galleons skirted coasts or threaded rivers with cargoes, of which the inscribed word was a precious feature. In the progress of transportation we may trace the influence of the mails. Runners were succeeded by horsemen or coaches, packets by steamers, coaches by trains — and now enters the airplane.

The establishment of the transcontinental Air Mail September 8, 1920, provided a picturesque and startling contrast to the Pony Express and the tortuous sailings around the Horn. It has quickened written communication and relieved the over-burdened older forms of transportation. Within the memory of some now living it once required six months to transport a letter from New York to San Francisco with a charge of \$10.00 an ounce. The perfected operation of the Air Mail will make it possible to send a letter from Coast to Coast in from thirty-six to fifty hours, at the usual two-cent rate.

When the Air Mail was started it had comparatively few supporters. Only those in the department, the air services or the industry who possessed vision, could foresee other than failure, and even many of them were skeptical. The rapid growth of the system is due to the peculiar adaptability of aircraft, to devotion to duty on the part of the personnel and to the help which the Army provided in the early days during the war when the Post Office Department first prepared to fly the mails.

HOW THE ARMY HELPED

In the beginning the Army Air Service turned over for this work six Curtiss J. N.-4-D. training planes and detailed six lieutenants to fly them back and forth between New York and Washington. The newspapers made much of the event, but regarded it rather as an experiment. It was proposed to carry 200 pounds of letters for an average non-stop flight of three and a half hours. The Air Mail and Army pilots worked night and day. Unsatisfactory terminal facilities, mechanical difficulties and inexperience with adverse weather conditions were handicaps to be overcome. And they were overcome, for from the very start the "experiment" proved a success.

The pilots navigated through snow and rain storms, sleet and fog. One pilot in particular persisted in taking out the mails when his plane was the only machine aloft. He conducted all sorts of experiments in compass navigation. Knowledge thus gained enabled

him to fly on a comparatively straight course even in the fiercest storm and thickest fog.

During this period the service was operated by the Army. Three months before the Armistice it was turned over to the Post Office Department. Six other planes equipped to fly for an hour longer than the training machines were added to the first squadron until November that year, when the department formally took over the service. In addition to the twelve machines, it received from the Army Air Service six Curtiss R.-4 planes powered with Liberty motors.

There was much speculation regarding the Liberty engine at that period, but the Air Mail worked them steadily and demonstrated their worth. The six original machines, Curtiss training planes, are still in daily service between St. Louis, Chicago and Twin Cities. The first one to carry mail had flown more than 25,745 miles up to October 1, 1920. Five of the Curtiss R.-4's are still operating on the New York-Washington and New York-Cleveland routes.

AIR PATHS ACROSS THE CONTINENT

The transcontinental route was planned that first year. In September two pilots made pathfinding flights from New York to Chicago, flying one way each day. After the Armistice the War Department turned over one hundred De Haviland-4 machines and the Air Mail Service endeavored to place them in operation between New York and Chicago. It was then found that alterations had to be made.

While the department was seeking commercial planes, the L. W. F. Engineering Company set to work reconstructing one of the Army surplus D. H.-4's. Longerons were made firmer by sheathing in nickel steel. Steel tubes strengthened the landing gear. Axles were set ahead a bit, thus reducing to a minimum the tendency to nose over on landing. The pilot was transferred to the rear seat. The test flight of this machine, witnessed by Government officials and representatives of the industry, proved the soundness of the policy guiding the alterations. Many of these planes are now carrying mail.

Incidentally it was their successful use that led the Army Air Service to make similar modifications. These machines have become one of the favorite types with pilots in both services. Considerable numbers have been reconstructed by the Aeromarine, Boeing, Dayton Wright, Gallaudet, Thomas-Morse and other companies.

The Cleveland-Chicago route was opened with the first dozen of these planes. Regularly scheduled flights commenced on May 15th,

1919, the first anniversary of the Air Mail. The second dozen planes to leave the factories served to start the New York-Cleveland route July 1, 1919, and the New York-Chicago system was complete.

LARGER CARGO SHIPS SOUGHT

Meanwhile the mails were being flown on the meagre appropriation allotted for that purpose. Only \$850,000 was appropriated for the fiscal year of 1918. It was the only mail service of its time and the first and only development work of a commercial nature in the world. However, it was believed that with a steady service a saving could be effected above the cost of ordinary transportation. Officials believed that planes carrying from 1,500 to 2,000 pounds would reduce the cost, small as it then was, to possibly 40 per cent of that entailed by operating the smaller planes.

Bids were invited for these larger ships. The Glenn L. Martin Company, the Thomas-Morse Aircraft Corporation and the L. W. F. Company undertook to construct them according to specifications for performance. The individual companies were permitted to produce planes of individual type and design so long as they responded to certain tests.

MARTINS THROUGH STORM AND SNOW

Of these machines the Martin planes went into operation late in 1919. While qualifying as far as performance was concerned, the large mail ships had difficulty landing on the small fields. Had adequate terminals awaited these huge planes, pilots would have been spared much trouble. As it was the Martins operated through the winter of 1919 and 1920 in storm and snow. It is stated that two of these ships have the best performance records in the Air Mail. During the winter, which was extraordinarily severe, the Martins got through from Cleveland to Chicago when the railway trains were stalled. Again, one of the Martin pilots flew straight through a cyclonic storm which caused much damage to shipping and to structures on the earth. The pilot reported that the experience was like a storm at sea which only a staunch ship could weather.

The planes operated throughout a most severe winter, sometimes with skis — often taking off fields after literally being dug out of snowdrifts in which they were buried above the lower wings. It was this performance that firmly established the reputation of Martin machines as reliable cargo carriers. One of these Martin mail planes flew 185 hours without being overhauled.

The Martin mail planes, largest machines in the service, fly from four to five hundred and fifty miles at 100 miles an hour without

having to land for fuel. They are built for a crew of two. There are four mail compartments in the fuselage, two in the nose and two in the rear of the pilot's cockpit. The mail is deposited in these compartments through the top of the fuselage and released through trap doors in the bottom.

When these big planes were installed on the New York-Chicago route, the department was able to take off a 60-foot mail car in each direction. And the Martin planes carried from 1,000 to 1,500 pounds of mail—from 40,000 to 60,000 letters daily each way between New York and Chicago, making only one stop, at Cleveland.

But the experience with the Martins on the small available fields precluded the possibility of using the big L. W. F. tri-motored biplane over the mountainous areas, and accordingly the Army Air Service was given an opportunity to take it over. It was named the L. W. F. "*Giant*," as it was—and is—America's largest landplane. Here again, the Air Mail, by experimenting, had shown the Army the way.

But this was not all. When the Thomas-Morse mail plane was completed, it was found that it was the fastest big plane ever produced. Powered with two 300 h.p. Wright motors, it was capable of a speed of 134 miles an hour, with a full load. Again the Army Air Service was afforded a chance to secure a big and fast machine, and the Thomas-Morse accordingly became America's fastest bombing machine. It has become an accepted fact that while military machines are not always convertible into commercial planes, the opposite holds for commercial craft. Any commercial airplane can be transformed overnight into some kind of valuable military plane.¹

THE TWIN-MOTORED DE HAVILANDS

Late in 1919 the L. W. F. company turned over to the Air Mail its first twin-motored De Haviland. The plane has a mail compartment in the nose. It carries more fuel and its tail group differs from the ordinary De Haviland. The landing gear has been strengthened. The twin-motored De Havilands are carrying mails over the flat lands between Cleveland and Omaha today and also on the St. Louis-Twin Cities route. The Army Air Service, still profiting by the experiment of the flying mails, has had many of them built for dual control instruction work on twin motors.

TRANSCONTINENTAL ROUTE AUTHORIZED

By this time the Air Mail had progressed sufficiently to warrant extension through to the Pacific Coast. Congress was asked to

¹ Further data concerning the Martin, L. W. F. and Thomas-Morse planes will be found in the appendix.

appropriate the necessary funds and \$1,250,000 was set aside for establishment of the New York-San Francisco route. While waiting for the appropriation, Air Mail officials prepared the route. Adequate landing fields were sought. Municipalities were consulted. The route as finally chosen was decided upon principally because residents of the respective towns showed so much interest in the Air Mail. At least 75 per cent of the fields were provided by Chambers of Commerce. Had it not been for this aid the mails could not have flown through to the Coast, because the appropriation was not large enough to supply landing fields and repair depots.¹

The Omaha-Chicago Division was charted on January 10, 1920, and the service was immediately established on a regular schedule. This was one of the sections of the country where weather conditions were most severe that winter of 1919-1920, and a number of machines were damaged by snow and sleet. Daily service has been maintained since May 15, 1920, and the fields improved so that inclement weather does not cause trouble for the planes.

ANOTHER AIR LINE CHOSEN

The Second Assistant Postmaster General, Otto Praeger, and his aides later made inspection trips over two of the proposed routes between the Mississippi River and the Coast. One of these included Omaha, Cheyenne, Salt Lake City and Reno. The other extended from Omaha through Dodge City, Kansas; Phoenix, Ariz., Bakersfield, Cal., to San Francisco. The northern route was chosen.

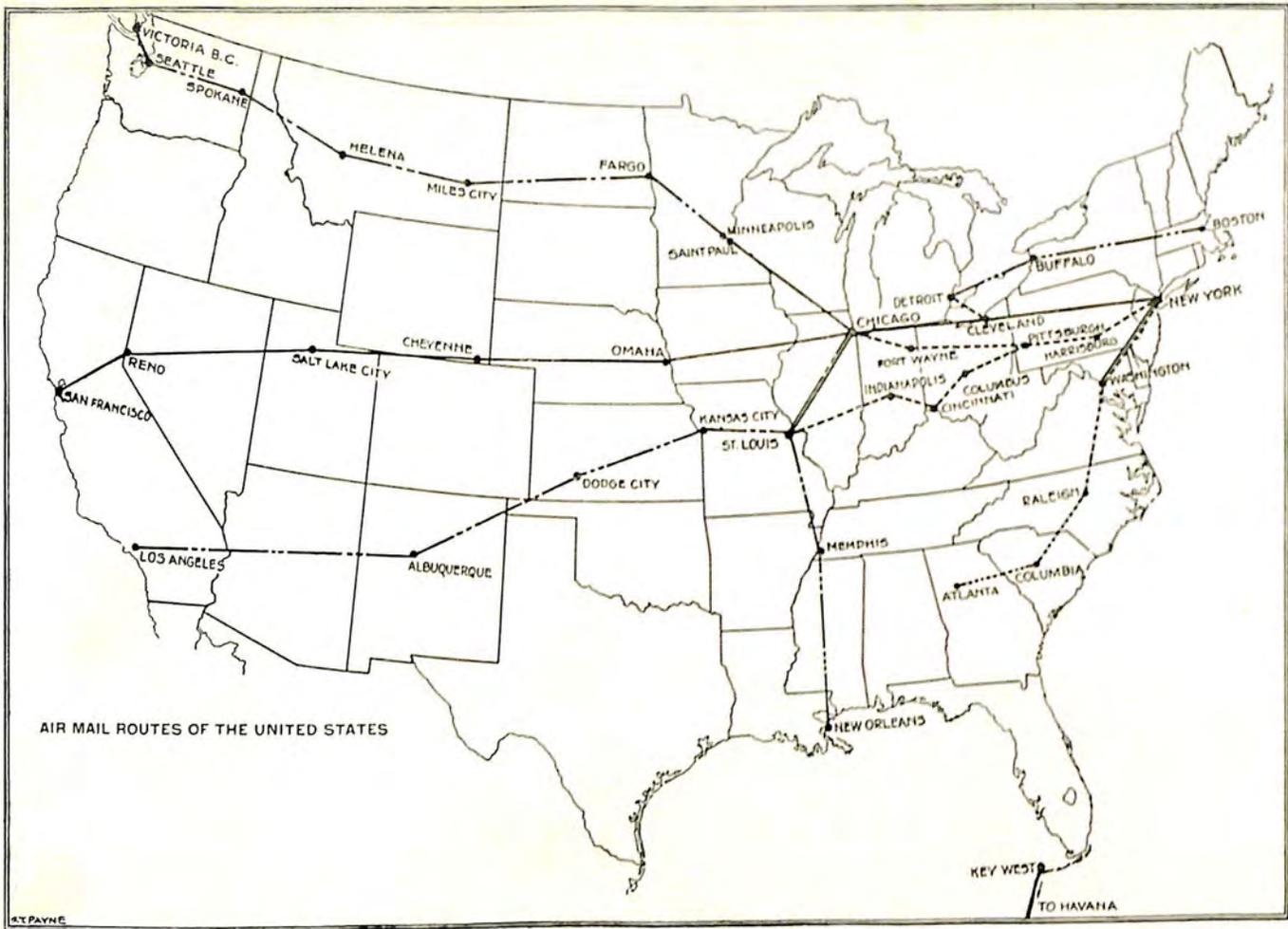
The Curtiss mail plane that left Curtiss Field, Long Island, on the morning of September 8th, carried many hundreds of pounds of mail. Another ship was sent out of San Francisco with New York mail at the same time. Despite heavy storms and fog, these planes brought the mails through in 20 hours less time than Coast to Coast mail had ever traveled.

ADEQUATE LANDING FIELDS REQUIRED

Working out of the main stations at Cheyenne, Salt Lake City, Reno and San Francisco, and the intermediate stations at North Platte, Rock Springs, and Elko, Nev., the pilots soon acquired maps, photographs, weather reports and full and complete descriptions of that part of the country. The maps are original. It has been learned that the mountain regions of both East and West have not been properly mapped for aeronautical purposes. Existing charts are not complete and in many instances are not accurate.

In a pioneer undertaking, such as the transcontinental Air Mail,

¹ A discussion of Air Mail terminals will be found in Chapter IX. . .



AIR MAIL ROUTES OF THE UNITED STATES

ST. PAYNE

AIR MAIL ROUTES OF THE UNITED STATES

ROUTES OPERATED BY POST-OFFICE DEPARTMENT OR PRIVATE CONTRACTORS(.....)

Post-Office Department

New York to Washington	200 miles	
Twin Cities (Minneapolis and St. Paul) to St. Louis, via Chicago	630 "	
New York to San Francisco, via Cleveland, Chicago, Omaha, Salt Lake City and Reno	2,630 "	
		3,460 miles

Contractors

Seattle, Wash., to Victoria, B. C.	84 miles	
Key West, Fla., to Havana, Cuba	90 "	
		174 miles

ROUTES FOR WHICH CONTRACTS HAVE BEEN ADVERTISED OR LET(.....)

Advertised

Cleveland to Detroit		110 miles
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Contracts Let

Pittsburgh to St. Louis, via Columbus, Cincinnati and Indianapolis	600 miles	
New York to Atlanta, via Washington, Raleigh and Columbia	815 "	
New York to Chicago, via Harrisburg, Pittsburgh and Fort Wayne	735 "	
		2,150 miles

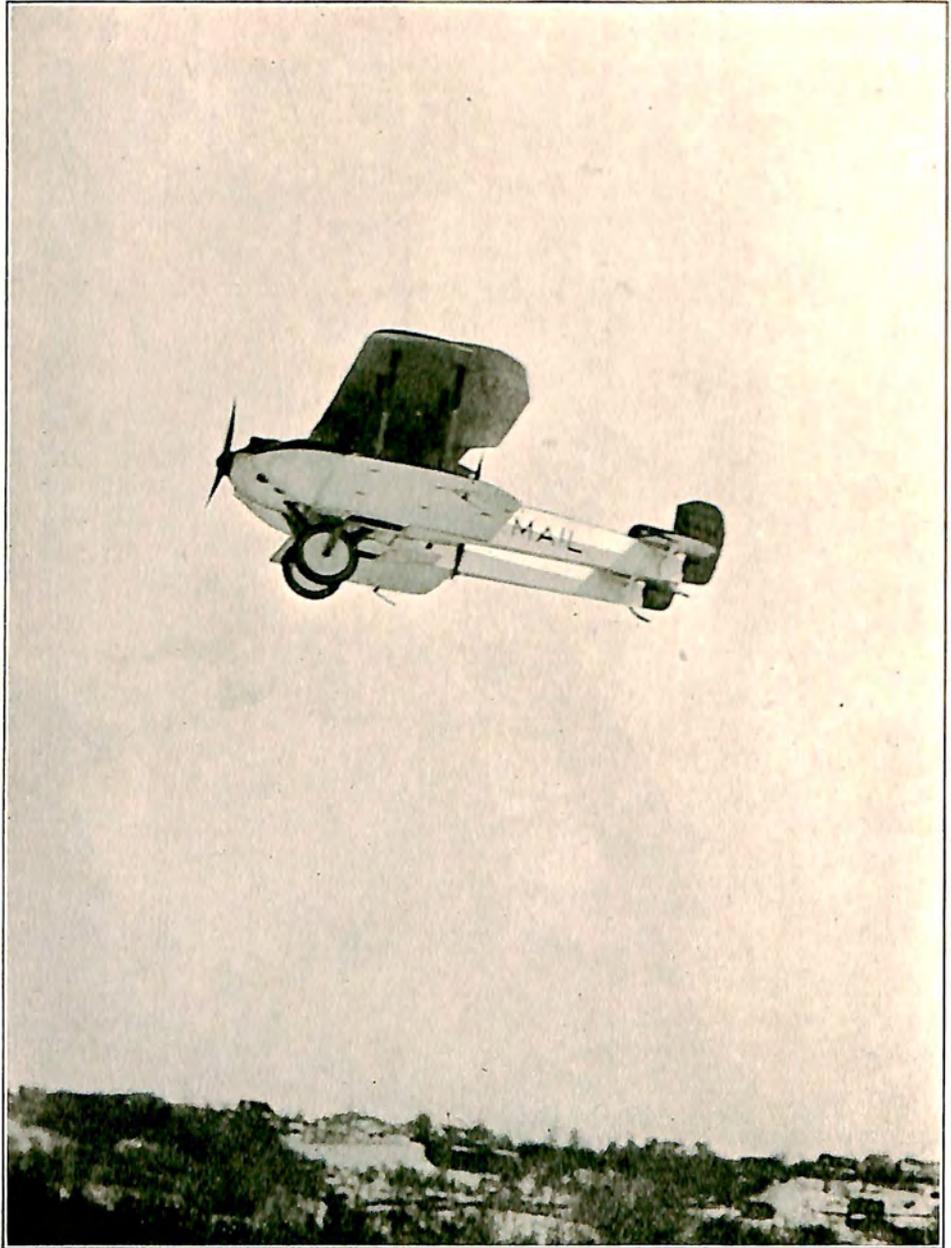
EXTENSION OF GOVERNMENT OPERATED ROUTES RECOMMENDED(.....)

Boston to Detroit, via Buffalo	695 miles	
Chicago to Los Angeles, via Kansas City	2,040 "	
St. Paul-Minneapolis to Seattle	1,465 "	
St. Louis to New Orleans, via Memphis	620 "	
		4,820 miles

Grand total		10,714 miles
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Glenn L. Martin Mail Plane en route from Chicago to New York. Martin mail planes operated through storms and blizzards when rail and water transportation was halted.



Thomas-Morse Wright-engined Mail Carrier.

much had to be learned through actual experience. Several planes were damaged in landing on the new fields in the Far West. E. Russell White, the Acting Second Assistant Postmaster General, felt that much more local aid and co-operation would be necessary before the service approached the desired degree of perfection. It was due to direct appeal by Mr. White that the Pacific Coast newspapers undertook a campaign to provide this much-needed help.

HOW MAIL IS SPEEDED UP

In his letter to the press, written in October, 1920, Mr. White predicted that the Transcontinental Air Mail would shortly justify itself. And it did. In supplementing the railroad service, it not only speeds up delivery from coast to coast, but actually advances all mail sent from east to west and west to east. This includes all mail whether dispatched originally by train or plane.

The bulk of New York's tremendous mail is deposited in letter boxes in all parts of the city after 4 o'clock in the afternoon. It is clear that this mail — amounting to many carloads — cannot be collected, delivered at the post offices and distributed in time to get all of the San Francisco and Pacific Coast Mail on the 8:40 o'clock train, which is the only through mail train of the day west of Omaha. Planes at 5:30 o'clock in the morning take 400 pounds each, or 16,000 of these left-over letters and deliver them to that same train connection at Chicago. This mail so far has been advanced 24 hours. The Air Mail at Chicago then awaits the arrival at Chicago of Train No. 43 from which it takes 1,000 pounds of Pacific Coast mail, 40,000 letters, and carries these to Cheyenne, where it overtakes Train No. 35's connection and puts it aboard. These 1,000 pounds have been advanced so far 24 hours. At Cheyenne the Air Mail takes from the train the 16,000 letters originally started by plane from New York to Chicago and delivers them that same afternoon in San Francisco. The train would not have arrived in San Francisco until the next afternoon.

By this service the planes advance daily 400 pounds of mail 42 hours and 1,000 pounds 24 hours into San Francisco. The 42 hours' saving cuts nearly in half the train time between New York and San Francisco.

Leaving San Francisco at daybreak, planes advance the mail 24 hours by putting it on Train No. 20, leaving Ogden, Utah, at 6:25 o'clock that afternoon. Leaving Salt Lake at 6 o'clock in the morning, the planes advance 12 hours into Cheyenne, the mails from the Salt Lake and Los Angeles lines and local night accumulations in Salt Lake.

At Cheyenne mail is taken from Train No. 6 for New York and advanced 24 hours into Chicago. Leaving Chicago at 6 A. M., mail is delivered in New England and Atlantic states one full business day ahead of the old system.

This eastern delivery is aided materially by the New York-Washington route, which takes the New England night mail out of New York City and delivers it in Washington or advances it aboard Southern trains at noon that same day. The northbound mails are flown from Washington and entrained for New England points in time to make delivery possible one business day in advance of ordinary train service.

HOW THE SERVICE AIDS COMMERCIAL FLYING

Commercial aeronautics in America is indebted to the Air Mail for its pioneer work. Regularity of service had to be demonstrated before business could be interested in utilizing aircraft. This has been the Air Mail's greatest contribution to commercial aeronautics.

In the existing state of incoherency with regard to laws, insurance, credit, inspection of aircraft, licensing of pilots, etc., no private enterprise could have attempted the proof of practical commercial aeronautics on a scale comparable to that of the Air Mail.

It was a stupendous task to endeavor to lay out a series of Air Mail routes from ocean to ocean. Knowledge could be gained only through actual experience. Extremes of weather are encountered and the varied topography makes it difficult for pilots to maintain a true course. The endeavor is ultimately to operate all aircraft by compass, so that regardless of fog or storm, day or night, the ship may safely pursue its way without loss of time. But a great many things need to be done. Maps must be altered and improved, for most of them are incomplete. New instruments now under experimentation must be perfected. But aerial navigation is every day approaching a more satisfactory state.

In the meantime the Air Mail pilots hold before the commercial pilots a splendid example. The *esprit de corps* is comparable only to that in military service under stress of war. Navigating as best they may with existing instruments, Air Mail pilots continue to fly as long as flying is possible. Many times they are compelled by exceptional circumstances to pursue their course between the clouds and the ground, and it is only after they have exhausted all resources for staying up that the morale of the service permits them to descend.

The aim of the Air Mail service of course is to make longer and longer jumps between properly equipped terminals and with ade-

quate emergency fields scattered along the way. Eventually, the mails will fly both day and night and it is certain that the course of commercial transport through the air will follow the path as laid by these pioneers.

NAVIGATIONAL INSTRUMENTS DEVELOPED

As has been indicated, possibly the most important development contributed by the Air Mail to commercial aeronautics is the establishment of radio communication between the mail planes and ground stations. This wireless system is now being installed on all planes. There are various kinds of radio equipment, each performing special services, developed during the year by the Air Mail Service and the Bureau of Standards.¹

COST OF OPERATION — COST OF POSTAGE

It is not generally known that a letter addressed east or west, north or south, will as likely go by Air Mail part of the way as by train. You mail your letter in the ordinary way after affixing a two-cent stamp. Whether it flies or travels the ground route depends on the time and location of mailing. The governing factor in movement is time. Postage receipts are not included in Air Mail figures, because so much other work is involved in handling that letter. The average cost of operation, including personnel, expenses, capital outlay represented and daily deterioration of equipment is 90 cents a mile per plane. This means that it costs the Air Mail Service only 90 cents a mile to transport from 16,000 to 40,000 letters at from 100 to 150 miles an hour.

To actually figure out the difference in operating costs of the Air Mail and Railway Mail would require volumes of reports and then the sum total would not be a concise result because costs differ on all divisions. The service is elastic and in fact, a co-operative one, railway mail cars being taken off and planes put on in their stead only when they can replace the cars at a saving in time and expense.

WHAT THE AIR MAIL SAVES

As an example, take the route between the Twin Cities and St. Louis, by way of Chicago. The Air Mail Service on this route operates at a total cost of \$280,000 a year. It displaces rail transportation valued at, or which would cost the Government \$261,608 a year. Therefore the actual expense or cost to the Government of operating this route is only \$20,744 a year, and more than 70,000,-

¹ For details of Air Mail Radio system see Chapter IX.

000 letters are advanced in delivery to the addressees. This is not a "paper" saving, but actual reduction in the cost of transporting and distributing mail in cars while trains are en route from one place to another. The number of pieces of mail carried has no direct bearing on the saving effected in the cost of mail transportation. The postage on 70,000,000 letters, if none weighed more than one ounce, would amount to \$1,400,000, but it would not be fair for the Air Mail to attempt to take credit for this revenue, and as a matter of fact no part of it is included in the Air Mail figures.

Nevertheless, a direct saving is made in another way. A standard 60-foot mail distributing car has between 600 and 700 letter-case separations or pigeon-holes, and is a traveling post office. Under a recent ruling of the Interstate Commerce Commission, railroads receive \$.3375 a mile for operating a 60-foot car. The distance between Chicago and the Twin Cities is approximately 400 miles, and at \$.3375 a mile, 365 days in the year, it costs the Department about \$95,000 to operate one car. Three 60-foot distributing cars operated in one train between Chicago and the Twin Cities cost the Government \$285,000 a year.

The average cost per mile for operating a railway mail car does not include the cost of clerks, terminal floor space and distributing space required in shipping mail over the roads. For example, there is a terminal railway post office in every large mail center. It operates independently of the local post office. It distributes only transit mails and performs the same kind of distribution made in mail cars en route from one city to another. Railway postal clerks are employed in the terminals six days a week, eight hours a day, or forty-eight hours a week. The cost of distribution is less in a terminal railway post office than in trains because road clerks will not average six hours daily distributing the mail, and their salaries are higher than those in the terminal offices. The mails now carried by airplane are distributed in these terminal railway post offices with a saving of clerical cost in addition to the saving in car pay. It is possible to hold mail from a train due to leave New York at night and arrive in Chicago the next evening, and land the mail by plane in Chicago five hours ahead of the train, redistribute and have it ready to go out on other trains or planes long before the arrival of the first train. It is in contraction of railway distributing space and elimination of clerical hire that the Air Mail saves money, aside from the reduction by half in cost of holding the mail, because it costs money for every minute that a letter is in transit or lying idle—and the airplane cuts that period in half.

"THE MAILS MUST FLY"

It is this element of speed that dominates the service and accounts in part for its peculiar efficiency, an efficiency that is not confined to officials and pilots but extends throughout the rank and file of the mechanical and clerical corps.

Otto Praeger, as Second Assistant Postmaster General, is known as the sponsor of the Air Mail. Had it not been for his initiative, persistence and intelligent direction, the service would never have succeeded. Explanation of this success is further found in Mr. Praeger's personnel. E. Russell White as assistant to Mr. Praeger was charged with much of the responsibility of maintaining the transcontinental mail. The engineering work has been superintended by Major L. B. Lent, the transportation of mails by Carl F. Egge, and operations by Charles I. Stanton. J. C. Edgerton, who aided Mr. Praeger in the early days, is developing the radio.

However, the most romantic personality is the pilot. He takes the mail through. Therefore the public is interested in him. Realizing this interest and desiring to help in the public support of the Air Mail Service, five newspapers along the transcontinental route in September offered prizes aggregating \$1,000 to the three pilots making the best performance on that system in six months. The newspapers co-operating in this are the *New York Evening Post*, the *Chicago Tribune*, the *Omaha Bee*, the *Salt Lake Tribune* and the *San Francisco Examiner*. It was stated that speed was not the essential point in performance, but regularity of service and maintenance of schedules were features to be considered. The Manufacturers Aircraft Association, Inc., and the Aero Club of America co-operated with the managing editors of the five newspapers and the office of the Second Assistant Postmaster General in charge of the Air Mail, in keeping an account of the performance of every one of the fifty pilots in the service.

CHAPTER IV

AERIAL FOREST PATROL EXTENDED; TIMBER CRUISER TAKES TO THE AIR; FOREST OBSERVERS FIGHT PESTS AS WELL AS FIRES; AIRCRAFT IN MINE RESCUE WORK.

THROUGH the operation in 1920 of a few aircraft lent to the Forest Service by the Army, there was saved from destruction by fire standing timber valued at more than the total Army Air Service appropriation for the fiscal year 1920-1921, or approximately \$35,000,000. Between 900 and 1,000 fires were reported, most of which were extinguished by ground forces directed from the air.

Out of the aerial forest patrol there have developed new and distinctly profitable uses for aircraft in the various operations connected with the timber industry. Difficulties of transportation, limitations of time and other obstacles peculiar to the nature of the work have been solved, through experimental aircraft services established by certain great lumbering companies in Canada.

AERIAL FOREST PATROL

The operation of the experimental aerial forest patrol service which the U. S. Army Air Service maintained during the summer of 1919 in conjunction with the Forest Service proved sufficiently successful to warrant its development.

Plans for the work to be carried out in 1920 were formulated at a conference at March Field, Riverside, Cal., between representatives of the Air Service and the Forest Service. As a result the organization of the Aerial Forest Patrol was so modified as to make it an integral part of Forest Service activities, though still operating under the direction of the Army Air Service.

The importance of adequately protecting our timberland against fire can be appreciated from statistics compiled by the Department of Agriculture, which show that some 10,000,000 acres of standing forests are burned each year. As the entire forest area of the United States is 463,000,000 acres, and reforestation takes about twenty years, it follows that, at an average of 10,000,000 acres

destroyed annually, our timber resources will not last long. The problem is further complicated by the ever increasing use of lumber and of pulp in the manufacture of paper and also by the fact that we have always used more timber than we have permitted to grow.

The Department of Agriculture estimates that 100 airplanes in daily service would keep the Pacific Coast forests safe from fire, an area which contains 52 per cent of all the timber in the United States. As fires destroy approximately \$20,000,000 worth of lumber each year, not counting the damage done to private property, the eagerness of the Forest Service to be permitted to use airplanes is readily appreciated.

Although Forest Service reports have for some time urged immediate action, Congress appropriated in 1919 only \$50,000 for aerial forest patrols, which sum was not even sufficient for providing hangars, repair shops, or personnel. All these were lent to the Forest Service by the Army Air Service and the Army pilots and observers were paid out of the Army appropriation for their work in behalf of forest conservation, although this appropriation in itself was inadequate for our national defense.

If the Department of Agriculture secures favorable action from Congress regarding the recommendations made in the summer of 1920, the aerial forest patrol will be extended to include all national and private timber lands in the United States. The Air Service desires to give further aid and the Operations Group has recommended that five squadrons be made available for duty with the Forest Service.

OPERATION OF AERIAL FOREST PATROLS IN 1920

During the summer of 1920 the airplanes of the Army Air Service principally patrolled the national forests of Oregon and California.

Near the end of June a main base was established at Eugene, Ore. During suitable weather one plane, leaving the field at 8:30 A. M. flew north over the Cascade Mountain range to a point opposite Portland, where it changed course to the west and landed at the Portland municipal airport. At 2 P. M. the return journey was begun, the course being laid over the western part of the Willamette Valley and the Coast range, the airplane arriving at Eugene about 4 o'clock. Also, one ship flew south to Medford, skirting the Coast range of mountains and returning to Eugene on the easterly side of the Willamette Valley and skirting the Cascade Range. Another patrol flew from the sub-base at Medford by way of Sumner Lake, to Alturas, Cal., and returned to Medford.

The entire Army personnel was in charge of Captain Lowell Smith stationed at Eugene. A Forest Service representative was also stationed at Eugene, who acted as a liaison officer between the Air Service, the Forest Service, the State Forester, and the private owners. Each plane was nearly always in communication by wireless with the main or sub-base. The northern patrol covered daily a route of 360 miles and the western patrol from Eugene covered 326 miles, each with one landing for fuel and oil. A total of 719 fires were discovered and reported during the summer by the Oregon aerial patrols. Two forced landings were made, resulting in serious damage to the planes, but causing no injury to the occupants.

NATIONAL PARKS PROTECTED

The California airplane patrol of the national forests started about June 1st, 1920. Headquarters were located at Mather Field, near Sacramento. Practically all of this work was carried on by the 9th Aero Squadron, Army Air Service. It was divided into detachments and these detachments were located as follows: One at Red Bluff with eight planes; one at Fresno and one at Mather Field. Each detachment consisted of about 25 officers and men.

Three patrols were operated out of Red Bluff: one went to Alturas and return, covering Mt. Lassen, the east half of Mt. Shasta and the Modoc region; the second to Montague and return, by way of the Coast slope, covering the west half of Shasta, the Klamath and the Trinity regions; while the third covered the California Forest, by way of Vovelo and Lakeport.

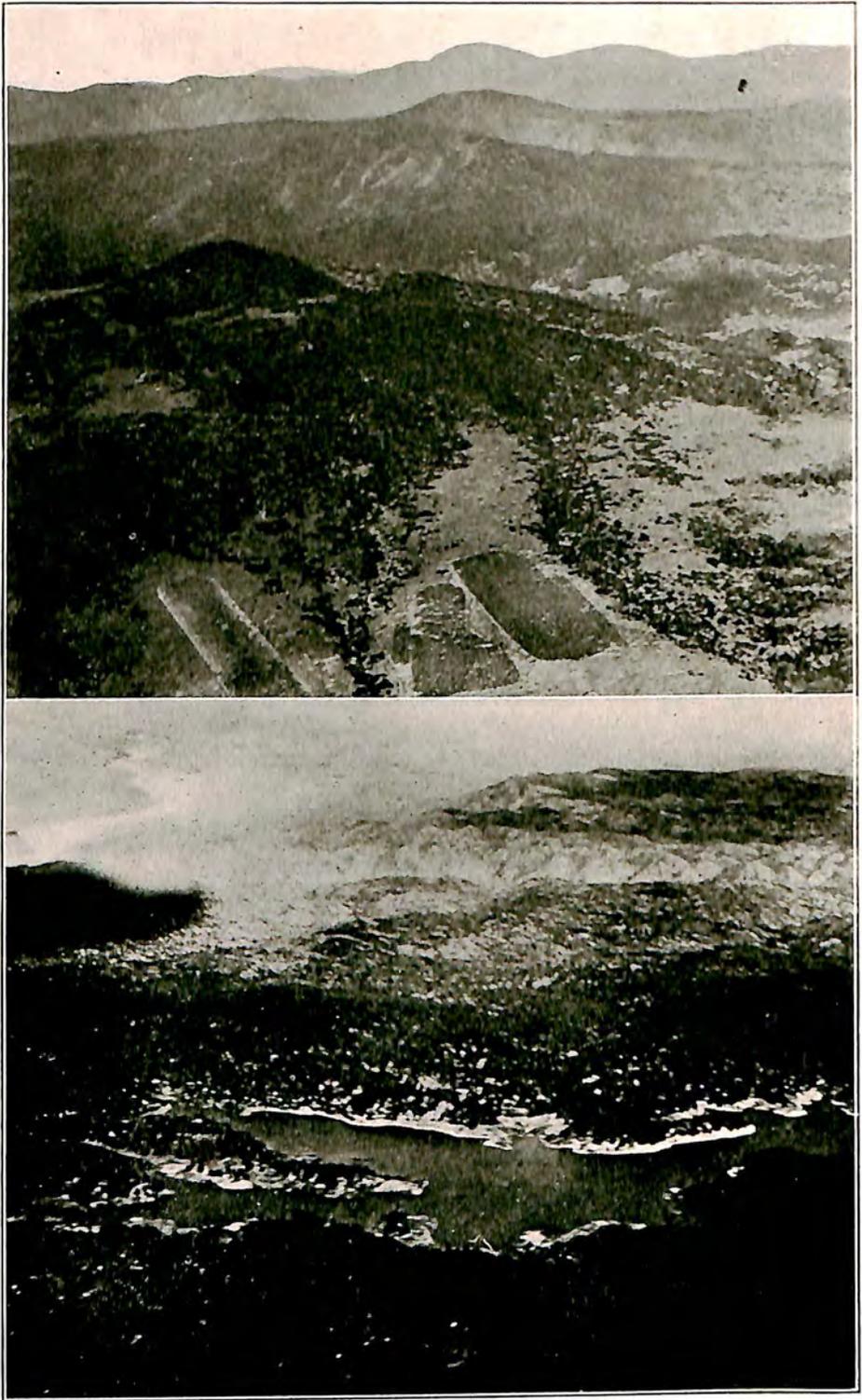
Two patrols operated daily out of Mather Field. One flew to Red Bluff, covering the north half of the Eldorado, Tahoe, Plumas and part of the Lassen forests; the second to Cooperstown, covering the south half of the Eldorado and the Stanislaus. Two planes were operated out of Fresno each day, one flying north to Cooperstown, covering the Sahara, Yosemite National Park and the Stanislaus forests; and the second south to Bakersfield, covering the south half of the Sahara and the Sequoia forests.

The March Field detachment protected the entire southern part of the state. One patrol covered the Angeles and Cleveland Forests, landing at San Diego, and the second flew north to Santa Barbara.

At each base a liaison officer was located. This officer in each case was an experienced forester, detailed for this special work. All matters in connection with airplane patrol out of each base in question were taken up with and through this officer, who also acted as a clearing house for all fire reports. At each base the



The Flying Boat Brings Vacation Woods Within Hours of Great Cities.
Lake Shawinigan, Canada.—Photo, Laurentide.



Fire in Santa Isabel Forest, Green Horn Range, Colorado. *Below*—Little Bear Lake, Aerial Fire Patrol District No. 1, March Field, Riverside, Calif.
—Photos, Forest Service.

liaison officer received fire reports by radio or from the pilots after landing. He in turn transmitted the report to the Forest Supervisor.

Paul G. Redington, Forester in charge of the California district, states that 33 per cent of the 196 forest fires discovered and reported by that part of the 9th Aero Squadron operating out of Mather Field this year were accurately located. "And 'accurately,'" said Mr. Redington, "in this case means that these locations given us by the airplane fire patrols were all within one-fourth mile of the exact location as later determined by actual surveys on the ground."

"This record, when supplemented by the further facts that an additional 19 per cent of the fires discovered were reported within one-half mile of their actual location, that 10 per cent of the total numbers were discovered by the air patrol before the rangers knew they even existed; and that 42 per cent or 83 of the fires were reported by radio, while the ships were in flight, demonstrates without a doubt that airplane fire patrol in California has been successful.

"Besides acting as lookouts to detect and report fires, airplanes were used this year to direct fire fighting operations and to patrol fire lines which have been established, but which needed watching to see that the flames did not get beyond control. The case of the Mill Creek forest fire, on the Lassen National Forest, where 25,000 acres were burned over, is an example. Here a special reconnaissance plane equipped with radio and with a forest officer for observer, hovered over the fire and actually directed the movement of bodies of forest fighters by wireless messages received right on the fire line. In addition this plane patrolled twice each day some fourteen miles of completed fire lines, from which all men had been removed. If reports from the air showed the line to be clear, the fire fighters were kept at work elsewhere, but if the observer wirelessed in that the fire had broken away, then a force of men was rushed to the spot and the fire coralled again."

HOW FIRES ARE RECORDED

At each base of operations of the airplane forest patrol there is a sending and receiving radio set and a wireless telephone attachment. There are also maps, covered with bright-colored pins. For every fire reported a pin is inserted in the correct location. When the fire is a day old a pin of a different color is put in its place. When the fire is extinguished the pin is exchanged for one of black. Fires reported from other sources than the forest airplanes are

marked with another color pin. Thus the map is an up-to-date and accurate history of the season's airplane patrol.

During August, the height of the forest fire season, the air over the Oregon forest was filled with smoke to an altitude of 11,000 feet. The pilots were compelled to fly at least 12,000 feet in order to be able to look down through these smoke screens. While ordinarily able to detect a fire and accurately locate it for a distance of forty miles where there is much smoke the observers' vision is limited to within twelve miles.

But if the observer in the airplane is handicapped by the dense clouds of smoke that drift up from the blazing forest, the lookout on mountain tops and at the head of ravines is rendered helpless. He cannot locate a fire accurately, and in many instances cannot detect another fire springing up in a new area.

Reconstructed De Haviland planes equipped with Liberty motors were used on the aerial forest patrol. While on patrol, the planes are throttled down to a speed of 100 miles an hour. Each plane is equipped with a radio set, and at each base a receiving set is installed, with capacity of receiving up to within 100 miles under good conditions. There was considerable difficulty with the first radio set installed on the planes. The Air Service finally supplied sets which operated successfully, and the patrols were kept in constant communication with their base and with each other. This successful operation of wireless made unnecessary the use of carrier pigeons.

CANADA TO PROVIDE AERIAL FOREST PATROLS

The results achieved by the aerial forest patrols which operated over some of the American national forests in 1919 have attracted considerable attention in Canada, where vast timber tracts, many of them still unexplored, require adequate protection.

Several schemes are under consideration for the protection of Canadian forests by aerial fire patrols. Arrangements have been entered into by the Air Board of Canada, the Commission of Conservation for Ontario, the Department of Agriculture and the Chief Forester for New Brunswick to use in the summer of 1921, according to the nature of the ground to be flown over, airplanes or flying boats both for carrying out fire patrols and for the conveying of entomologists to ordinarily inaccessible places. The latter officials are to visit portions of forest areas in search of outbreaks of spruce bud-worms, etc.

TIMBER CRUISING

Closely allied to the aerial forest patrol is timber cruising from the air. Our Forest Service's successful operations have led pri-

vate interests to undertake patrols of their own, fire protection being but one of many ends which it is sought to achieve.

The Laurentide Company, Ltd., of Grand Mere, Quebec, Canada, was one of the first thus to put aircraft to a practical test. This firm owns thousands of square miles of timber scattered over an area about 270 miles long and 160 miles wide, part of which slopes toward Hudson Bay. Much of this territory is unsettled, part of it is inhabited only by Indians, and as a rule the country is so wild that it is not uncommon for quantities of logs to be three years in transit from the timber land to the mills, so difficult is it to discover lost "drives."

In the summer of 1920 the Laurentide Company operated two Curtiss-built H. S.-2-L flying boats fitted with Packard built Liberty 350 h.p. engines. More than 16,000 miles were flown over this territory and some 5,000 photographs secured. The flying service of the firm, which was established early in 1919 by Stuart Graham, an American who served in the Royal Naval Air Service during the war, included in its activities fire patrol, mapping, timber cruising, general patrol, photography, passenger carrying and general surveying of the Laurentide properties.

The two H. S.-2-L flying boats were flown from Halifax to the northern country by Mr. Graham, his wife and a mechanic accompanying him each time on the 650-mile overland journey. The party carried in the flying boat a canoe, paddles, a silk tent, ammunition, fishing tackle, blankets, much food and cooking utensils, for it was realized that if a forced landing occurred it might be weeks before the party could make their way back to civilization. These precautions have been continued, and no aircraft ever sets out over the northern woods without such emergency equipment. During this very hazardous trip Mrs. Graham acted as navigator. Arriving at Grand Mere, Indians came for many miles to see the aircraft. They christened them "Kitchi Chshee" (big duck), and "Big Ducks," the H. S.'s have remained.

DISCOVERING LOST LOG JAMS

The two flying boats were at once put into service. Reporting forest fires was given priority over other work and the fire protection authorities were notified without delay.

Besides this fire patrol work the operations of the two flying boats consisted mainly in transporting company officials between various camps and surveying logging operations from the air. During the season 133 passengers, many of them women, were carried without accident of any kind, while more than 400 square miles

of territory have been covered in single trips. The logging manager of the firm made several trips to determine how rapidly the logs were coming down stream and in one case he discovered several million feet of logs which had jammed in an isolated section and had remained unnoticed all winter. Had this jam not been discovered it would have represented a great loss to the company besides causing a jam of other logs. From the air the manager was able to estimate the number of logs and determine the time it would take to saw them. All this was done at a great saving in time, only hours being required for these cruises as against many days for overland journeys.

At one time it was necessary to make a boundary survey of a district. The starting point was extremely difficult to locate. Had this work been done on the ground, twenty-two miles of actual surveying would have been necessary in order to locate the point. One of the flying boats rapidly solved the problem by photographing three sides of the triangle necessary to locate the point and by also taking views of the course of operations. The whole work was made possible through a few hours' flight and proved to be exact. When the land party went in this district, its work had been reduced from weeks to days and provisions, transported by aircraft, were found stored at every place the party was compelled to stop.

On another occasion word was received that a prospective buyer for a certain district would arrive within a few hours. An observer was sent up in a flying boat, photographs were taken, and five hours later, when the buyer arrived, the company was able to handle the transaction with full information as to the land, the nature of the timber it carried, etc. An area of 150 square miles can be covered in a three-hour flight by this method, whereas it requires a whole day to cover only ten miles on the ground. The advantages of aircraft over older methods are thus obvious.

STAKING A CLAIM FROM THE AIR

Here is a part of Mr. Graham's report:

"On July 22nd, with a crew of four, including Mrs. Graham, who acted as cook to the party, a trip was made into the heart of the woods to stake out two mining claims for molybdenum. Never did such a conglomerate load leave an air station on a flying boat, with complete camping and surveying equipment, including a folding canoe, blankets, two tents, fishing and hunting gear and, most unusual for the woods, a crate of eggs and a couple of gallons of fresh milk, which were carried without trouble. The trip on the ground necessitated a long detour requiring three days to perform,

but it took less than an hour by air. For four days we worked from daylight till dark blazing the line and marking the discovery and corner posts, and on the fifth day, with a much diminished load of freight, but an additional fifty pounds of mineral specimens, we broke camp and returned to our base, having done the same work a ground party would have performed, but our staff was less and we saved about six days in time. The claims were adjacent and were situated between two fairly large lakes. They had been located by a hunter, but as the country was not well known and as a photo mosaic had already been made of the territory, this was furnished the owner with the claim posts marked on the photograph rather than sending the usual drawings.

OBSERVER ESTIMATES STAND OF TIMBER

"In aerial survey in the pulpwood industry, where spruce and balsam fir are the chief woods sought for, it is not expected to determine the exact timber stand, but after making a sketch map of the country the burnt area, muskeg, wind slash and timber species are marked in and when this is passed to the cruiser he is enabled to go right to the timber and make a correct estimate instead of spending days over valueless ground in search of pulpwood. The same result is obtained by making a photo mosaic of the country, the topographical features being correctly depicted, which is not possible in a sketch map. Once the mosaic is obtained, the supplementing of the more accurate timber notes from the air is not very difficult and the result is a very valuable map."

SEARCHING FOR TIMBER PESTS

A great amount of such aerial photo survey work was carried out by Mr. Graham's party over practically unmapped territory. One trip extended over ten days, during which time a distance of 1,300 miles was flown and 400 miles of territory were mapped from the air.

During these operations Dr. J. M. Swain and Ronald D. Craig, of the Commission of Conservation, Ottawa, made a trip over the spruce and fir tracts to determine the efficiency of locating the devastating spruce bud-worm from the air. The ease with which details of this kind may be seen from the air astounded both of these men and they decided that this was the only means of quickly locating the ravages of this insect. Dr. Swain later made an extended trip, following out the idea which he had formed during his former aerial journey.

In order to supplement the operations of the two H. S.-2-L fly-

ing boats, two Curtiss "Seagull" flying boats were added to the company's fleet for use in the lighter type of work, while special twin-motored airplanes are being studied to meet other requirements peculiar to the Canadian woods. The Laurentide Company is constructing an elaborate land and seaplane station at Grand Mere, with hangars, workshops and living quarters for the flying personnel.

At the same time other lumber companies, among them the Spanish River Pulp and Paper Company of Sault Ste. Marie; the Price Brothers Pulp and Paper Company, of Quebec, and the Brown Corporation, of Berlin, N. H., are planning flying services of their own.

USE OF AIRCRAFT IN SPORT

The Laurentian Club, the great sporting and hunting club of Canada, which maintains scores of club houses throughout the wild regions between the St. Lawrence and Hudson Bay, is organizing an airplane line for the transportation of members and guests between its various club houses.

The cost of operating the large H. S.-2-L flying boats in the service of the Laurentide Company has been about \$1.00 per mile of travel, while for the smaller Curtiss "Seagull" flying boats the cost was about 50 cents. The firm expects, however, to reduce costs considerably by a better utilization of its aircraft, including in one flight many duties. The actual cost of mapping has been about \$6.00 per square mile for a map containing all details at a scale of 400 feet to an inch, where an airplane was used for mapping only. By combining the map work with other duties, such as fire patrol and transportation, the items of expense would be greatly reduced. But even at the highest figure stated the cost of mapping was far below that entailed by a land expedition.

AIRCRAFT AN AID TO THE FARMER

The Bureau of Entomology has for more than a year, through the courtesy of the U. S. Air Service, prosecuted its work of utilizing aircraft in the discovery of destruction of plant pests and it has met with great success.

In certain notable examples aircraft demonstrated their utility. They were particularly valuable in the scouting work necessary along the long stretches of the Rio Grande, on the Mexican border, where roads are poor and common means of transportation inadequate. They were used by the Bureau in scouting over territory infested by the Japanese beetle in the immediate vicinity of Riverton, N. J., and have enabled the observers to get a much better view of the territory than would be possible on the ground.

The experience gained from these experiments shows conclusively that the airplane can be put to excellent use in supplementing cotton survey work, particularly in determining the location of cotton fields situated in wooded and sparsely settled country, where they might otherwise escape detection.

AIRPLANE IN MINE RESCUE WORK

The Bureau of Mines in 1920 made preliminary plans for the utilization of aircraft in rescue work by quickly transporting engineers and oxygen apparatus to mine disasters. The U. S. Air Service maintains planes at McCook Field, Dayton, Ohio, in readiness to assist the Bureau of Mines Safety Station at Vincennes, Ind., in its rescue work.

The Bureau of Mines district engineer at Vincennes is gathering data on possible landing fields near the coal fields where the mine rescue airplanes will be called upon to operate. It is realized that the greatest difficulty confronting such a service is the serious lack of airports and landing fields in that vicinity. To operate with any certainty of success, mine rescue airplanes would require landing fields both at safety headquarters and at the mines.

To supplement the mapping work carried on by the Civil Operations Group of the Army Air Service, the Bureau of Mines engineers have been instructed to compile in the course of their field work comprehensive data on the surface conditions near each mine visited and map places suitable for landing. This data will be submitted to the Air Service as fast as it accumulates; thus in time comprehensive aerial maps of each mining district will be developed.

CHAPTER V

NEW MARINE USES FOR AIRCRAFT; SEAPLANES NOW "THE EYES OF THE FISHING FLEET"; SEALING OPERATIONS IN THE ARCTIC; U. S. COAST GUARD SAVES LIFE AND PROPERTY AT SEA.

NEW uses for aircraft over the water, in addition to the transport of goods and passengers, were revealed during 1920. It was discovered during the war that fighting aircraft could discern objects beneath as well as on the surface of the sea and an inevitable development was the fish patrol which, in the few months of operation during 1920, was responsible for the elimination of much expense and a great increase in the hauls of the Atlantic and Pacific fishing fleets.

Seaplanes that are seaworthy as well as airworthy now form an indispensable unit of the U. S. Coast Guard. At the single station operated during 1920, lives and property were saved by the flying guardsmen and the indications are that specially designed guns on seaplanes may in the future actually shoot lines to shipwrecked vessels or, if of sufficient size, such as the N. C.'s or F.-5's, even alight and remove passengers from the ship's life boats.

AERIAL AID TO FISHERIES

The Bureau of Fisheries, Naval Aviation and Coast Guard were instrumental during the year in developing fish-spotting to such a degree that commercial aircraft companies and fishing fleets are preparing to extend co-operation which has proved to be mutually beneficial.

It appears that the idea originated in 1919, with the Gloucester, Mass., Board of Trade. Naval Aviation was quick to respond to a request for equipment and experimental observation flights were carried on from Cold Springs Inlet to the Delaware Breakwater, thence to Five Fathom Bank and return. The result was to convince all commercial interests and Government departments concerned.

Since then fish-spotting from the air has been carried on also off the Virginian and Southern California Coasts. The Syd Chaplin aircraft interests, of Los Angeles, operated Curtiss seaplanes

for ten months. Patrols have also been sent out by the Naval Air Station at San Diego. Flights in connection with the menhaden fleets, on the east coast, were made at first through the courtesy of the Naval Air Station at Hampton Roads, Capt. S. H. R. Doyle, commanding, but this work will in the future be done by private companies.

Capt. Doyle's account of 1920 operations is particularly interesting. The C. E. Davis Packing Company, of Fleeton, Va., obtained the assistance of the Navy Department and detailed one of its fishermen to act as spotter in aircraft. The fishermen found that best results, in so far as menhaden were concerned, were obtained at an altitude of three to five hundred feet, although excellent vision was possible as high as three thousand feet.

The daily patrol was established at Hampton Roads on June 14. At 5 A. M. an H. S.-2-L seaplane left the station. The party consisted of pilot, radio operator and spotter. Radio apparatus was also installed on the fishing fleet and a shore station was established at Fleeton.

"In addition to radio," Capt. Doyle reports, "the planes also carried international signal flags, which were flown from the bow of the seaplane, suspended from an eye-bolt and weighted with lead. Squared charts of the coast were divided into sections and these sections into sub-divisions, the sections being lettered and the sub-divisions numbered. All fishing vessels and planes were provided with charts of this character.

RADIO REPORTS SCHOOLS OF FISH

"Due to the fact that co-operation was established with firms who were interested exclusively in catching menhaden, no other kind of fish were sought by the seaplanes although the spotter reported that he was able to easily spot blue and other kind of food fish.

"Patrols were operated daily with the exception of Sundays and a few other days on which flying and fishing operations were hampered by weather conditions, (mostly low visibility, due to fog and rain) and from this it would seem logical to state that the planes can operate whenever it is possible for fishing vessels to put their small boats and nets overboard. The patrols averaged four hours in duration.

"At the beginning communication between planes and vessels was carried out entirely by flag signals, but was rather unsatisfactory as planes had to travel, in some cases, a distance of fifty or sixty miles to notify the vessels by flags of the location of schools of fish.

Very good results were later obtained through the medium of radio.

"In a great many cases the vessels have been directed to bodies of fish which were within several miles of them and of which they had, apparently, no knowledge. In many instances the entire fishing fleet were found heading directly away from the fish and would, undoubtedly, have lost the entire day if it had not been for the assistance rendered by the plane.

"Summing up, it is the opinion at this station that aircraft can be used to great advantage by the fishing industry and that the best type of plane would be similar to the Aeromarine Model 40 or Curtiss M. F., carrying five hours' fuel and radio equipment. The duties of radio operator and spotter could be combined so that only two persons would be necessary to operate the machine. A certain number of vessels in the fishing fleet should be equipped with radio and a shore radio station should also be established."

NEW AND LUCRATIVE FIELD

The Bureau of Fisheries sees a new and lucrative field in spotting from the air. The Bureau's report, prepared especially for this Year Book is as follows:

"In a general way, a flight over any given region 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, which may be distinguished by their color, the eddies along their courses and by their reaction to the wind. Even when the observer considers himself familiar with a given territory, the view from aircraft shows him clearly many things which were either unknown, or imperfectly understood before. And in the case of new territory, observation from aircraft if possible, should be an essential part of fisheries investigation work.

"Besides the general value of such observation, in no other way can such a clear idea be obtained of the abundance or scarcity of fish of schooling species, and the characteristic appearance of the schools, as well as of all other forms of surface life. The location and extent of nets, number and position of fishing craft, and many other things relating to the fisheries, can be thus accurately observed in a mere fraction of the time that would be required in any other way. It is earnestly recommended that workers for the Bureau

should, whenever aircraft are available, supplement their observations by a bird's-eye-view of the region in which their work lies.

"The most evident opportunity for the practical use of aircraft in the commercial fisheries at the present time, lies in their employment as scouts for the purse-seine fishermen, in the pursuit of such species as menhaden, mackerel, bluefish, kyacks and other schooling fish. In the case of the spring mackerel fishery it is believed that the use of aircraft would save much time in locating the fish upon their first appearance, and in enabling the fishermen to keep in touch with the fish as they appeared further north. The chief service rendered would be notification of the fishermen of the general vicinity of the schools, and it would require actual trial and practice to determine how much could be done in directing fishing vessels to particular schools by means of radio-telephone or other methods of signaling. It would appear that the menhaden fishery offers the most promising field for experiment in this direction.

"The benefit to the fishing fleet would be in time and fuel saved in the search of fish, and the concentration of effort on large schools instead of wasting time on small, scattered bunches of fish. It is quite possible also that schools of large fat fish might be distinguished from those of smaller, leaner fish, although this would require experience in observation. Another field for experiment would lie in the guidance of fishing steamers to large schools not visible from the crosstrees, but plainly visible from aircraft, and communication by means of wireless telephone, marking buoys, or other devices, which would enable the boats to set the seine around the, to them, invisible fish. Such co-operation would be of great advantage to the Naval Air Service, as well as to the fishing interests, as it would provide for the naval aviators excellent practice in scouting, station finding, and communications."

AIRCRAFT IN SEAL HUNTING

The successful use of aircraft in fisheries turns attention to kindred pursuits. The Newfoundland Government expected, early in 1921, to have aircraft in operation in connection with the sealing fleets of the north. The theory of operation is this: The aerial observer will spot a herd of seal. The machine then descends to the ice and the hunters make their kill. The pelts are stacked on the "ice pans," to be picked up by surface ships when navigation is possible. The pelt stacks are located from the air and collection thus facilitated. It has been demonstrated that it is possible for a seaplane to alight on or take off from a snow field (see Aeromarine report in Chronology) and this proof is believed to be of peculiar significance in estimating future usefulness of aircraft in the Arctic.

LIFE SAVING AT SEA

Utilization of aircraft in Coast Guard work, which had been planned as far back as 1916, but which had been delayed by the war, was brought about finally in the month of September, 1920, when four H. S.-2-L seaplanes began operations at Morehead City, N. C.

Up to the time this volume went to press much experimental work had been accomplished, demonstrating to the satisfaction of the Coast Guard that aircraft would unquestionably provide great assistance along the following lines:—

1. Saving life along the coast and at sea contiguous to the coast.
2. Saving property along the coast and at sea contiguous to the coast.
3. Enforcement of customs laws.
4. Transporting Government officials where time is the important element or where other means of conveyance fail.
5. Fisheries patrol, assisting commercial fleets along North Carolina Coast.
6. Reconnaissance of water and land areas in surveying, mapping, etc., especially in connection with Coast Guard communication system.

The Coast Guard is indebted to Naval Aviation for the training of its personnel and use of equipment. The Navy has turned over to the Coast Guard a number of surplus seaplanes from the abandoned air station at Morehead, N. C. The State of North Carolina has placed at the disposal of the Guard, at nominal cost, a part of the tract of land once comprising the station.

The area within the radius of operations of the aviation station at Morehead City extends from Cape Henry on the north to Cape Romaine on the south and to a distance offshore of about one hundred miles. The location of the first station is particularly fortunate in that it is at a point 68 nautical miles from Cape Hatteras, 13 nautical miles from Cape Lookout and 80 nautical miles from Cape Fear, the coast line between these points comprising one of the worst stretches of our coasts in point of number of marine disasters occurring on or off the coast. It is also an extent of coast line and inland waterway peculiarly inaccessible for officers of the service engaged in inspection and construction of beach units of the service and in the maintenance of the communication system.

In the saving of life at sea by aircraft, the Coast Guard reports actual rescues of persons in the water. Instances have arisen when boats have foundered within sight of the Guard, but distance precluded rescue by surface boat. Then it was that the seaplane, at

home equally on the water as in the air, flew swiftly with succor. The commanding officer of the Morehead Station states that he has arranged for the reporting of accidents and that he has two planes ready for emergency use.

It is fully expected that seaplanes will, on the first opportunity, be the means of saving life by contributing to the location of vessels in distress, first by scouting, second by radio or direct report, and, third, by carrying means of relief. "In some cases," the Coast Guard reports, "should it prove impracticable to get a line to a vessel by means of the beach gun, aircraft properly equipped might effect the purpose desired. To this end a design of gear has been developed and the tests to prove its practicability or to develop it further will be undertaken shortly."

The Coast Guard is particularly impressed with the assistance aircraft provide in searching for derelicts when the object of the search is within a reasonable distance of the coast. The commanding officer of the aviation station would make arrangements with the commanding officer of cutters at nearby ports so as to be able to assist them effectively in searches. The recovery of derelicts under these conditions and their return to their owners as well as their elimination as dangers to navigation can well be classed as "saving property."

The duties of the Coast Guard in the prevention of smuggling and the relation of aircraft thereto are dealt with in the Appendix.

CHAPTER VI

AERIAL PHOTOGRAPHY—ITS USES IN SURVEYING, MAP MAKING, EXPLORATION, CITY PLANNING, ETC.; HOW AERIAL MAPS ARE MADE

AERIAL photography has been one of the richest contributors to the development of useful activities for aircraft. So successful have been experiments conducted by the U. S. Coast and Geodetic Survey, during 1919 and 1920, that it is planned, with the assistance of the U. S. Air Service, Naval Aviation and private operators, to revise, by means of aerial photography, the entire American shore line of existing charts of the Atlantic and Pacific Oceans.

The aerial camera, during 1920, occupied an important part in laying out commercial, postal and military routes over the United States and to Alaska; in making preliminary surveys of little known regions in our island possessions; in locating railroad rights of way at far less expense and in a fraction of the time once required; in exploration of Arctic and Antarctic regions, accomplishing in days what once would have occupied years; in urban uses, such as city planning, rail and water terminal improvements, real estate exploitation, fire insurance classification and the correction of congestion evils; and, finally, in what is proving to be a most attractive and lucrative branch—the addition to art of beautiful views which could be obtained in no other way than from the air.

A HERITAGE FROM THE WAR

It was the war which revealed somewhat the possibilities of aerial photography. Aircraft operating under Brig. Gen. William Mitchell, commander of American air forces at the front in France, frequently carried on photographic observation at 25,000 feet. Since the Armistice, equipment has been so improved that work is possible at 30,000 feet. But important as was the part taken by aerial photography in the war, General Mitchell sees even greater opportunities in peace. "The most important element in the development of a country," he writes, "is to have a good map of the country concerned, which will show how roads, railroads, paths, canals, or anything necessary

for communications can be established through it. In the United States, less than 40 per cent of our area has adequate maps. In this country there is no way by which mapping can be completed of the whole area for many years except from the air, and with the proper distribution of aerial mapping facilities throughout the country we will be able to map everything necessary within three years."

WORK BY U. S. COAST AND GEODETIC SURVEY

The first topographical experiments with aircraft were made by the Coast and Geodetic Survey in the summer of 1919. In June and July of that year, at the request of the Survey, photographs of Atlantic City were taken from Air Service planes. This area was selected because it is characteristic of much of the Atlantic coast line. Though experimental in character, the work was of such value that the results are now being utilized to revise existing charts of the New Jersey shore.

The photographs were taken from an altitude of 7,000 feet, from a "K-1" mapping camera, using a lens of 10-inch focal length. The individual photographs were then assembled into a mosaic over a rough control scheme. Study of these photographs by members of the Survey, according to a special report prepared for this review, revealed interesting possibilities in revision, especially along those sections of the Atlantic coast where the shore line is frequently changed by action of the sea.

During the same period, Naval Aviation, at its Key West station, investigated the possibilities of aerial photography as an aid to hydrographic surveying.

In March, 1920, a single strip of photographs along the outer coast of New Jersey was made for chart revision by the Air Service from an altitude of 10,000 feet, using a "K-1" camera with a 300 mm. lens.

There are two methods, the Survey writes, used in reducing the photographs to chart form. A strip mosaic limited to ten photographs is assembled. This is compared with the latest topographic sheet of the area and if no discrepancies appear between control points, a tracing is made of the features wanted on the chart and this tracing is reduced photographically to scale. The second method differs in that, if discrepancies appear when the mosaic is compared with the sheet, a reduced photograph is made of the mosaic on the same scale as the topographic sheet. A direct comparison can then be made to locate the cause of error. The reduced photograph is then treated as an ordinary survey, and adjusted to the nearest control points.

In stating its intention to utilize aircraft in revising the shore line charts of the Atlantic and Pacific oceans, the Survey writes: "Experiments to date appear to indicate that the existing methods and apparatus are adequate for revising the coast line or distinguishable features that were shown on the original survey."

URGENT NEED FOR BETTER MAPS

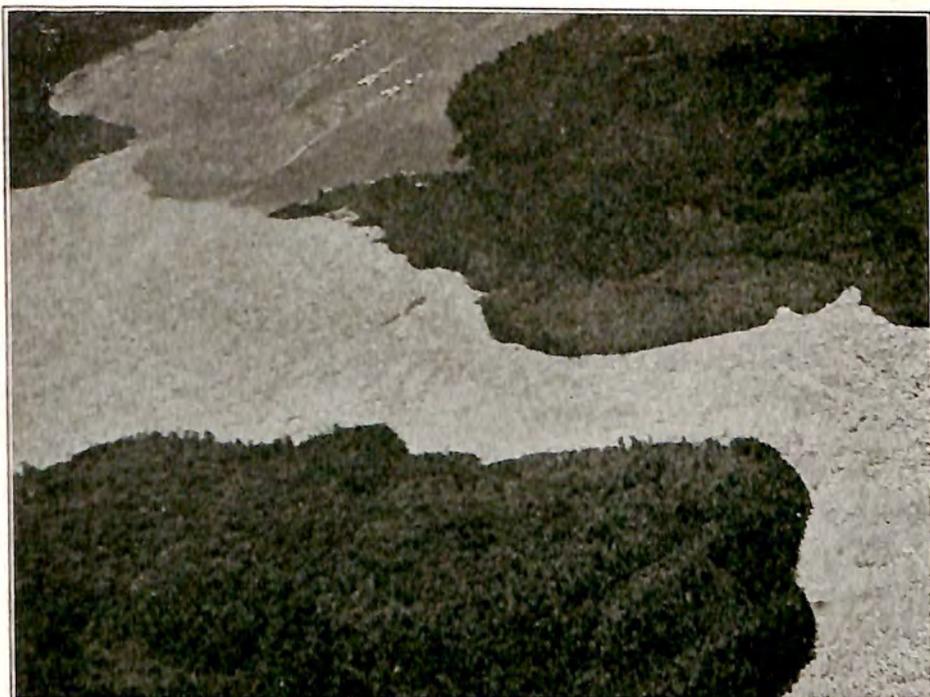
On December 30th, 1919, there was created by executive order a Board of Surveys and Maps. The work of this Board is to co-ordinate the activities of the various map-making agencies of the government and to endeavor to prevent unnecessary duplication. The Board functions by means of standing committees, on two of which representatives of the Air Service are serving. These are the Committee on Information and the Committee on Photographic Surveying. A number of tests are now in progress to determine the further availability and economy of aerial photography in map-making and aerial surveying.

If we are deficient in our maps for surface traffic, it must be apparent that the lack is much more pronounced with relation to traffic through the air. Every pioneer flight made by service aircraft has contributed something. There are three outstanding examples in 1920. The first was the remarkable 8,000-mile recruiting flight which Commander A. C. Read made in the famed N. C.-4 flying boat down the Atlantic and Gulf coasts and up the Mississippi and Ohio river valleys.

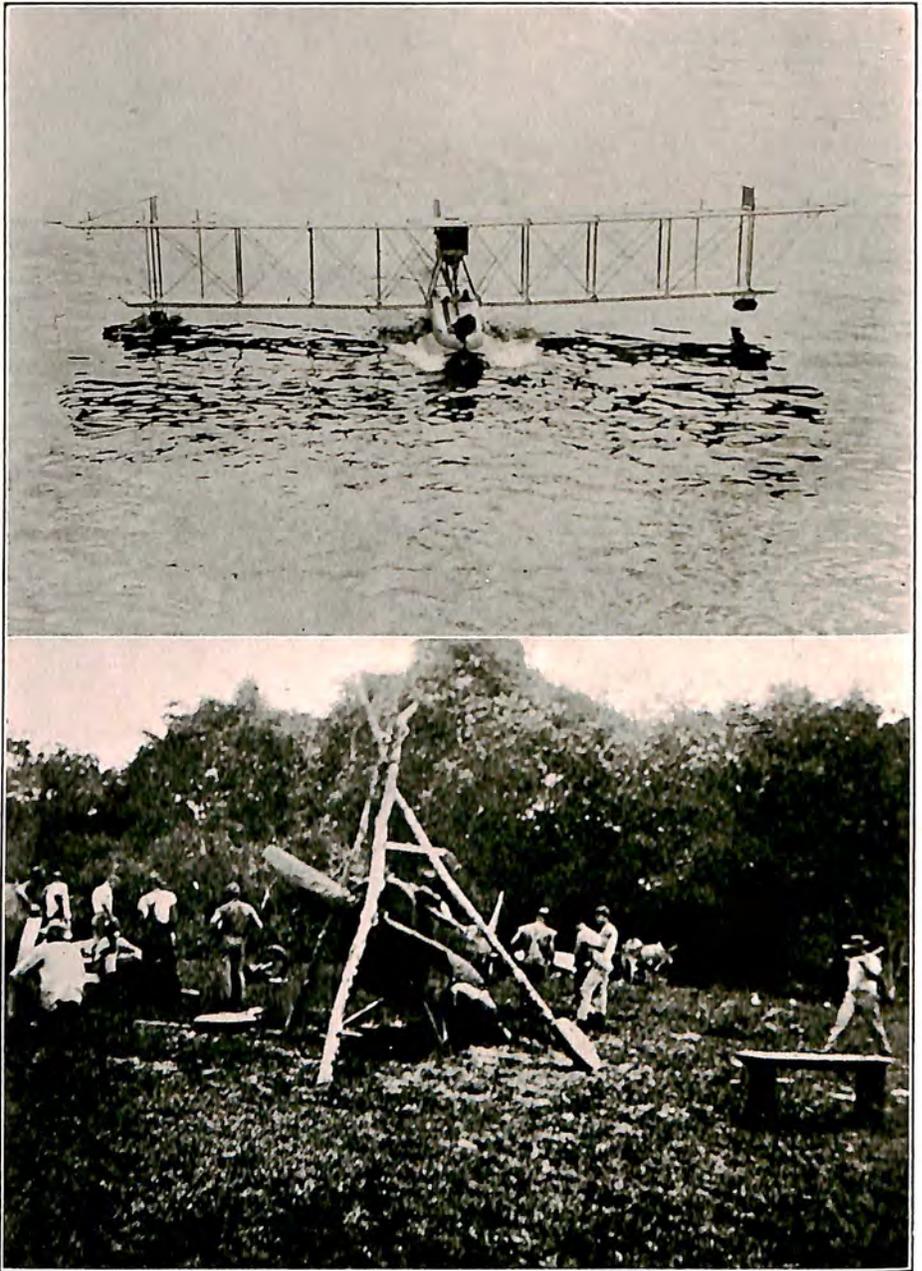
One of the worst handicaps Commander Read encountered was the lack of satisfactory maps. He reported: "In the long amount of coastal work done, the charts of the coast line have been observed to be fairly accurate. They are, however, sadly lacking in up-to-date information concerning land marks. While running in a fog along the coast of Louisiana a landing was made off a large town called Chinens Caminada, according to the chart. No vestige of life was found. Later it was learned that the entire town had been wiped out by a hurricane and flood in 1893."

The round trip flight to Alaska which Capt. St. Clair Street and Capt. Howard T. Douglas, with a squadron of four Air Service planes, made late in the summer, provided the Survey with new photographs and data. It is expected that the Canadian government, which assigned a representative to accompany Capt. Douglas in his ground work through the Yukon, will co-operate with the American authorities in map revision.

"The recent flight to Alaska has covered areas impossible to cover by other means," is the comment of Gen. Mitchell, "and



The Timber Cruiser Takes to the Air. Logs in River Ready to be Sorted.
Below—Laurentide Flying Station, Grand Mere, Quebec. The flying boats are
Curtiss H. S.-2s with Packard-constructed Liberty Engines.



Airplane in Fish Spotting. Curtiss H.S.-2 taking off at Hampton Roads.
Below—Setting up a Marine Corps Plane after a field had been cut from a
jungle in Santo Domingo.—Photos, Naval Aviation and Aviation Section,
Marine Corps.

brought to us knowledge of the glacial formations, channels, mountain lines, and rivers in a splendid way. In a country such as Alaska, the routes for carrying out ore from the mines and for carrying supplies to the seaboard in a time when the country is frozen up and unsuitable for winter travel can be found most readily by aerial photography."

Existing maps of British Columbia and Alaska are worth but little, in the opinion of Capt. Street. For hundreds of miles they flew over territory which had not even been mapped in a primitive fashion and through a vast region the only available information came from trappers or miners.

The pilots of the Aerial Mail, who fly day in and day out as a matter of routine, defying weather which during the war would have driven most machines to earth, have been compelled to "make" many of their own maps. They have received much assistance through Air Service flights. They have supplemented ordinary commercial maps with information which they themselves have gathered, and the result, if some adequate means of co-ordination can be effected, should be the accumulation within a short time, of data covering the transcontinental route which will be of much value to the Survey in correcting existing records.

AIRCRAFT IN EXPLORATION

In Chapter V, on "New Marine Uses for Aircraft," there is a hint of the utility of the flying machine in frigid zones. Already considerable progress has been made in aerial exploration in the far North. Aerial photography and quick transportation are the chief contributions.

In 1920 Capt. Daniel Owens conducted an expedition into Labrador. A Boston financier desired accurate information concerning timber resources. This involved a survey of the land and a report as to the best route for transporting the logs to tidewater.

Capt. Owens had twenty-five men in his party. He and another pilot — William F. Kenny — purchased a Curtiss training type airplane. Owing to the prolonged summer daylight they were able to work two shifts and consequently the Curtiss, which proved to be as adaptable to scientific uses as to Army training, was flown actually from eighteen to twenty hours a day. In ten days 15,000 pictures were taken, some with ordinary aerial cameras, others with motion picture equipment. In these ten days accurate information was obtained covering one and one-half million acres. How long would it have required to accomplish this work by ground methods? A conservative estimate is five years, assuming that a much larger party was employed.

Capt. Owens performed a hazardous task. In the miles of forest over which he and Mr. Kenny flew there were very few clearings suitable for forced landings. But they had no trouble keeping aloft. In fact, the only accident that befell them was when their steamer crashed into an ice floe.

The experience of the Owens party in mapping is similar to the work which is being done by the Laurentide Company in logging operations in Canada. (See Chapter IV.)

FLYING IN THE ANTARCTIC

In October, 1920, there sailed from Norfolk, Va., a ship bearing the British Imperial Antarctic Expedition, headed by John L. Cope. Mr. Cope took with him a specially designed airplane for use in his explorations. Several other planes are now building and will be sent to the Antarctic base.

The British party includes an experienced pilot who has endeavored to offset the difficulties of flying in extremely cold regions by enclosing the motor of his plane in an insulated chamber which can be heated to a satisfactory working temperature. The landing gear is fitted with skis to permit running on snow or ice and a special "all-clear wind screen" is provided to prevent obstruction of view by snow. The hangar problem has been met, to a degree, by the fact that the planes have folding wings and can be stowed away in comparatively small quarters. The machine is especially equipped for photographic work and will carry, besides its crew of three men, a sledge, a tent, icepicks, a light hangar and food for three weeks.

The Cope expedition proposes at first to map the western coast line of the Weddell sea and later to complete the charting of the entire Antarctic coast region and, finally, to make a dash for the South Pole by air. This would involve a 360-mile flight from the base and would carry the aviators over a plateau at an altitude of 11,000 feet.

Aircraft are expected to cut down the time required for polar exploration, which has hitherto consumed years for a single trip. Because of the possibility of covering wide areas in a single day's flight, flying time can be selected when bright sunshine renders conditions ideal for aerial photography. It is estimated that in three flights—250 miles in one direction, 50 miles at a right angle to it and returning on a parallel to the outward course—it will be possible to cover a stretch of coast which, to traverse in the old way by sledge, would require at least 80 days.

Thus science takes to wing.

AND IN THE TROPICS, TOO

The station records of the Army and Navy Air Services reveal interesting excursions into the little-known territory of our island possessions. Near Central America, for example, there are thousands of islands which depend upon shallow-draft sail boats for communication. Trips require many days and but little intensive exploration had been done. The all-seeing eye of the aerial camera has been turned upon these regions and as a result geographies are being improved.

If continental United States is inadequately mapped, what of Hawaii and the Philippines? Flights are constantly being made in the islands by our Service planes and full utilization of the scientific results of these tours awaits only more adequate co-ordination of our aerial activities in Washington.

LOCATING A RAILROAD BY AIR

The Air Service, which is keen to aid commercial aeronautics in every way possible, reports the following concerning the locating of a railroad in the Philippines by means of aircraft:

"Locating a railroad by airplane is the latest venture of the Third Aero Squadron, Camp Stotsenburg, Philippine Islands, and one long flight has enabled a railroad engineer to determine which one of three general routes will be utilized for the new road. The saving of many months and thousands of dollars has resulted. Instead of three parties of locating engineers being sent out to make the preliminary survey only one will now be necessary.

"The Manila Railroad Company has planned the extension of its line from Cabanatuan through parts of the provinces of Nueva Ecija and Nueva Vizcaya to Bayombong. Parts of the two provinces are very thinly settled and no comprehensive maps or surveys were available.

"The military authorities are vitally interested in the extension of the Manila Railroad Company line, and accordingly permission was obtained from the Commanding General, Philippine Department, to use a government airplane on the preliminary reconnaissance trips.

"The first trip was made by Mr. E. S. Von Piontkowski, Chief Engineer, in a D. H.-4 piloted by Lieut. W. C. Maxwell, 3rd Aero Squadron. Lieut. Maxwell, with the railroad officials in the gunner's cockpit, passed over Mt. Arayat and then followed the Pampanga River until he picked up the railroad line at Gapan. He followed the river from Cabanatuan on to Pantabangan and over Mt. Pangloriahan, thence to Bayombong.

"The railroad engineer on the return was enthusiastic over the trip, declaring that the single flight has saved him months of tedious work in running lines through difficult territory. Before his surveying party is sent he plans at least one additional reconnaissance trip."

AIRCRAFT IN URBAN DEVELOPMENT

It is many leagues from Philippine engineering to transportation problems in the heart of New York City or Chicago. Yet aircraft provide a common utility.

City planners who have long drummed into the unheeding ears of the American public the wisdom of starting new cities aright and remedying the old by applying a little wisdom in the disposal of terminals, municipal buildings, residential districts, sanitation facilities, etc., have found in aircraft a propagandist as well as a powerful servant.

"There would be fewer opponents of city planning, could they see the average city as it actually is from the cockpit of an airplane," says a writer in the *American City Magazine*. "A view of a city from above gives to the city planner its appearance as a whole. Some men have the rare gift of visualization and can construct the picture from a knowledge of its parts. The successful city planner must accomplish this by some means or other, because in the broad sense city planning disregards concentration or details and concerns itself primarily with the formation of the complete entity. The airplane does not give that confusion of detail one is so apt to get on the ground, and the general plan stands sharply out. Maps and drawings cannot give just this result because they cannot adequately differentiate the old buildings from the new, or, indeed, show anything except in a conventional and mechanical manner.

"When a city-planning scheme is decided upon, it is rare that there are suitable plans or maps to guide one. Plans, as a rule, are littered with streets projected, subdivisions proposed, buildings and improvements not existing on the ground. Everything that the map shows has to be verified before planning work can begin. Aerial photography avoids this by the production of a pictorial survey accurate to the very minute the picture is taken. The city planner making a flight over a city can correct his maps in the air, mark the limits of the built-up area, etc., and altogether form a fairly good estimate of the correctness of the maps.

"From the air, the value of space, fresh air and light are realized much more than on the ground, where one is too near the picture to comprehend it properly. And, again, parks, open spaces and trees are seen as distinguishing landmarks. Buildings seen in bulk suggest questions at once — open space? residences? adequate roads? factory locations? and so on. One strives to reconcile all these features in the scheme of things. No amount of map study could place them in the same relationship one with the other and with the city as a whole."

If not "town planning," then "town correction." Here, too, is where the aerial photographer is making good. The Fairchild Aerial Camera Corporation, to which the compilers of this volume are indebted for much information, states:

"We recently took a series of views of the congested areas of New York to show for the American Red Cross the block after block of tenement buildings with no parks or playgrounds. A hundred ground pictures would not record what this one aerial view showed.

"Real estate is most advantageously shown by the aerial view. The New York *Evening Post* is one of the pioneers in this movement. Every Saturday the real estate section of the New York *Evening Post* contains an aerial view of some new real estate development. Many engineering firms have had aerial views taken of properties. Insurance companies examining risks have found the aerial mosaic of great value in revealing the character and type of buildings, together with their surroundings."

THE TECHNIQUE OF AERIAL PHOTOGRAPHY

Preceding sections of this chapter may have raised a question in the mind of the reader just how aerial photographs are made and applied, not only to scientific but commercial problems.

Major H. K. Maxwell, formerly in charge of photographic training of the British Royal Air Force, and who since the war has been engaged in commercial aerial photography, has contributed his views:

"There are two distinct branches to this fascinating work — vertical photographs taken directly above the object and oblique views taken sidewise, the latter called bird's-eye views." He writes:

"Vertical photographs have been made of river and canal systems, harbor works and ports, oil fields, ranches and farms, town sites, railways, roads, street car lines, plants, factories, etc.

"Rivers were depicted so that the currents, rocks, depths (in shallow water), condition of the banks, trees, course and surrounding country were plainly discerned. The constantly changing terrain in the oil fields and all approaches have been successfully mapped by the aerial camera. Mosaics of ranch lands have been made portraying grazing and cultivated areas, fences, dams, irrigation, timber, nature of the terrain whether hilly or flat, condition of roads and trails and, in fact, everything that would require weeks by the old system. Yet the airplane photographer does it in a few hours.

"Scale maps of cities involve many problems, because of the varying height of buildings and the multiplicity of streets which must be photographed at certain set times owing to shadows and difficulty in eliminating an accumulated error over long lines of streets and avenues. Large cities are at present difficult to map in this manner, although it is only a matter of time and experience.

Cities 25 square miles in area have been mapped accurately, every possible detail being shown, even trees and shrubbery in the gardens.

MAKING VERTICAL PHOTOGRAPHS

“Three methods of making vertical photographs are, first, matching and joining the photographs, by which the mosaic is correct, but the scale may not be; second, carrying out a preliminary survey by triangulation so that definite, marked points will appear in each photograph and then making the mosaic from known measurements between these points; third, building up a mosaic from actual survey data of the terrain.

“The second and third methods cost three or four times as much as the first and, though they are suggested for accurate work, the first will prove satisfactory if care is taken, sometimes scaling to 1/50th inch error, which compares favorably with a majority of maps.

“It is almost impossible to make a map or mosaic from aerial photographs without a suspended camera, either controlled by hand or gyroscopically — and the latter at present cannot be practically carried out; a plane which not only gives a clear and uninterrupted view to the pilot (especially) and photographer but has a high speed and a ceiling of at least 16,000 ft. which it can reach fully loaded in at least 30 minutes and maintain for at least three hours; a pilot who is not only a perfect flier, but can accurately fly a series of straight lines over country which has few if any prominent land marks, with a perfect and concise knowledge of map reading and cross country flying generally, and a certain amount of photographic knowledge; an aerial photographer with a steady hand and an absolute mastery of his camera under all conditions, a trained reader of maps, and all sorts of country and a clear and concise knowledge of his object; a skilled surveying or civil engineer to arrange the scale and method of procedure and put resulting photographs into accurate map form. There is also required a skilled darkroom staff, probably the most important of which is the printer; for aerial negatives are nearly always a little uneven and if this is not corrected in the printing room, a resulting mosaic will look like a patchwork quilt rather than an evenly colored picture of the terrain.

MAKING OBLIQUE PHOTOGRAPHS

“There are many ways of making oblique photographs of scenery, real estate and properties, but there is only one way in which this sort of subject can be fully depicted and that is by flying around it at heights and over certain points which have been decided before-

hand and on knowing which, photographs can be obtained, giving any angle of view required. In this way the resulting photos show the extent, size, position, height, shape, and every detail of the buildings and grounds concerned in a way which is so much better seen and easily comprehended, that a photo taken from the ground can show no comparison.

“All governments are interested in this work, but the U. S. Army Air Service, without doubt, has accomplished more and progressed further in solving the many intricate problems than the others, especially in the survey and mapping division; while its oblique work with the long focus lens will remain for some time the best that has been produced.”

CHAPTER VII

AIRCRAFT THE NEW VEHICLE FOR NEWS GATHERING; HOW FLYING HAS AFFECTED THE PLANNING AND EXECUTION OF MOTION PICTURES.

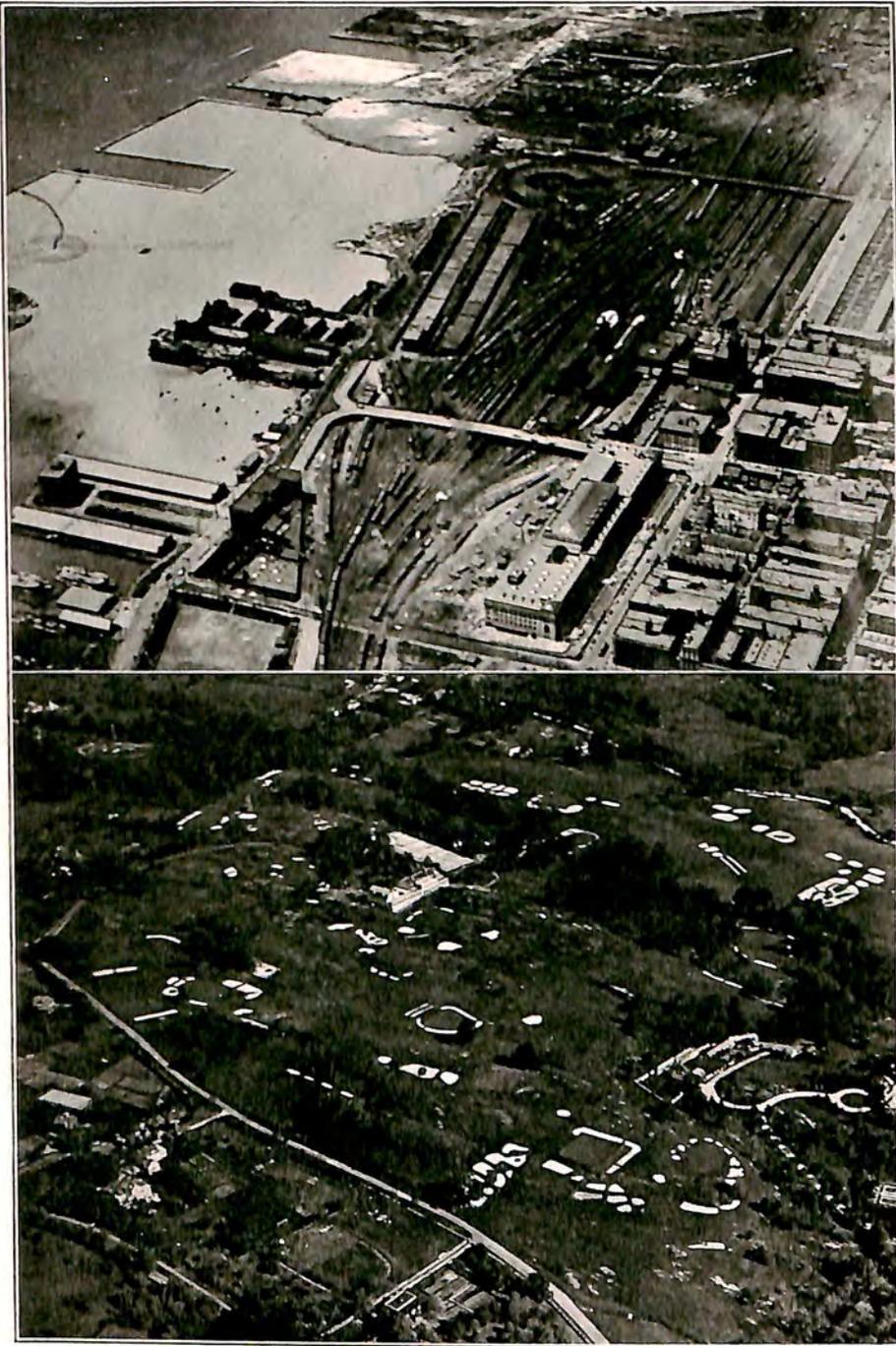
THE AIRPLANE AND THE NEWS

TWENTIETH century journalism, dependent for success as it is on speed and enterprise in news gathering, has been influenced to no small degree by aircraft. Always alert for improvements in methods of circulating their publications and of presenting the news and photographs in a better manner, editors have begun to recognize in the airplane a servant able to do their bidding in numberless ways. In so many instances in recent years, notably 1920, have aircraft been of use to journalism that it will not be very long before the plane will become a necessity to the fourth estate in its varied activities.

Leading newspapers, such as the *New York Times*, *Tribune*, *Herald*, *World*, *Evening Post* and *Globe*; *Boston Post*, *Philadelphia Ledger* and *Press*; *Chicago Tribune*, *Detroit News*, *Milwaukee Journal*, *St. Paul Press* and *News*, *Omaha Bee*, *Salt Lake Tribune*, *Los Angeles Examiner* and *Times*, *San Francisco Examiner*, *Bulletin* and *Call-Post*, *Portland Journal* and *Seattle Times*, have especially assigned reporters to keep in touch with and chronicle the latest developments in aviation. Many of these aerial journalists have "covered" their stories by airplane, undergoing varied and thrilling experiences in getting the news. It is safe to say that newspapers in almost every state in the union have employed the airplane for advertising, news gathering, aerial photography, the transmission of photographs and deliveries of the publications.

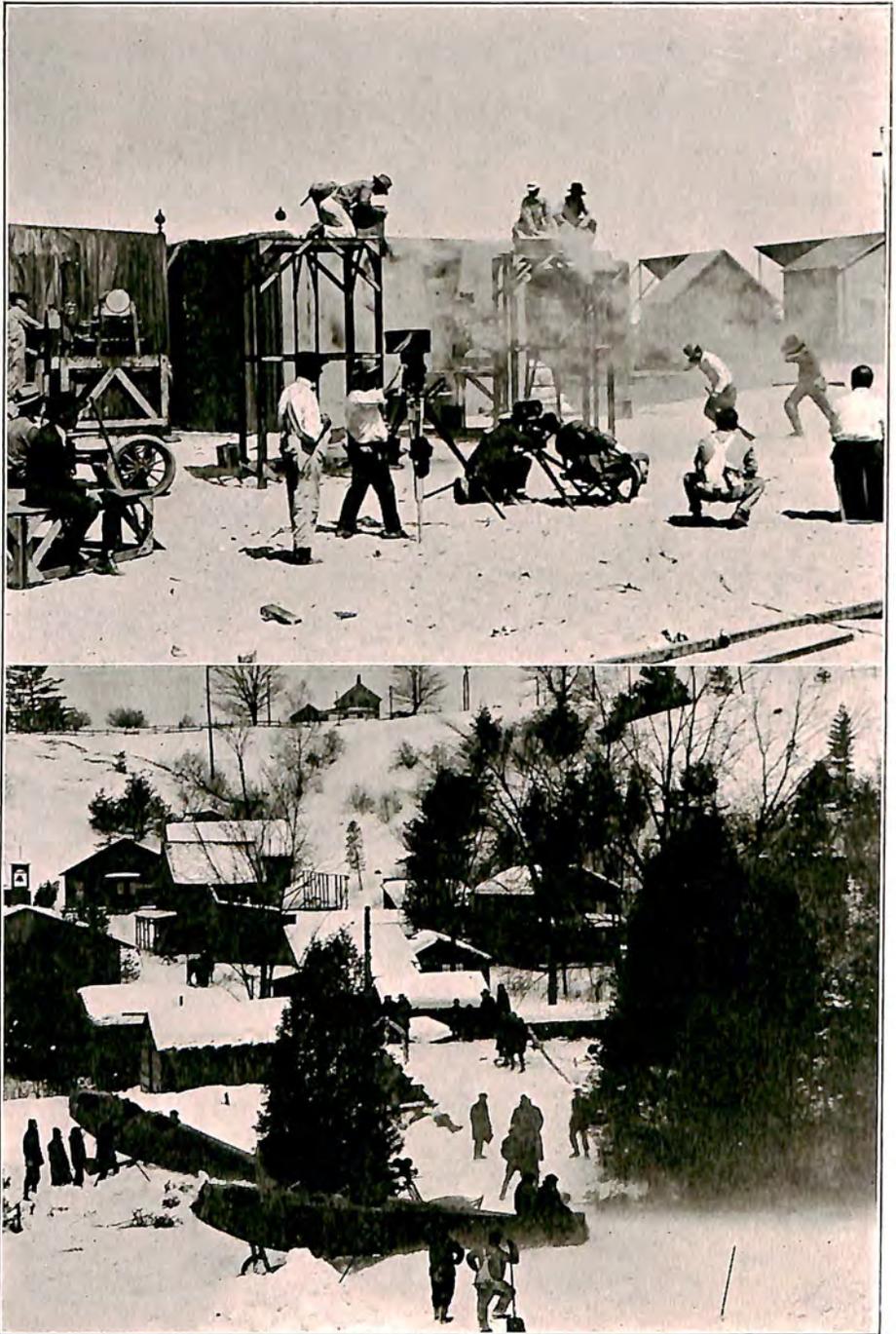
PUBLICITY MAKES NEWS

When, in early 1919 the airplane, with its war developed possibilities and peace time proposals, became available for the commercial needs of the people, many journals turned to it as a remarkable instrument for publicity. It is no doubt true that the editors at the inception of their use of aircraft had the advertising aspects of their experiments uppermost in their minds. When

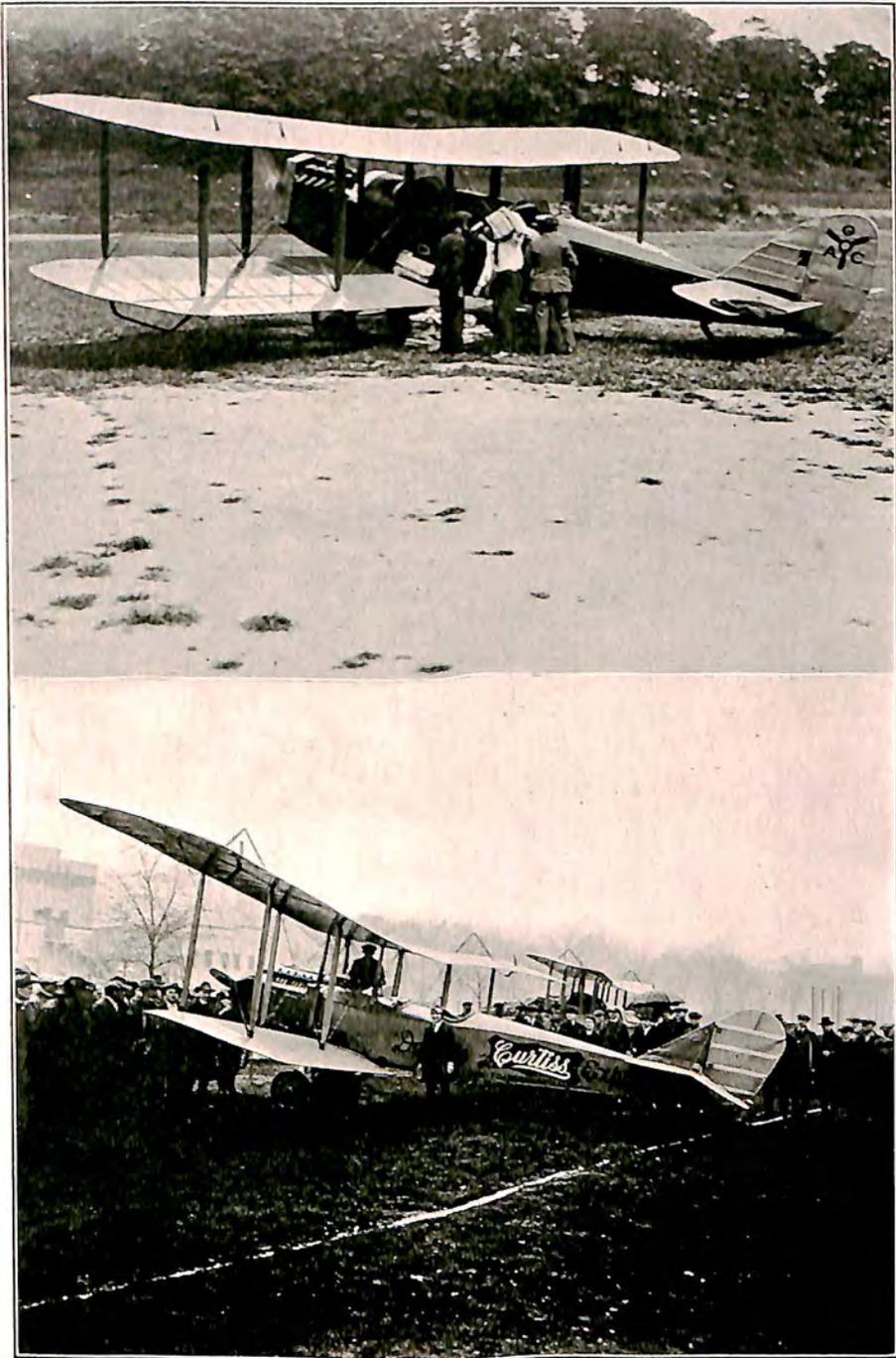


Study of the Toronto Harbor Front.—Photo, Major H. K. Maxwell.

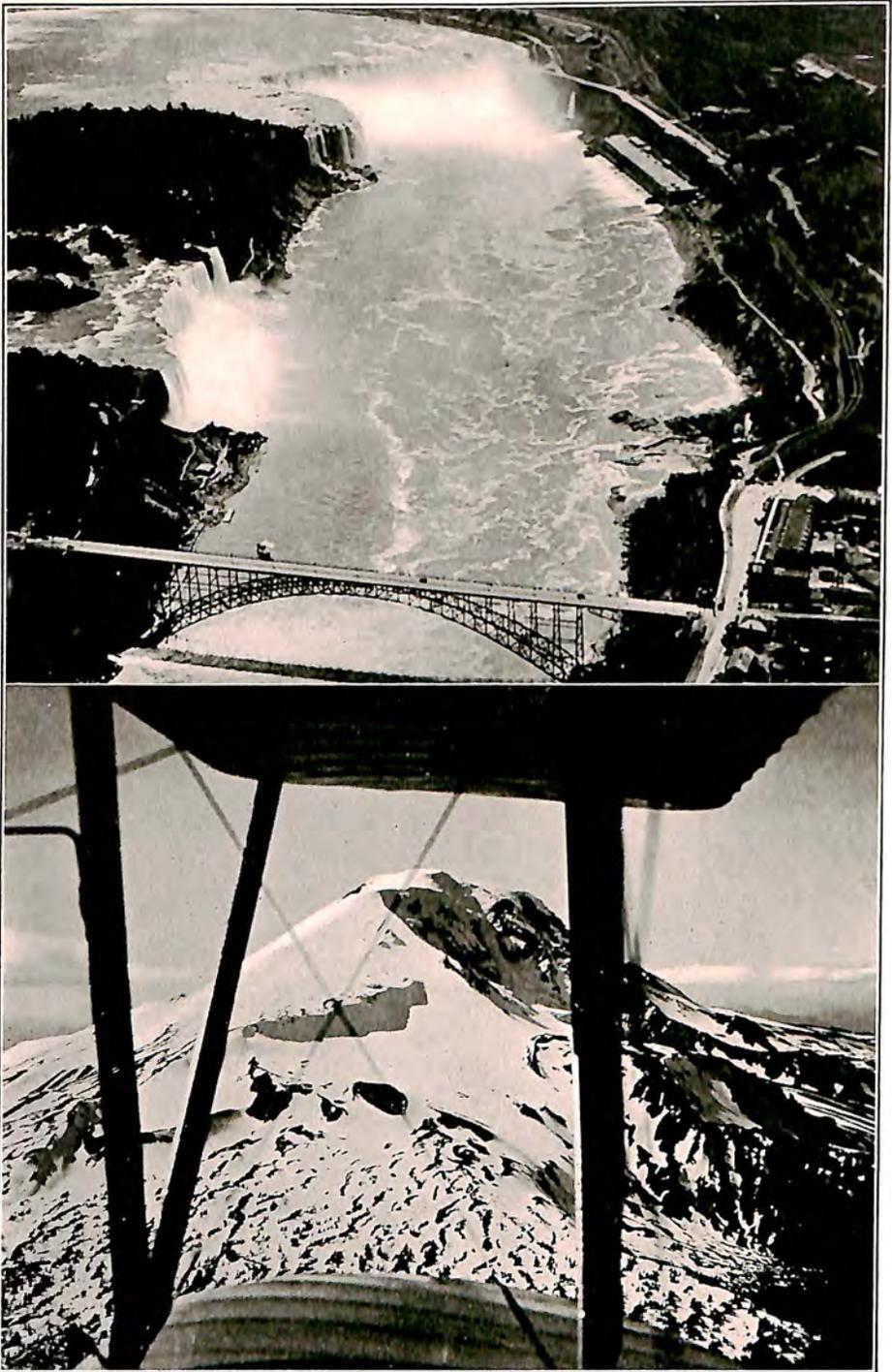
Below—Golf Course of Greenwich, Conn., Country Club.—Photo, Fairchild Aerial Camera Corporation.



Making "Desert Sand Storms" and "Arctic Blizzards" with the aid of airplane motors.—Photos, Goldwyn.



New York Evening Post Speeds Circulation by Gallaudet "Liberty Tourist."
Below—Arrival of Curtiss Aircraft Merchandise Express from New York to
Minneapolis.



Aerial of Niagara Falls by Major H. K. Maxwell. *Below*—Mt. Adams of Cascade Range, taken from a Boeing airplane at 9,500 feet.—Photo 1920 by Strang.

the San Francisco *Bulletin*, for example, sent a woman writer in a plane over San Francisco Bay to drop wreaths on the deck of the ferry boat upon which General Pershing stood and when it dispatched another plane with a Thanksgiving turkey for the Farallone Islands, it is self-evident that the business office as well as the news gathering columns was served. Similar benefits undoubtedly accrued to the business department of the San Francisco *Call-Post* when it staged a speed contest in which an automobile, an airplane and a railroad train contested for first place. This trial brought out that a railroad train starting with a first edition of the paper and an automobile speeding with a second edition could both be beaten over a 125-mile course by an airplane bearing a third edition. If these were publicity features, they were "news" as well.

The service of the airplane to the city editor in his task of gathering the happenings of the day is of comparatively recent origin. The history of this new adjunct of the "city room" has been an absorbingly interesting one, however. One of the first instances of a bit of genuine aerial reporting was that performed in connection with the burning of the U. S. Army Transport *Mt. Vernon*, which caught afire 500 miles from San Francisco. Willis T. Chapman of the San Francisco *Call-Post* with a staff photographer, flew out to the burning steamer in a plane, visualized the situation and on the way back wrote his story on a typewriter in the clouds, thus scoring a well earned "scoop" over the competitive papers of the city.

ASSOCIATED PRESS UTILIZES AIRCRAFT

Recognizing the efficiency of the flying machine, Harold Martin, eastern superintendent of the Associated Press, chartered a Curtiss "Seagull" to aid in "covering" the America's Cup Races off Sandy Hook in July, 1920. Robert Wright, of the Associated Press staff, wrote such a vivid description of the races as he viewed them from the sky that his stories were published in practically all newspapers of the agency's membership.

The New York office of the Associated Press felt that the utilization of aircraft was epochal and sent broadcast an announcement in which it was stated:

"Whereas 17 years ago, when the last International Yachting Classic was held, the Associated Press covered the event from ship and shore, this year it is reporting the races from land, sea and air, by wireless telephone and land wire."

Among other newspaper men whose names are familiar to the public by reason of their journalistic adventures in the air are Jesse

Butcher of the New York *Times*, Jack Binns, New York *Tribune*, J. Earl Clauson and Harold Wengler, New York *World*, Richard J. Watkins, New York *Herald*, Gene Fowler, New York *American*, Gordon Lamont, New York *Evening Post*, Frank Hill, New York *Globe*, Stanley Prenosil, Associated Press, Tom Handley, New York *Telegraph*, Floyd MacGriff, International News Service, Theodore E. Hedlund Boston *Post*, William D. Tipton, Baltimore *Sun*, Morrow Krum, Chicago *Tribune*, Bogart Rogers, Los Angeles *Examiner*, and Bill Henry, Los Angeles *Times*.

Another example of journalistic enterprise was that of the St. Paul *Dispatch* and *Pioneer Press* in sending a plane to get the details of a cyclone which had swept a district 500 miles from Minnesota City and destroyed means of quick rail or road transportation.

Many other instances, such as the reporting of the World's Series by the Philadelphia *Ledger*, could be cited to show how the flying machine has served the newspaper as no other agency could. The future use of the airplane by the editor will only be limited by the extent to which airports are developed. Newspaper reporters perform their work under great pressure; speed is their watchword and they cannot take anything for granted. The news gatherer has not the time to investigate if a certain town or city has a landing field. He must have definite information that such is the case before he can employ the plane to get him to his destination.

NEWS PHOTOS FROM THE AIR

The fact that the pictorial end of news getting has progressed more rapidly than the reportorial may properly be ascribed to the ability of the aerial press photographer to do his work without landing. With the supply of war pictures rapidly diminishing, the editors of the picture supplements, a feature of many of our leading journals, have welcomed the advent of the flying machine to provide them with novelties in the way of photographs. Many of these pictures have been supplied by Air Service and professional flyers who have taken up this work as a vocation.

Sky views of estates, beautiful homes, inspiring bits of scenery and cities have found their way into the picture supplements in recent months. Special photographers were sent over the stadia where the collegiate football and World's Series games were played to snap views of the crowds and plays. The field of aerial photography has unlimited possibilities and the newspapers are not unmindful of them.

SPEEDING UP DELIVERY

For every photograph which airplanes have caught and carried to newspapers, they have transported hundreds of copies of the publications themselves. The saving in time in bringing the paper to its readers by the airplane is incredible in some instances. The *New York Times* sensationally demonstrated this when it delivered several hundred copies of its first edition to the Republican National Convention in Chicago on the same date of issue. Ordinarily, by rail, the *Times* would reach Chicago the following day, or eighteen hours later. Delegates to the Convention who were handed copies of the paper could hardly believe their eyes and many of them sent telegrams of congratulation on the feat to the publishers.

So, too, the *New York Evening Post*, which on several occasions utilized aircraft in delivery. One, when rail and water transportation was tied up by strikes, an Aeromarine flying boat carried an edition of the *Post* far into New Jersey, giving subscribers delivery quicker than under ordinary circumstances. Again, when Franklin D. Roosevelt, Democratic Vice-Presidential nominee, was notified, a Gallaudet land plane carried a special edition to Poughkeepsie.

The *Cleveland Plain Dealer* in September, 1919, made deliveries to all parts of Ohio by means of aircraft. It established a record of 67 minutes between Cleveland and Akron. The *Denver Post* made several deliveries throughout northern Colorado, while the *Oregon Sunday Journal* similarly used the airplane in carrying its issue to Astoria. The *Pittsburgh Press* on October 9, 1920, delivered 200 copies of its paper by air to Altoona, Pa.

These instances have been chosen from scores of others where the airplane has demonstrated its worth as a circulation medium. This use of aircraft is still embryonic, but as time goes on there is no doubt that publishers will avail themselves to a greater degree of its benefits as a quick and certain carrier.

Summing up the relation of aircraft to the press it may be stated that aviation as a unit has proven its absolute efficiency. It slashes time, bringing the news to the reader of newspapers hours earlier than otherwise could be possible. It has opened up a new source of pictorial news and ways of "covering" events. While, earlier in the game, editors hesitated to permit their reporters to go aloft on assignments, the lack of accidents have given them a confidence in the safety of aircraft. Could the proper support, however, be extended to a movement to bring about the accomplishment of a unification of such air traffic facilities that now exist and for the

intelligent promotion of landing fields through or under centralized Federal control, it is highly probable that the press will adapt the airplane to its needs to a greater degree.

AIRCRAFT AND THE MOTION PICTURE INDUSTRY

Aircraft were quickly adopted by the motion picture industry as a medium for advertising and publicity; as an adjunct in manufacture or staging; and as an important factor in the transportation of the finished product.

Practically since the Armistice, aircraft have been used in an increasing degree for the making of travellogues; they have to be used like automobiles and trains as part of film dramas; they have brought to the reels greater novelty and beauty of scene taking in addition an almost human part in the action.

Next to the newspaper, the motion picture is possibly the most effective medium for publicity. Yet the motion picture companies have found aircraft as productive of results in advertising their own products as in furnishing publicity for other activities. As far back as March, 1919, Dorothy Dalton opened Paramount Week by airplane, and by the summer of 1920, such films as "The Great Air Robbery" were accompanied by airplanes in dozens of cities

"They have proved a most powerful factor," states the Associated First National Pictures, Inc., "in assisting the exhibitor to advertise coming attractions." Mary Pickford in "Daddy Long-legs," a First National attraction, has been advertised in many places by handbills scattered from the air.

Theatre owners in various parts of the country have found aircraft of great value and one at least, at New Brunswick, N. J., has procured a machine and established a flying station as a regular part of his business.

Aircraft have performed a double duty in news weeklies and travellogues. They have been the means of obtaining the picture and have frequently formed the main attraction in the feature themselves. The Pathé Exchange has consistently used aircraft in filming interesting pictures and important events. The President's departure for Europe on the *George Washington* in January, 1919, was filmed from seaplanes. Air views have been made throughout the world, and places hitherto inaccessible to the photographer in their grander aspect, such as Yosemite Valley, the peaks of Yellowstone National Park, Mt. Rainier, Mt. Lassen, the Alps and the Andes. Horse races, automobile races, baseball and football games, tennis matches, etc., have been subjects for aerial photography and film weeklies. The 1919 and 1920 World's Series baseball games were taken from the air.

So quick were the motion picture producers to adopt the airplane as a mechanical aid in the taking of pictures that film stars had scarcely had their first air rides before they were called upon to fly in earnest. Omer Locklear and other pilots flew in serious aerial film dramas. The "Eagle's Eye" was an interesting stunt drama. "The Great Air Robbery," featuring Omer Locklear and Francesca Billington, was perhaps the first successful attempt at landing flying and a good story into a homogeneous artistict product. The Associated First National Pictures, Inc., the Metro Pictures Corporation, David Wark Griffith, The Goldwyn Film Company, the Selznick Pictures Corporation and the Universal Film Manufacturing Company have produced pictures in which flying has been an essential part of the action.

The Curtiss "Avion," three-motored "Eagle" type eight-passenger land plane used in passenger work between Los Angeles and San Francisco, was filmed in "The Furnace," William D. Taylor's special production for Realart.

Small airships, blimps, have also been used by motion picture concerns both as outlook for the filmer and as dramatic elements. In "Just Out of College," the hero, played by Jack Pickford, advertises Bingo pickles successfully by using his lighter-than-air craft.

The Marshall Neilan Production Company of Los Angeles successfully employed a Pony Blimp which they had rented from the Goodyear Tire & Rubber Company for getting large-sized views of battle scenes staged for the film "Custer's Last Stand." The airship, during the taking of the picture, was exposed to snowstorms, but operated successfully in spite of the fact that no shelter was available. The result was that the film concern purchased the airship and intends to use it in filming big battle scenes in the future.

Aircraft are also used to produce auxiliary scenic effects. The airplane propeller in action sends forth a formidable gust of air. This has been utilized to create for pictorial effects blasts of wind, rain, sand and snowstorms, to simulate forest fires, etc. The fuselage of the machine, containing the motor with the attached propeller is used for this purpose, and effects are obtained that otherwise would be impossible. The light during a genuine storm of any kind is apt to be too poor for pictures. "Had they waited for a real snowstorm," says the Goldwyn Company of the directors of "The North Wind's Malice," "it would have been impossible to photograph it because of the dimmed light."

The Associated First National Pictures, Inc., says, "The airplane motor has solved this production problem (that of storms)

in conjunction with elaborate hydraulic effects and light. The trees now bend before the gale created by a powerful airplane motor, leaves quiver, and the fury of the elements is depicted with amazing realism."

In viewing the enormous number of motion pictures displayed each week, the thought is suggested that the directors must have a serious problem in obtaining suitable sites for the production of each new undertaking. The location scout of the past has had to do his work on foot or in motor car, and consequently has been handicapped where great areas had to be surveyed. Here is where the airplane provided a solution. Some time ago, Marshall Neilan of Associated First National Pictures, flew with Emery Rogers as pilot, from Los Angeles to Glacier National Park. They sought suitable locations for the filming of "Pards," a new film story of the far west. Not only were the locations found but it was demonstrated that aircraft could be suitably used on outings, for Mr. Neilan carried with him a complete camping kit and supplies, operating independent of any other kind of transportation. Those who remember the lovely scenes in Viola Dana's "The Willow Tree," will find added interest in the fact that the Metro directors employed aircraft to survey Catalina Island. Airplanes in transportation were also utilized by the Metro Studios in connection with the "Four Horsemen of the Apocalypse." This great picture was taken largely in the San Fernando Valley, near Los Angeles. Five thousand people were employed, and it was not always possible to tell when they would be needed. To transport them in the morning and then hold them all day was too expensive. Accordingly the directors hit upon the plan of utilizing aircraft to fly over the San Fernando range to the city and carry the word when everything was ready.

A mountain location was needed in a new Mary Miles Minter production for Realart. The director was taken aloft to scout the California mountains. He required a stream winding in a certain way with hills and trees in the background in a certain position. To find such a combination with an ordinary conveyance would have been impossible, hence literally the bird's-eye-view or more truthfully speaking, the airplane view.

In the opinion of Jerome Lachenbrouch of the Goldwyn Studios, "The time will soon be at hand when the airplane scout will go off daily on his photograph searches for new locations."

4 Literally hundreds of instances could be cited where motion picture theatres have transported films where express or mail services have failed. The high cost of transportation by air, when

such emergency trips were made, did not enter into the situation because the theatres stood to lose everything they had invested unless the film for which they had purchased the exhibiting right, was received at the time called for. This package-carrying feature has been greatly stimulated through the extension of the Aerial Mail.

Following is a partial list of films in which aircraft assisted in the making:

- All Soul's Eve*, Realart film. Used in storm scene.
- Are All Men Alike?* Metro film, featuring May Allison. Airplane used in action.
- Best of Luck, The*, Metro film, featuring Jack Holt and Kathryn Adams. Airplane used in action.
- Body and Soul*, Metro film, featuring Alice Lake. Airplane used to locate scenes.
- Eagle's Eye, The*; Associated First National Film. Airplane used in action.
- Fall of Babylon, The*, Griffith film. Airplane used in action.
- Fib, The*, Selznick film. Airplane used in action.
- Flying Pat*, Griffith film, featuring Dorothy Gish. Airplane used in action.
- Four Horsemen of the Apocalypse, The*, Metro film. Airplane used to locate scenes, bringing supplies, etc.
- Fox News Travellogues*, Yosemite Valley, etc., made from airplanes.
- Furnace, The*, Realart Pictures Corp. Honeymooning through Europe in a Curtiss Eagle, "Avion."
- Go and Get It*, Associated First National Film, featuring Pat O'Malley. Airplane used in action.
- Great Air Robbery, The*, Universal film, featuring Omer Locklear. The Airplane used in action.
- International Universal Exchange*, Current Events filmed by airplane.
- Jack Knife Man, The*, Associated First National film. Airplane motor used for storm effects.
- Just Out of College*, Goldwyn film, featuring Jack Pickford. Blimps used in action.
- Married Life*, Associated First National film. Airplane used in action.
- Nomads of the North*, Associated First National film. Airplane used for storm effect.
- North Wind's Malice*, Goldwyn film. Airplane motor used for storm effects.
- Pards*, Associated First National picture. Airplane used to locate scenes, and in action.
- Pathé News*, Airplane used in filming dozens of air travellogues, interesting events, etc.
- Polly of the Storm Country*, Associated First National Film. Airplane used for storm effects.
- Scoffer, The*, Associated First National film. Airplane used for storm effects.
- This Is the Life*, Goldwyn film. Airplane used in action.
- Unseen Forces*, Associated First National film. Airplane motor used for storm effects.
- Way Down East*, Griffith film. Airplane used in action.
- What Women Love*, Associated First National Film, featuring Annette Kellerman. Airplane used in action.

Willow Tree, The, Metro film, featuring Viola Dana. Airplane used in locating scenes.

Woman in His House, The, Associated First National. Airplane motor used in storm.

Yesterday's Wife, Selznick film. Airplane used in action.



Covering News by Airplane. International Yacht Races. *Resolute* and *Shamrock* passing the starting ship.—Photo, U. S. Air Service. Below—Cyclone at Fergus Falls, Minn. A Curtiss biplane carried *St. Paul Dispatch* reporter and photographer to the scene.



The Dayton Wright "Aerial Coupe," Wright Engine, Landing at Sunset.

CHAPTER VIII

IMPERATIVE NEED FOR IMMEDIATE FEDERAL CONTROL OF THE AIR; ACTION URGED BY STATES, LEADING AERONAUTICAL, LEGAL AND DEFENSE BODIES; ANALYSIS OF INTERNATIONAL AERIAL CONVENTION

THE progress of American aeronautics was seriously delayed in 1920 through the lack of competent national regulation. The fact that the International Aerial Convention was linked up with purely political problems growing out of the war, contributed to the failure to bring the subject before Congress.

The aircraft industry, abruptly divorced from military activity, struggled to establish itself in commerce. Flying utilized in warfare, when the national need overrides all else, is one thing; the art applied to peace, when profit and loss and public safety govern, is quite another. Modern business development depends largely upon credit and insurance, while permanent success in the operation of any transportation enterprise can be assured only if the public is protected against injury or property damage that may be caused by the use of unfit equipment or unskilled crews, or both.

America can not hope to build up a great aerial reserve for purposes of national defense until proper legislation assures capital that it is entering a business project instead of a romantic adventure and rates of insurance are likely to remain unsatisfactory so long as no competent Federal agency exists to determine the airworthiness of craft or the competency of pilots.

That there were in operation in the United States in 1920 nearly 100 aerial transport companies is evidence of the efforts which the industry has made to maintain constructive supervision. But this can only be a temporary expedient, which should be promptly followed by suitable legislation.

Therefore the Manufacturers Aircraft Association has co-operated with the American Bar Association, the Aero Club of America, the National Aircraft Underwriters Association, and other bodies in urging immediate relief. The American Legion, supplementing its declaration in favor of a separate department of the Air, for reasons of national defense, also urged, at its convention in September, in

Cleveland, the prompt consideration of aerial legislation by Congress.

In the absence of Federal control, demands were made that states or municipalities should act. But tempered thought, in such instances as that of New York, led the legislatures not only to refrain from confusing the situation with state laws, but actually to memorialize Congress for prompt relief.

The aeronautical organizations, too, were active, and similar resolutions were adopted in January in Chicago by the Mississippi Valley Aviation Clubs Association, and by a conference at the Hamilton Club of Chicago; and in April in San Francisco, by the Pacific Aeronautical Association.¹

AMERICAN BAR ASSOCIATION ACTS

At a conference of State and Local Bar Associations of America, held in August, 1919, in Boston, in anticipation of the meeting of the American Bar Association, a resolution was adopted declaring it to be the sense of the conference that jurisdiction of aeronautics and aerography lay properly in admiralty, with limited reservations in favor of the common law. A committee consisting of the following was formed:

William Velpeau Rooker, Indianapolis, Ind.

Simeon E. Baldwin, New Haven, Conn.

John P. Briscoe, Prince Frederick, Md.

Stiles W. Burr, St. Paul, Minn.

R. E. L. Saner, Dallas, Texas.

Mr. Rooker at once undertook extensive circularization of all interests connected with aeronautics, and as a result, on July 1, 1920, he reported:

"It appears that throughout the United States there is intense interest in the subject we have in hand. This interest has been evidenced in many cases by the appointment of municipal and other commissions to investigate and report conclusions in respect of aviation and aerography as affecting jurisprudence and the political rights of people and communities. In many instances expression of the conclusions of these investigators has been made apparent in municipal ordinances and regulations affecting aerial navigation and prohibiting the use of the air over cities for navigation. In some of the states statutory provisions are in effect. These statutory provisions generally pertain to the police regulation of aviation, and attempt to save the political rights of the states.

"The manufacturers of air craft are pursuing investigations along lines which embrace not only the jurisprudence of aviation, but also fiscal and mechanical matters.

"The Federal Government is active through various agencies in its endeavor to ascertain and solve numerous problems affecting aviation and aerography, including the matter of jurisprudence.

¹ See Chronology and Appendix.

"Universities are working on the subject through their geometricians, astronomers, physicists, economists and other agencies.

"A survey of the situation proves that aeronautics is a fact now in our presence, and one which commands the most lively interest of society. . . ."

With reference to the International Aerial Convention, Mr. Rooker wrote:

"If the United States shall become signatory to the convention it will become the foundation of a body of law governing aerial activity in this country."

Mr. Rooker prosecuted a work, the value of which to the nation and the art is difficult to adequately estimate. His was a preliminary survey which presents the subject in its broader aspects and enables those who wish to study our aerial legislative needs to approach the task intelligently.

Mr. Rooker's committee informally reported at the American Bar Association meeting in St. Louis August 20. The committee, he stated, was of "the opinion that the jurisprudence of aeronautics, aerography and aerophony were in admiralty and therefore within the powers of the Federal Government, as distinguished from the states."

INTERNATIONAL AERIAL CONVENTION

In the Appendix will be found the complete text of the International Aerial Convention. It is thought advisable, however, to summarize the Convention in this chapter so as to make possible a clearer interpretation of the document and the steps which preceded it.

It is conceded by those competent to judge that the International Aerial Convention should become the foundation of our national code of the air. The convention will become effective, insofar as we are concerned, when Congress ratifies the signatures of the American representatives. This ratification may be made subject to an amendment to the Convention in the spirit of the American reservations.

Ratification of the Convention, or the adoption of a national code of the air will make necessary the creation of a Federal Government Agency competent to promulgate and administer the "rules of the air."

The principal efforts toward the drafting and adoption of an international code of the air, prior to the war, were made between 1910 and 1913 by the International Aeronautical Federation and by the International Juridical Association, when these authoritative bodies elaborated at their annual congresses a set of regulations which should apply to the control of international air navigation.

However, no general understanding was brought about until after the great war. The Peace Conference created an Aeronautical Commission which was directed to draft a Convention for the Regulation of Air Navigation to which all the twenty-seven Allied and Associated Powers were to become signatories. October 13, 1919, delegates representing sixteen of the Allied and Associated Powers signed the original draft of the Convention for the Regulation of Air Navigation. These powers are:—Belgium, Bolivia, Brazil, the British Empire, China, Cuba, Czecho-Slovakia, Ecuador, France, Italy, Panama, Poland, Portugal, Roumania, Siam and Uruguay.

Several Powers—among them the United States and Japan—having made reservations to certain provisions of the Convention, the latter was amended to insure an agreed text. The amended Convention was signed on May 31, 1920, by the eleven Allied and Associated Powers which had not previously become parties to it, the United States signing with certain reservations which will be dealt with below. The other signatory states comprise:—Greece, Guatemala, Hayti, Hedjaz, Honduras, Japan, Liberia, Nicaragua, Peru and the Serb-Croat-Slovene State.

PRINCIPAL PROVISIONS OF THE CONVENTION

The Convention, as amended, consists of nine chapters comprising forty-three articles which constitute the fundamental text of the document, and of eight annexes, which afford a technical interpretation to some of the provisions of the Convention. While the provisions of the Annexes may be modified by the International Commission for Air Navigation which the Convention provides for under the direction of the League of Nations, any modification of the articles of the Convention can be proposed for adoption by the Commission for Air Navigation only if it has been approved by at least two-thirds of the signatory Powers.

GENERAL PRINCIPLES

Chapter I, (Articles 1-4) dealing with general principles, recognizes that each country has absolute sovereignty over the air space above its territory and its dependencies, and the territorial waters of both. Aircraft of the contracting States are granted freedom of passage over the national territory provided the provisions of the Convention are observed. But if a State prohibits aircraft of the other contracting States from flying over certain areas of its territory, this prohibition must equally apply to its own private aircraft.

The United States objected to this latter provision, making the following reservations:

“The United States expressly reserves, with regard to Article

3, the right to permit its private aircraft to fly over areas over which private aircraft of other contracting States may be forbidden to fly by the laws of the United States, any provision of said Article 3 to the contrary notwithstanding."

NATIONALITY OF AIRCRAFT

Chapter II, including Articles 5 to 10, deals with the nationality of aircraft. Article 5 provides that 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.

This article elicited objections from several States, because its provisions would actually bar aerial intercourse between contracting and non-contracting States. This provision was made to prevent aerial traffic with the Central Powers until the latter would be permitted to adhere to the Convention, and also to force those States which had remained neutral during the Great War to adhere to the Convention.

The United States and Canada both objected to this article on the ground that it would hamper air navigation between the countries in the Western Hemisphere, several of which are not parties to the Convention. Hence in its reservation the United States "reserves the right to enter into special treaties, conventions, and agreements regarding air navigation with the Dominion of Canada, and (or) any country in the Western Hemisphere if such Dominion and (or) country be not a party to this Convention."

The Canadian reservation to this article, aiming at a reciprocity arrangement with the United States, reads:—

"Although the United States may not be a party to the Convention, Canada may make arrangements with the United States permitting the flying of aircraft which, by terms of the Convention, might be legally registered."

The Dominion of Canada also objected to the compulsory registration of kites and captive balloons which is implied by their coming under the generic term "aircraft."

Several neutral countries of Europe objected to Article 5 on the ground that it would compel them to prevent the flight over their territories of aircraft of the late enemy countries until such time as the latter also became parties to the Convention. In the case of the Allies the same difficulty would not arise because the Peace Treaties grant them the right of flying over the late enemy countries without reciprocity.

In order to meet this objective of neutral countries, a Protocol to

the Convention was drawn up by the Council of Ambassadors, on the recommendation of the Aeronautical Commission in Paris, whereby a State which has accepted the Convention in other particulars will be authorized to permit the flight over its territory of the aircraft of specified non-contracting States. These derogations will be for a limited period, but will be renewable unless an objection is lodged by a contracting State.

This Protocol to the Convention has been signed by most of the contracting States, the United States signing with interpretative reservation which is practically identical with the American reservation to Article 5 (see above), except that it does not specifically mention the Dominion of Canada.

The remainder of Chapter II deals entirely with the registry of aircraft.

CERTIFICATES OF AIRWORTHINESS AND COMPETENCY

Chapter III provides for the issuance, by the contracting States, of certificates of airworthiness to every aircraft engaged in international traffic and of certificates of competency to the commander and crew of such aircraft.

According to Annex B, the design of every type of aircraft in regard to safety must conform to certain standards which will be fixed by the International Commission for Air Navigation; however, until these standards have been fixed each State is free to determine its own standards.

Annex E enumerates the minimum qualifications necessary for obtaining certificates as pilots and navigators of aircraft.

ADMISSION TO AIR NAVIGATION ABOVE FOREIGN TERRITORY

Chapter IV grants every aircraft of a contracting State the right to cross the air space of another State without landing, in which case the aircraft must however follow the aerial route fixed by the State concerned and it must land if signalled to do so for reasons of general security.

Aircraft flying from one State to another must, if the regulations of the latter require it, land at one of the air ports specially designed for this purpose. The provisions of Annex H, dealing with Customs, oblige any aircraft crossing the national boundary to land at and to depart from specially designated "customs aerodromes" but these provisions were strongly objected to by both the United States and the Dominion of Canada. The United States reservations on this point read:

"The United States reserves complete freedom of action as to

customs matters and does not consider itself bound by the provisions of Annex H or any article of the Convention affecting the enforcement of its customs laws."

The Canadian reservation is equally comprehensive, being to the effect that "it shall not be necessary to observe the provisions of this Annex."

The stringent control which Annex H provides for international air navigation may be justified by the existence of strongly fortified frontiers in Europe, but in the Western Hemisphere, where boundaries are not, as a rule, fortified, the provisions of Annex H would mainly result in retarding the growth of air navigation.

Chapter IV further provides that each contracting State has the right to establish restrictions in favor of its own aircraft insofar as they carry persons or goods between two points on its territory. Aircraft in transit through a contracting State shall be exempt from any seizure on the ground of patent infringement, subject to the deposit of security.

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

An aircraft engaged in international navigation must be provided with the certificates of registration, airworthiness and competency above mentioned; with a list of passengers, if it carries any, and with bills of lading and manifest, if it carries freight; with journey, aircraft, engine and signal logs, provided for in Annex C; and, if it is equipped with wireless, with a special license.

Every aircraft flying for whatever purpose above the territory of a contracting State must furthermore bear its nationality and registration marks and comply with the Rules as to Lights and Signals and the Rules of the Air provided for in Annex D.

PROHIBITED TRANSPORT

Chapter VI prohibits aircraft from transporting explosives, arms and munitions of war in international navigation as well as between any two points in the same State. The carriage of photographic apparatus on board aircraft may be regulated by each State.

STATE AIRCRAFT

Chapter VII specifies the nature of State aircraft. These are:—military aircraft and aircraft exclusively employed in State service, namely, mails, customs, and police. All other aircraft are deemed to be private aircraft and shall be treated as such, except that an aircraft commanded by a person in military service detailed for the purpose shall be deemed to be a military aircraft.

Military aircraft can fly over the territory of another contracting State only with a special authorization, in which case they shall enjoy the privileges accorded to foreign warships. These privileges a military aircraft cannot, however, acquire by virtue of a forced landing or a landing upon summons, nor do they apply to police and customs aircraft.

INTERNATIONAL COMMISSION FOR AIR NAVIGATION

Chapter VIII institutes a permanent Commission for Air Navigation placed under the direction of the League of Nations and composed of: two representatives each of the United States, France, Italy and Japan; one representative of Great Britain and one each of the British Dominions and of India; one representative of each of the other contracting States.

Each of the five States first named (the British Empire 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 votes of all the other contracting States."

This system of voting is justifiable on the ground that the aeronautical interests of the States which have a plural vote are greatly superior to those of the States having a single vote.

STANDARD AERONAUTICAL MAPS

Annex F provides for the publication of two types of standard aeronautical maps, termed *general* and *local maps*, respectively.

FINAL PROVISIONS

In the Final Provisions of the Convention, embodied in Chapter IX, the contracting States agree to collect and to disseminate statistical and meteorological information, to publish the standard aeronautical maps above mentioned and to establish a uniform system of ground marks and wireless stations necessary for international air navigation. The international system of ground marks adopted is described in Annex F.

The Dominion of Canada objected to these ground marks, making the reservation that "it shall not be necessary to prescribe that aerodromes be marked as specified in Section II."

The final articles of this chapter provide that a non-signatory State which took part in the war of 1914-1919 may adhere to the Convention only if it is a member of the League of Nations, or until January 1, 1923, if its adhesion is approved by the Allied and Associated Powers. After this date such a State may be admitted

if it is agreed to by at least three-fourths of the signatory and adhering States.

The practical interpretation of this chapter means that Germany, Austria, Hungary, Bulgaria and Turkey cannot become parties to the Convention without the consent of the Allied and Associated Powers, for the votes of the latter greatly exceed those of the States which remained neutral during the Great War.

CHAPTER IX

AIR PORTS; GROUND ORGANIZATION; AERIAL COMMUNICATIONS

PROPER terminal facilities and means for maintaining communications constitute one of the most important of the complex problems confronting American aeronautics.

AMERICA'S LACK OF AIR PORTS

The United States is sadly lacking in air ports, as may be seen from the following statistics, which the Manufacturers Aircraft Association has compiled from the latest available information. On Dec. 1, 1920, there were in the United States and its possessions a total of 271 air ports, there being included in this number the air stations of the Army, the Navy and the Marine Corps, which are not, as a rule, available to private flying activities. This number does not include landing fields which may be used in case of emergency only.

Although the Army Air Service lists about one thousand emergency landing fields throughout the United States, the number of air ports is, as has been said above, only 271. The nature of these air ports is given in the tabulation which follows:—

AIR PORTS IN THE UNITED STATES AND ITS POSSESSIONS

United States Army.....	23
United States Navy.....	9
United States Marine Corps.....	3
United States Air Mail Service.....	22
Municipal Air Ports.....	145
Private Air Ports.....	69
Total.....	271

The United States has thus one air port for every 14,000 square miles of territory, whereas the United Kingdom (Great Britain and Ireland) has, according to the latest information published by the British Air Ministry, 101 air ports, or one for every 1,200 square miles of surface area. This comparison vividly illustrates the backward state of this country in aerial communications.

Nevertheless, a certain advance has been made during the past

year as a result of various endeavors tending to remedy this deplorable situation. At the end of 1919 the total number of air ports in the United States was 115, or one for every 31,000 square miles of surface area, and of this number only a very small portion was controlled by municipalities or by Chambers of Commerce, whereas at the end of 1920 fifty-three per cent of the American air ports were under the direct or indirect control of communities. This evolution is a healthful sign.

Owing to the immensity of the effort which such an enterprise involves, no single agency, governmental or private, can possibly create all the air ports which the United States needs. While the federal government, and, in particular, the Army Air Service, are directly interested in seeing the number of our air ports grow because of their potential value for national defense, there is no appropriation providing for the creation of air ports. Hence, this undertaking must draw its main support from those agencies of human activity that will, in the end, derive the greatest benefit from the existence of suitable air ports — the communities.

Progressive cities are beginning to perceive that a well planned air port will in the near future enable them to reap big benefits from the air transport services which will connect the main centers of population, because the course of the coming air routes will be largely controlled by the existence, or absence, of air ports.

MAIN AIR ROUTES IN THE UNITED STATES

At the present time only one important air route exists in the United States. This is the air mail route which leads from New York by way of Cleveland, Chicago, Omaha, Cheyenne and Salt Lake to San Francisco, a total distance of 2,650 miles, with branches from Chicago to St. Paul-Minneapolis and to St. Louis, and from Washington to New York. Along the New York-San Francisco air route there are fourteen air ports, with a number of emergency landing fields in between. This route, owing to the fact that it links many of our most important centers of population by the shortest practicable line between New York and San Francisco, is bound to become before long our main aerial highway for the carriage of mails, passengers and light freight. Hence, the principal communities which are situated along this air route should create thoroughly modern air terminals or co-operate — as many of them do — with the Air Mail Service in its efforts to improve the equipment of the transcontinental mail air ports.

These improvements are particularly made with a view to permit mail airplanes to fly by night as well as in daytime, which would

reduce the time of coast to coast transit from 57 hours to about 36 hours. The mail air ports are now being equipped with flood lights, that is, lights mounted along the sides of the field a few feet above the ground, which illuminate the landing area with a steady sheet of white light. The source of the light is invisible from above so as not to blind pilots about to land. These flood lights are supplemented by a system of ground lights — red at one end of the field and green at the other — which mark the limits of the landing run. The ground lights are sunken in the earth beneath thick glass which is flush with the surface and so permits airplanes to roll over it.

These air ports represent the most advanced kind now in existence and may serve as models to municipalities desirous of establishing up-to-date air terminals.

HOW AN AIR PORT SHOULD BE BUILT

Whether the importance of a community warrants the building of a thoroughly modern air terminal, or whether a minor air port will satisfy its needs, or be within its financial resources, it is essential for the success of air navigation that all air ports conform in certain particulars to a common standard. This standard has been worked out by the Army Air Service in a set of specifications, the most important of which are reproduced herewith.

Location.—The location of an air port should be so selected as to bring it within reach of transportation facilities of either railroads or shipping, and, where available, both, for the aerial transportation of passengers and express will be closely interlinked with these two movers of commerce. The site should be capable of expansion.

Size.—While the size of air ports depends upon many problems individual with each city, there is an indispensable minimum size for air ports which are intended to take care of all types of present airplanes under all conditions of traffic and weather. This minimum size should allow a run-way of at least one thousand yards in any direction from which the wind is likely to blow. Such a field would enable the average pilot to take any airplane aloft and to land safely in case of engine failure.

Smaller fields, allowing a run-way of not less than six hundred yards in any direction, will enable the average pilot to land and to take off in any airplane without accident, provided no engine failure occurs. Fields of this and even smaller size, can serve in case of emergency.

The value of air ports and emergency landing fields is furthermore influenced by the presence or absence of obstacles. An obstacle too

feet high, for instance, will make at least 700 feet of the runway unavailable for use by airplanes. The available length of the runway should be computed by subtracting seven times the height of the obstacle from the length of the field in the direction of the runway.

Shape.—The best shape for a landing field is that of a square, for this permits of an easy return in case of engine failure. Where the condition of the terrain prevents the laying out of a square field, an L-shaped field may be chosen, provided the width of each arm is not less than one-third the length of it.

Character of Ground.—The ground should be firm under all weather conditions and should be level and smooth, to enable airplanes to roll upon it without injury. It should be covered with sod.

Approaches.—Surrounding obstacles, such as high buildings, high-tension power lines, tall trees, etc., besides limiting the amount of field available for landing, provide an element of danger.

Marking.—Experience proves that a white circle, 100 feet in diameter with a band three feet wide, provides a marker that can be spotted from the greatest distance a pilot can see on a clear day. Such a marker can easily and cheaply be built by digging out the earth to a depth of about six inches and filling in with crushed rock or gravel. The circles should be whitewashed from time to time.

Besides its visibility, the 100-foot circle marker of the Air Service offers pilots the advantage of enabling them to form a fairly correct estimate of the size of the field on which they are about to land.

The Air Service has elaborated an identification system which assigns to each State a letter or group of letters, and to every air port a number. This symbol, made in white letters 15 feet high and 3 feet wide, is placed in the northwest corner of the field and thus enables a pilot not only to identify an air port, but also to correct his bearings. The name of the air port may further be inscribed within the circle in letters having the same size as the identification symbol.

A wind indicator, such as the standard aviation wind cone, should be placed at one corner of the field 30 feet off the ground. The wind cone enables aviators to know at a glance the direction of the prevailing wind and contributes to their safety by indicating the direction in which they should land.

SOME OTHER REQUIREMENTS FOR AIR PORTS

The number of hangars and the size of the workshops an air port requires must naturally be determined by its present and prob-

able future importance. If a town lies on an air route linking two important cities, its air port will have to handle an increasing volume of traffic. In this case it is desirable to provide on the field a landing cross enabling airplanes to take off and to land during the rainy season, when the rest of the field may be too soft for the purpose. A landing cross can easily be made by excavating a cross-shaped path having a width of some 150 or 200 feet, if possible — though one 50 feet wide may still serve the purpose. This path must be thoroughly drained and given a top dressing of cinders, well watered, and then rolled. Such a cross also makes a distinctive field marker.

Although the system of ground marks adopted by the Air Service has given satisfactory results, experiments are still being made to find out whether an improved system cannot be devised. The Air Mail Service, for instance, is experimenting with different color schemes and letterings. The hangars are painted white or green on the walls and brilliant orange on the roof, the identification word "U. S. AIR MAIL" being painted on the roof in white letters. This color scheme can be seen from a greater height and at greater distances than almost any other combination of colors.

The International Air Navigation Convention's air port requirements¹ differ somewhat, but until the Convention is ratified by the United States, it is thought best to follow the specifications above outlined, as these can be altered with comparatively little difficulty.

THE IMPORTANCE OF WEATHER FORECASTING FOR FLYING

The weather plays a most important rôle in air navigation. Advance knowledge of the probable atmospheric conditions to be expected over a certain course is of inestimable value to pilots of aircraft, for it enables them to avoid fog and storm areas by flying above or below these disturbances, which are, as a rule, of limited extent.

With a view to satisfying this need of air navigation, the Weather Bureau in co-operation with several other Government departments has created a comprehensive method of charting the air and supplying weather reports to pilots. This work is described below in a communication specially written for this volume by Willis Ray Gregg, Meteorologist of the Weather Bureau.

THE WEATHER BUREAU AND AVIATION

"In the earlier years of its existence the work of the Weather Bureau consisted principally of collecting and charting weather reports from various parts of the country and in issuing bulletins and forecasts based thereon for the benefit of agriculture and

¹ See Appendix.

commerce. Observations of surface conditions only were taken and, although much progress was made in the study of the development of different types of weather and in the application of the results of this study to forecasting, yet it was very soon realized that the lack of knowledge as to changes taking place in the atmosphere above the earth's surface constituted a severe handicap. As rapidly, therefore, as funds for the purpose were made available, action was taken to overcome this handicap by the establishment of stations at which free-air observations could be made by means of kites and balloons. The data thus obtained, including measurements of air pressure, temperature, humidity, and wind, were studied with a view to determining the average condition at various heights and their relation to weather conditions at the surface.

"The Great War brought out the value of such data as nothing else could have done, and was largely responsible for the considerable expansion that was then made in aerological investigations. Further development and extension await necessary appropriations from Congress.

"The Weather Bureau now obtains observations by means of kites and small pilot balloons at six stations and by means of pilot balloons only at eight additional stations. By co-operation with the Meteorological Services of the Army and Navy pilot balloon reports from about a dozen Air Stations are also made available. The observations at kite stations are made once daily and those at balloon stations twice daily. In all cases these observations are telegraphed to the Central Office at Washington, D. C., where they are charted and carefully studied. Aviation Forecasts are then issued for the thirteen zones into which the United States is divided. These forecasts include a statement not only of current and probable future conditions of wind at various heights, but also those of visibility and cloudiness.

"Among the more notable instances of the kind of assistance that is furnished by the Weather Bureau may be mentioned the trans-Atlantic flights of the N. C. planes and of the British dirigible R.-34; the cruising trip of the N. C.-4; trans-continental flights from New York to San Francisco and from New York to Alaska; and the recent National and International Balloon Races at Birmingham, Ala.

"Besides forming the basis of daily and special aviation forecasts, the records obtained at aerological stations are studied and summarized at Washington, D. C.; and from time to time the results of these studies are published in such form as to be readily accessible for the information and guidance of aviators."

THE USE OF RADIO TELEGRAPHY IN AIR NAVIGATION

In the preceding section of this chapter it was shown how important a part the science of weather forecasting plays in regard to air navigation. But weather reports would lose much of their value were they not promptly transmitted to those concerned. In this transmission radio telegraphy fulfills an important mission.

RADIO SERVICE OF THE AIR MAIL

The entire Air Mail system is now linked up by a net of radio stations with the Post Office Department in Washington and with all repair depots of the service.

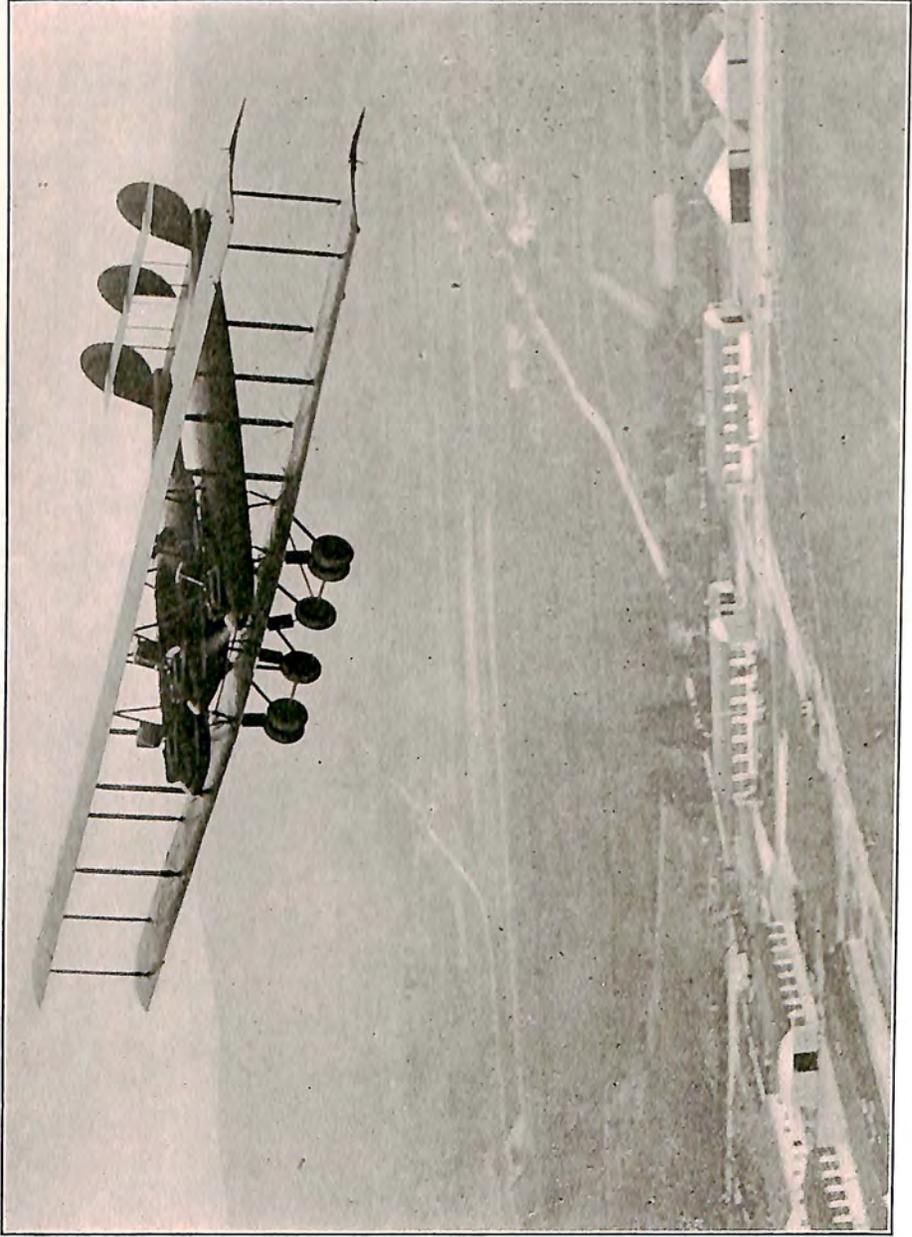
Radio stations of the Air Mail Service located at Washington and at College Park, Md., communicate with Bellefonte, Pa., whence the service is in touch with the Army Air Service experimental station at McCook Field, Dayton, Ohio. From there the radio extends to St. Louis, where the Air Mail has established its own station, which in its turn connects with Chicago and Omaha. The Omaha station is in touch with North Platte, Neb., and from there the radio service extends by way of the radio stations at Cheyenne, Wyo., Rock Springs, Wyo., Salt Lake, Elko, Nev., and Reno, Nev., to the naval radio station at Mare Island, Cal.

Co-operation between the United States Army, Navy and Air Mail has thus created a national emergency communication system that will eventually connect all parts of the United States and be completely independent of other methods, besides being much cheaper in operation than the leased wires heretofore used by Government bureaus. This system supplies communication for the transmission of orders, traffic dispatches, the dispatching of airplanes, weather reports, all business from field to field and, in fact, all routine and emergency matters.

The establishment of this coast to coast radio service was mainly prompted by the desire of the Air Mail Service to establish at the earliest possible moment facilities for night flying along the trans-continental mail route. While such a day and night service between New York and San Francisco would reduce the time of transit from 57 hours to 36 or 40 hours, the difficulties confronting such an enterprise are considerable. It involves the successful solution of such problems as flying and landing by night irrespective of weather, rapid communication between the airplane aloft and the stations on the ground, the transmission of orders, sudden storm warnings, etc. The instantaneous distribution of storm warnings is of great importance.



Skirting the Twin Peaks of Mt. Rainier in Boeing Plane—Photo, *Seattle Times*.



America's Largest Airplane, L. W. F. "Giant."

NEW RADIO INVENTIONS SOLVE AIR NAVIGATION PROBLEMS

It is not overstating the case to say that most of the above problems, in fact, the whole question of night flying, would have defied solution had it not been for some recent developments in the field of radio telegraphy, namely, the direction finder, the field localizer and the wireless telephone, or radiophone. The initial test and development of these three instruments, due to the joint efforts of the Signal Corps, Bureau of Standards and the Air Mail Service, constituted one of the most important stages in the progress of commercial aviation during the latter part of 1920.

The direction finder, or radio-goniometer, is a war development which has only recently emerged from the experimental stage. This remarkable instrument enables a pilot to wing his way to his destination independently of ground marks or maps and with greater accuracy than that obtained from the best sun observations. It has the further advantage that it works equally well in all kinds of weather.

One type of radio direction finder operates on the principle that as long as the airplane is headed toward the radio station located at the point of destination, the pilot clearly hears the signals issued by the latter; but as soon as the airplane deviates in the slightest degree from its true course, the signals decrease in strength and so warn the pilot that he is off his course. This, the most simple type of direction finder, was used by the late Sir John Alcock and Sir Arthur W. Brown during their direct transatlantic flight from St. John's, Newfoundland, to Clifden, Ireland. This instrument is so simple in operation that a pilot can operate it himself while guiding the airplane.

Another type of direction finder, which is more complicated and requires the attention of an experienced radio operator, enables the navigator of an aircraft to determine the exact location of his craft as to latitude and longitude. This instrument makes it possible for any aircraft to take its bearings from any two ground stations with which it is in touch. All the navigator has to do is to draw on his chart two lines indicating the direction of the two stations; the crossing point of the two lines represents the location of the aircraft.

While the radiogoniometer gives the aviator the horizontal direction and distance of a ground station, it does not afford him an indication as to the exact location of an air port once he is in its immediate neighborhood, nor as to his height above the ground. Altimeters are not very reliable within the last few hundred feet from the ground and it is just there that absolute accuracy is required by night or in a fog.

Here is where a second instrument enters to supplement the aviator's deficient knowledge—the field localizer. By the use of this instrument the pilot is not only able to tell when he is over the center of the field on which he desires to land, but he can also determine his altitude above the ground. The principle on which the field localizer operates is identical with that of the direction finder, except that direction is not determined horizontally but vertically.

A NEW DIRECTION FINDER

A further improvement in bearing determination by means of radio telegraphy is afforded by the invention of Major J. O. Mauborgne and Captain Guy Hill, of the Signal Corps, United States Army. This apparatus, called the resonance wave coil, combines the features of the direction finder with those of the field localizer, making it possible to determine both the horizontal direction and the vertical distance of a transmitter from the receiving station. It is thus possible to determine with great accuracy the position of an airplane in flight, the direction in which it is flying and how high it is from the ground. An additional advantage of this instrument is that it does not require any antenna or ground connection, so that its use on aircraft is greatly simplified.

This latest development promises to play a very important rôle in warfare, for it will promptly bring about the detection of enemy air raiders. Protection against bombing raids will greatly be improved thereby, as it will be possible to follow on a map the progress of the air raiders and take adequate measures against them before they reach their objective. Civil aviation will equally benefit by this instrument in that it will simplify the operation required by the aerial navigator for getting his bearings.

As if the wonders of radio communication were not sufficient, man by his genius has also developed and perfected wireless telephony until it has reached such a point that in clarity of reproduction it far surpasses the ordinary line telephone. The use of the radio telephone does away with the necessity for the pilot to be proficient in the Morse code. He can say what he has to say immediately and without any outside help. Having located an air port on a dark night or in fog, he can inquire as to whether the field is clear for landing, the direction of the prevailing wind, etc. If there be danger of collision in flight, he can tell the other pilot of the maneuver he intends to make under the circumstances. This will eliminate any possibility of misunderstanding that might arise through the use of mechanical signals.

It may be realized from the above to what an extent radio teleg-

raphy will influence the immediate development of air navigation. Its main result will be that aircraft will be navigated with a safety and dependability far exceeding that now obtained on steamships.

CHAPTER X

AERONAUTICS IN NATIONAL DEFENSE; MILITARY AND NAVAL AVIATION

Aeronautics has introduced a new element into warfare and has carried warfare into a new element.

"The arm that will serve the enemy will be that arm that is the newest, the most sudden and the most terrible—the airplane."—*Marshal Foch.*

"The battleship is dead. The future is with the airplane . . ."—*From Admiral Sir Percy Scott's book, "Fifty Years in the Royal Navy."*

"The air controls the water. Unless all warships can get under the water they will be blown out of the water. . . . As the locusts swarmed over Egypt, so will the aircraft swarm in the heavens, carrying (some of them) inconceivable cargoes of men and bombs, some fast, some slow. Some will act like battle cruisers, others as destroyers. All cheap (and this is the gist of it), requiring only a few men as the crew."—*Lord Fisher.*

MILITARY AERONAUTICS

WHAT CONSTITUTES THE AIR SERVICE

THE Air Service of the War Department is a separate and co-ordinate branch of the line of the Army.

It is not only a combat service, in the same sense as the Signal Corps and the Corps of Engineers, but is also a combat arm in the same sense as the Cavalry and the Artillery.

As a combat arm it is divided into three distinct branches—Pursuit, Bombardment and Attack. It is further divided into heavier and lighter-than-air branches, and the latter into balloon and airship divisions. Pursuit aviation is the operation of aircraft against aircraft in the common element—the atmosphere—whether over land or sea. Bombardment aviation is the dropping of explosives, torpedoes, gas or incendiary composition upon material on land and sea. Attack aviation is the direct assault upon personnel, whether on the ground, or on board ship, by aircraft armed with machine guns, light cannon, hand grenades or small bombs.

The Air Service operates its own complicated and difficult supply service that requires expert knowledge in widely different fields. As far as the rest of the Army is concerned, the duties of the Air Service are accomplished by pilots and observers in aircraft, but

in order to keep the equipment in the air, a highly-trained enlisted force is necessary. The manufacture of aircraft is a specialized art which calls into activity seventy-two distinct trades. The personnel of the Air Service must have a grasp of the art sufficient for the problems of maintenance as well as operation and this training is provided by means of twelve specialized schools of instruction.

ITS ORGANIZATION AND ACTIVITY

The Air Service is directed by a Chief, who is a Major General, and an Assistant Chief, who is a Brigadier General. Four great groups provide the channels through which the Air Service functions. They are:— Training and Operations, Supply, Information, and Administrative. In an effort to provide additional co-ordination and to facilitate decisions involving all branches of the Air Service, there is an Advisory Board, consisting of the chiefs of groups and of working members of wide experience in all the different phases of aviation.

The Air Service constitutes 80% of governmental aeronautical activity. By personal contact or correspondence, it endeavors to avoid duplication and to co-ordinate its work with that of the twenty or more additional governmental agencies having to do with aeronautics. Thus it is in direct touch with the Joint Army and Navy Board, which deals with the major problems of military and naval defense; the Aeronautical Board, the duties of which are more particularly to co-ordinate military and naval aeronautical activities; the Interdepartmental Committee on Meteorology, representing the War and Navy Departments and the Weather Bureau; the Board of Surveys and Maps, the Ordnance Technical Staff, the War Department Technical Committee, the National Advisory Committee for Aeronautics, and to a limited degree by representation on the unofficial Sub-Committee on Commercial Aviation of the Economic Liaison Committee for Foreign Trade, which has interested itself in the aeronautical establishments, ambitions or concerns of the Post Office, State, Commerce, Agriculture, Interior, Treasury, Labor and other departments.

The Air Service was very active in operations in 1920. In addition to the flying at the various fields, thousands of miles between stations were covered by air. The Air Service has maintained a policy of aiding commercial aeronautics wherever possible and has lent much assistance to such projects as the Aerial Mail, Aerial Forest Patrol, map making, etc. It has stimulated commercial enterprise by laying out routes and urging municipalities to establish air ports, along specifications prepared by the Service. In absence

of suitable aerial regulation, it has devised rules which have formed the basis for much commercial activity in various parts of the United States.

Early in the year Captain R. W. Schroeder established a new world altitude record at McCook Field, Dayton, Ohio. In the Spring the Air Service conducted a reserve aviators' contest on Long Island, which was participated in by many former service fliers now in college, but who desired to keep up their training. A remarkable round trip flight to Alaska was made late in the summer. Full accounts of all these activities will be found elsewhere in this volume.

THE ESTABLISHMENT AND HOW IT OPERATES

The Air Service must operate independently or in conjunction with the Army or the Navy or both. Operating as a service for the Military, it performs the functions of observation, gun-spotting, liaison, etc. Operating independently it becomes, in effect, a separate Air Force, pursuing, bombing, and attacking the enemy on the land, and on the sea, under the sea and in the air above both land and sea.

The framework of the Air Service is modelled along that of a Brigade. Such an organization is designed to have two or more wings. Each wing has two or more groups. The group is the tactical unit. Each group is divided into four squadrons. A squadron consists of three or more "flights." A "flight" is made up of three to five aircraft.

At present the headquarters of the Air Service's two wings are at Kelly Field, Texas, and Langley Field, Virginia, respectively. The group, squadron and flight organizations are incomplete, but, roughly, they consist of the following:—Groups—1 day bombardment, 1 pursuit, 3 observation, 1 surveillance, 1 army observation; Aero Squadrons—2 army observation, 9 observation, 3 surveillance, 4 corps observation, 4 day bombardment, 4 pursuit, 1 construction. There are also nine photographic sections, 32 balloon companies and 2 air park companies. These forces are stationed throughout the United States and insular possessions and also in Germany.

CHIEF OF AIR SERVICES CONCLUSIONS AND RECOMMENDATIONS

The policy of the Air Service lies not so much in the maintenance of a large establishment in the regular Army as in the building up of the National Guard and organized reserves with civilian equipment resources.

The Chief of Air Service, in his report for the fiscal year ending June 30th, 1920, as made to the Secretary of War, states:

"Consideration of the functions of the Air Service of the Army discloses the fact that in case of war it must undergo an enormous expansion of both equipment and personnel. In the matter of equipment, its problem is such that it cannot hope to solve it within itself, but must depend upon the whole manufacturing resources of the Nation; in fact, must depend upon resources not yet established and must lay its plans to the end that such resources shall be established and maintained. The Army must spend its appropriations in experimentation, in limited procurement, and in the test, under field conditions, of experimental productions, in order that it may know what equipment to use when war comes.

"Likewise for its personnel it is impracticable to seek an expansion of the Army Air Service that would begin to care for its war needs. It must therefore build its plans upon the annual training and passing into organized reserves of a reservoir of trained flying officers that will be immediately available in case of war; and for its enlisted personnel it must look to the enlisted reserve and to the mechanics engaged in civilian and commercial aeronautics and in aircraft manufactories—sources that are to-day so small as to be almost negligible.

"The vital interest of the Army Air Service lies therefore less in obtaining appropriations, more in securing legislation to foster sources of supply of equipment and personnel for the needs that will be so greatly expanded by war."

In his concluding recommendations the Chief, in the foregoing report, declares:

"The United States Government should adopt, at this time, a continuing program for the manufacture of aircraft, and should make adequate appropriation therefor, in order to stimulate the aeronautical industry of the United States. Attention is invited to the fact that the close of the next fiscal year will disclose the deterioration, from either use or storage, of practically all the airplanes which were purchased during the war for the Army to the point where they will be unsafe for flying. Adequate replacement will have to be made in order to enable the Air Service to meet not only its operating needs in carrying out its functions as a combatant branch of the Army, but also its present responsibility as the prime governmental agency to co-operate with other bureaus or departments of the Government in the use of aircraft for their purposes.

"Aside from this there must be considered the fact that in time of war this country must again rely upon the aeronautical industry and the facilities which commercial aeronautics will make available for its use. Modern industry requires great foresight in planning the objectives upon which it hopes to realize financial return. Unless the Government recognizes this business principle it can not hope to depend, for its war needs, upon the availability of suitable commercial aircraft and facilities for their employment, nor upon the existence of manufacturing plants and supplies of materials necessary for the rapid production of aircraft. In order properly to foster the aeronautical industry, the Government should announce, by legislative enactment, a policy which will provide for the manufacture of aircraft, covering a period of from three to six years, and must at the same time provide the necessary assurance that funds will be appropriated therefor annually during the continuances of the policy."

The aeronautical activities of the United States Navy are distributed among the following nine divisions constituting the Navy Department:

- The Office of Naval Operations
- Bureau of Navigation
- Bureau of Construction and Repair
- Bureau of Engineering
- Bureau of Ordnance
- Bureau of Yards and Docks
- Bureau of Supplies and Accounts
- Bureau of Medicine and Surgery
- Marine Corps

The Secretary's Annual Report, made public December 13, 1920, presents the status and organization of Naval Aviation.

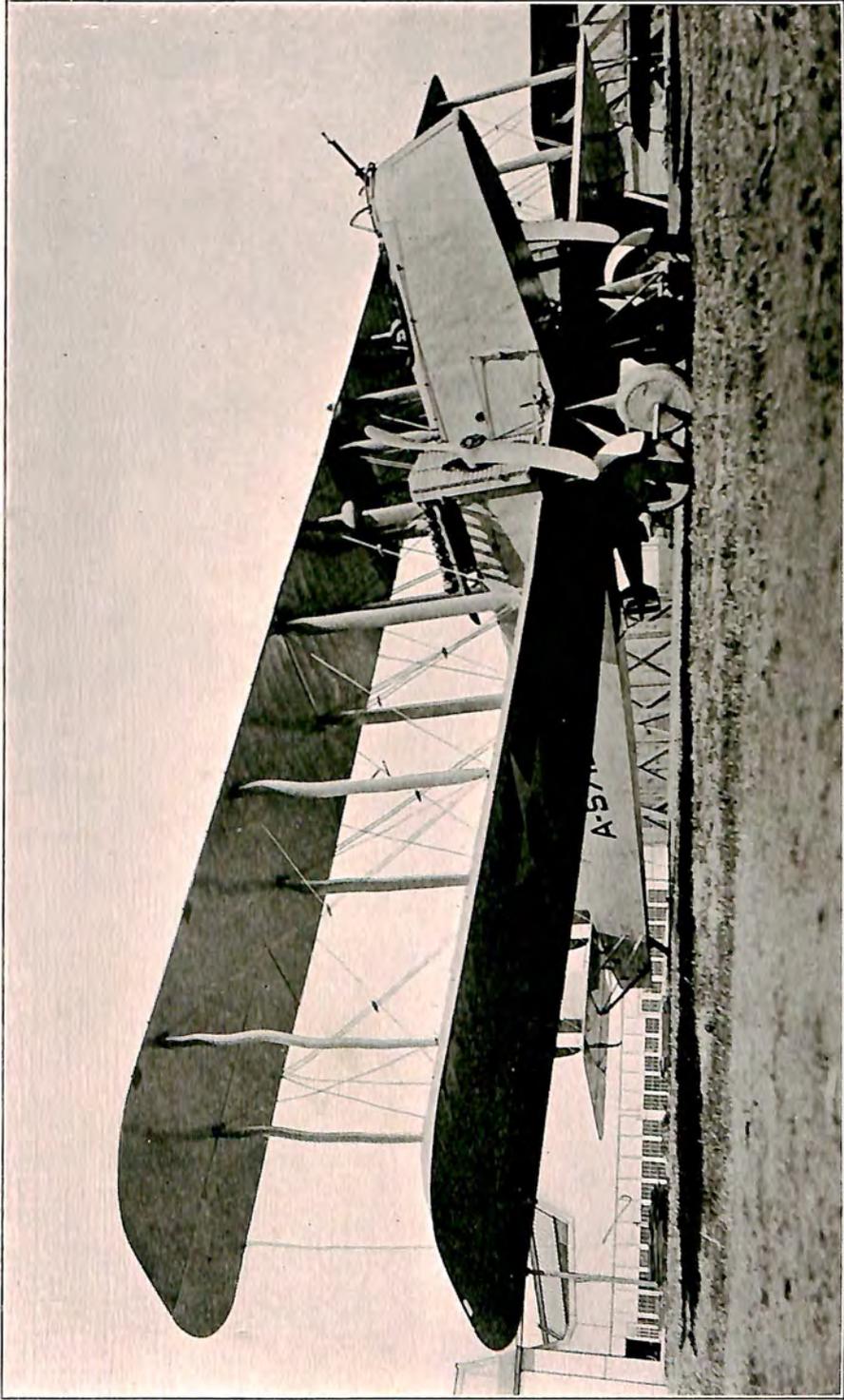
For three years prior to the spring of 1914, aviation was handled as a matter of experiment in the Bureau of Navigation, with a small appropriation, approximately \$10,000 per annum. There was no organization in the Navy Department in which aviation could properly fit, but the office best adapted for aviation affairs appeared to be that of Naval Operations, and accordingly a Captain was ordered to that office for aviation duty.

During the conflict with Germany, when aircraft developed from auxiliary into major weapons, threatening to displace in certain fields the older means of warfare, Naval, as well as Military Aviation, grew to such proportions that, because of the lack of the proper administrative machinery to take care of aviation, special and extraordinary means had to be taken to facilitate progress. The Planning Section of the Office of Naval Operations became the center of Naval Aviation activities, and all hands combined to make an unworkable organization function properly and unusual co-operation (a co-operation that could not be expected in peace times,) was extended by the Bureaus to facilitate the administration.

The Navy Department, it appears, has made every effort to mold aviation, its newest member, into its established organization, but this apparently having turned out to be an impossibility, Congressional legislation will be necessary to give aviation its proper standing in the Navy.

The Secretary in his latest annual report makes the following statement of conditions and recommends certain Departmental changes:

"At the present aviation funds for all purposes are allotted through the Office of the Chief of Naval Operations, who is directly responsible for the details of aviation. This plan is defective in that it charges the Chief of Operations with numerous details with which he should not be troubled



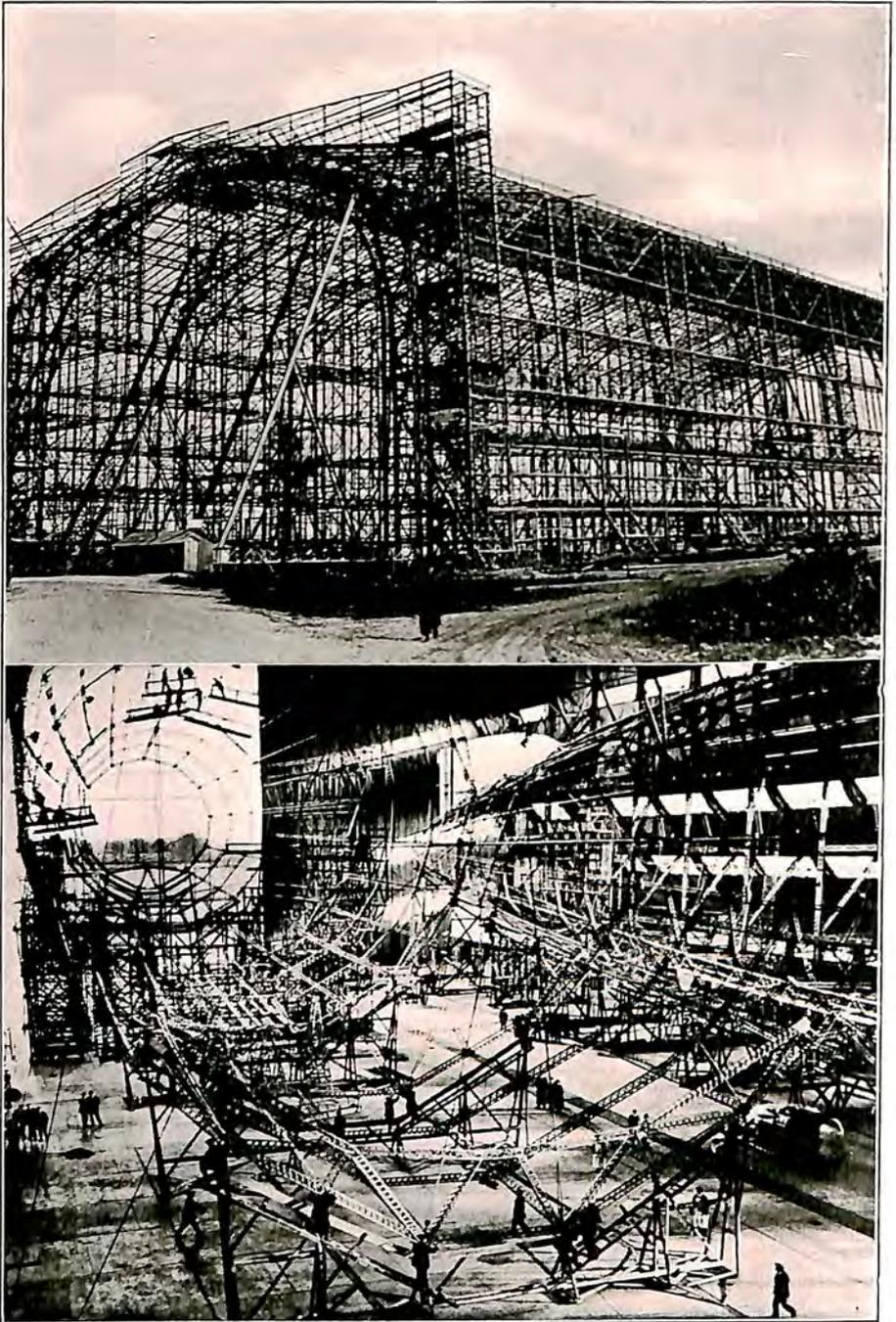
The Glenn L. Martin Torpedo Plane.



Lieutenant C. C. Moseley and Nerville-Packard Biplane of U. S. Air Service, in which he won the Pulitzer Trophy Race at Mitchel Field, Long Island, Thanksgiving Day, 1920. This airplane was entered in the Gordon Bennett Race.—Photo, U. S. Air Service.



Captain Harold E. Hartney and Thomas-Morse M. B.-3, Wright-engined, of U. S. Air Service. Captain Hartney won second place in the Pulitzer Race.



Dirigible Hangar which Naval Aviation is Constructing at Lakehurst, N. J.
Below—Z. R.-2, which U. S. is building in England.—Photos, U. & U.

or concerned and places under his office administrative duties concerning aviation which do not properly belong there. These duties are handled under the Planning Section of Operations, a section not created or equipped for administrative purposes.

"Under the present arrangement, cognizance of the many closely associated elements entering into the experimental design, development and operation of aviation, is scattered through various offices of the Navy Department and their co-ordination through the present departmental organization is attended with serious loss of time and with unnecessary difficulties. The aviation section of Operations is at present held tacitly responsible on all aviation matters. No responsibility or authority, however, is actually vested in the present organization assigned to the control of aviation; nor is it possible to delegate this authority without legislation.

"For the purposes of bettering co-ordination and in order to give the Navy Department an aviation organization competent to deal with corresponding organizations in the other departments of the government, it is important that a bureau for the direct control of aviation should be established."

The Office of Naval Operations has three main divisions: Materiél, Ship Movements, and Planning. It appears that the least unsuitable of these divisions in which to place aviation was the Planning Division. Aviation was therefore made a section of the Planning Division. The senior officer of this section (Section F), being simply the senior member of a subsection of the Planning Division, has no administrative or executive authority, and yet, if aviation does not properly progress, the responsibility for failure is brought to the door of this officer and the Chief of Naval Operations, to whom he is directly responsible. The Chief of Naval Operations has little time to concern himself with aviation affairs, and the senior officer of Section F has a most difficult time co-ordinating the efforts of the many Bureaus and directing where no power to direct is given, the training, supplies, and operations, so as to bring about the establishment of an efficient fighting unit.

The Bureau of Navigation directs all aviation personnel and controls the development of aerial navigational instruments, aerography, and photography. The Bureau of Construction and Repair has control over all matters pertaining to the design, construction, and repair of aircraft. The Bureau of Engineering controls the design and development of aircraft power plants, radio apparatus, and helium for lighter-than-air craft. The Bureau of Ordnance is charged with aircraft ordnance. The Bureau of Yards and Docks controls all aviation shore station buildings, construction, real estate, etc. The Bureau of Supplies and Accounts and the Bureau of Medicine and Surgery control the aviation matters germane to the general activities of these bureaus.

In spite of these great handicaps, the loyal officers assigned to aviation duties have by great effort brought about progress in Naval Aviation.

During the fiscal year ending June 30th, 1920, Naval and Marine Corps aircraft flew a total of 1,570,892 miles. Notable feats were the seven months' cruise through the West Indies of the F.-5-L squadron with the Atlantic Fleet, and the 8,000-mile recruiting flight of the N.-C.4 under Commander Albert C. Read, of trans-Atlantic fame.¹

The Secretary's Report indicates the existing disposal of naval aircraft equipment. Both the Atlantic and Pacific fleets now have units designated "Air Forces" made up of a Seaplane Squadron, an N.C. Squadron, a Ship Board Plane Detachment, and a land station. The Seaplane Squadron of the Atlantic Fleet is called the "Air Boat Squadron." The land station of the Atlantic Fleet is Hampton Roads and of the Pacific Fleet is San Diego. The aerial equipment of each land station is subject to the call of the respective Commanders in Chief of the Fleet. These naval air stations, in common with others, also report to the various naval district commanders.

The Atlantic and Pacific Fleet "Air Forces" have attached to them certain marine craft. The *Shawmut* and *Sandpiper*, are tender and auxiliary tender, respectively, for the Atlantic "Air Boat Squadron," which consists of F.-5-L's. The Atlantic N.C. Squadron has the *Harding* as tender. The Pacific "Seaplane Squadron" has the *Aroostock* as tender, while the Pacific N.C. Squadron has the *Mugford*.

The Ship Board Plane Detachment consists of equipment for the four battleships of each fleet that are fitted with turret platforms.

The Navy Department is converting the collier *Jupiter* into an experimental airplane carrier renamed the *Langley*. The Department is also converting into a tender a type B Shipping Board Transport, to be known as the *Wright*.

The R.-38 (renamed the Z.R.-2), the huge rigid dirigible purchased from England and now under construction there, was expected to be ready for flight to America by the Spring of 1921.¹ Fourteen officers and fifty-eight men are in training at Howden, England. Hangars for this airship as well as the one being constructed at League Island are being erected at Lakehurst and Cape May, N. J. Another hangar is to be erected on the Pacific Coast.

¹ See Chronology.

CHAPTER XI

GOVERNMENTAL POLICIES AFTER THE WAR; AIRCRAFT THE DECIDING FACTOR; CIVILIAN RESERVE IN TRAINED PERSONNEL AND PRO- DUCTION RESOURCES NECESSARY TO NATIONAL DEFENSE.

WHEN the terrible effectiveness of aerial warfare was revealed during the conflict with Germany, it became apparent to both civil and military leaders among the Allies, that, no matter what the outcome of the struggle then in progress, the first — and possibly the last — battle of the next war would be fought in the air. For they recognized in aircraft a swift, universal system of transport instantly convertible into vehicles of destruction.

This conviction was voiced by Great Britain and France as far back as 1917, when the United States had barely entered the war and was so occupied with the immediate needs of the Allies that she had no thought for her own future.

Thus England, with that wisdom and forethought which have characterized her governmental policies for generations, took time, during the darkest hours of the war, to lay plans for British dominion in the air, where there is — and can be — no insularity. The Parliamentary Committee on Civil Aerial Transport reported: "*Cost what it may, this Country must lead the world in civil aerial transport.*" *For the commercial aircraft of the future will be to aerial defense what the merchant marine has been to the Grand Fleet.*

PREPARING FOR THE FUTURE

The French were alert, mindful of the cruel misery of fear burdening an unprotected people. In April, 1917, M. D'Aubigny, President of the Aeronautical Subcommittee of the French Army, wrote a letter to M. Daniel Vincent, Under Secretary of State for Military Aeronautics, indicating the manner in which the entry of the United States into the war could best be utilized to help aeronautics. After a recital of all the things desired, he wrote: "*It is necessary to also hold account in the negotiations, of this other fact, that the*

war has given birth to a new industry, to which we owe in the national interest to reserve for after the war a vast market by limiting in whatever measure possible, the competition of foreigners." This is a literal translation from "History of the Aerial War," published in *La Vie Aérienne*, March 4, 1920.

The herculean efforts put forth by each of the belligerents in the construction of aircraft brought the production at the end of the war to a figure greatly in excess of even the colossal consumption at the front. It is estimated that at the time the Armistice was signed, or shortly thereafter, there were actually in existence in Great Britain, France, the United States and Germany more than 50,000 aircraft and possibly twice as many motors. Production in the United States had increased so rapidly during the closing months of the war that, by the end of 1918, we had on hand some 15,000 machines and 25,000 or 30,000 engines. The surplus in Great Britain was somewhat larger and in France somewhat smaller, but Germany is officially stated to have had some 18,500 aircraft liable to confiscation or destruction.

This latter fact is the central point of inspiration for the post-bellum aerial policies adopted by the Allies. Back of practically every public utterance in Great Britain and France has been the shadow of fear—the fear that the German mind, unchastened by defeat, defiant of a distraught world, would, at the first opportunity, arise like a winged plague.

So in the Armistice terms it was written that all manufacture of aircraft in Germany should cease for six months from the signing of the Treaty of Peace. It was provided further that the aircraft stocks on hand November 11, 1918, should be surrendered or destroyed. This done, the Allies felt that they could safely turn to their own problems.

THE "CATACLYSM OF PEACE"

It was a British statesman, who, beholding the vast aircraft industry nurtured by war, prayed Parliament for protection from the "Cataclysm of Peace." Parliament heeded; for the English have today an aerial policy which made possible the early adoption of a code based upon the international treaty, the encouragement and development of the "Key Industry," and, finally, centralization of all aeronautical activities into one department. Yet there remained the surplus aircraft. What to do with the thousands of "ships" and engines was the problem. To release them in the British Empire would be to imperil British industry. What more logical (from the British point of view), than to dump them in the most

favorable foreign market, thus eliminating competition and establishing new business lines for the plants at home?

And the United States was chosen as the dumping ground!

Among the first to perceive the dangerous significance of this move were officers of the United States Air Service. They appealed at once to Congress for protection. The House and Senate Military Affairs Committees undertook to add a rider to the current Army Appropriation Bill, but unanimous consent was necessary and this, due to the confusion of the closing days of the session, was difficult to obtain.

BRITISH DUMPING PLANS IN AMERICA

Senator Harry S. New, of Indiana, on introducing the amendment, which had the support of both parties, said:—

“I think that our military and naval leaders agree that the aerial arm is necessary to our national defense.—There are two ways in which to maintain and develop this arm:

- “1. By governmental appropriation only, which will mean simply experimental work and which consequently will entail a considerable yearly expense without an economic return.*
- “2. By governmental appropriation partly, but mainly by providing the aircraft industry with such legitimate encouragement and protection as will enable it to compete with similar industries in other countries for the aerial commerce of the world. The greater the share in aerial transport which a nation obtains, the less will be the military burden.”*

The Senator then described in detail the plan whereby the British Government hoped to rid itself of its surplus aircraft by the formation of the Aircraft Disposal Co. He said:

“According to the British aeronautical journal, the *Aeroplane*, approximately 10,000 airplanes and between 20,000 and 30,000 engines, which cost the British government between one hundred million and one hundred and fifty million pounds to manufacture, were turned over to the . . . syndicate for one million pounds, or less than 1 per cent. In the contract, however, it was stipulated that the British government was to receive 50 per cent. of all profits. Thus the enterprise assumes an international character of profound significance.

“Now, it has been printed in the public press of this country that the Aircraft Disposal Company contemplates the early dumping of at least 2,500 airplanes in the United States. The State Department reports that between May 4 and May 10, 57 airplanes with engines were invoiced out of London for America. So you see the material which England hopes to dump into this country is actually on the way. Indeed, I am informed that some of it already has arrived—and has been sold. It is stated that D. H.-9 airplanes, which cost the British government more than \$15,000 to make, have been sold to purchasers in this country for \$1,500—and others proportionately.”

The amendment was vigorously supported, but failed, leaving the United States Air Service and the American aircraft industry in a precarious position.

Before narrating subsequent events it is necessary at this point to consider France, Italy and Germany.

FRANCE AND ITALY FOLLOW SUIT

France made a move similar to Great Britain's. Plans were prepared for an extensive advertising program in the United States to be followed by the dumping of French war aircraft. Italy, too, was reported to have taken preliminary steps looking to dumping in the United States.

But the French did not press their plans. Possibly they were occupied too closely with the new Rhenish frontier; possibly they remembered that dumping was a device which the Germans brought to a state of perfection disastrous to the objective country.

THE ALLIES' DISTRUST OF GERMANY

On May 6th, 1920, M. Flandin, Under Secretary for Aeronautics, speaking at a banquet of the French Aero Club, said: "*I think that the Treaty of Peace, that destroyed all the German military airplanes, has rendered German aeronautics a great service by freeing it, through the limitation of the Treaty, from the embarrassment of the surplus aircraft, of which we are indefinitely to drag the weight.*"

But what of "defeated" Germany?

While the Armistice said much of what might not be done for six months *after* the signing of the Treaty of Peace, it said nothing as to what might or might not be done *before* the Treaty. So, for the fourteen months from Nov. 11, 1918, to Jan. 10, 1920, Germany was intensely active in design, new construction and operations, in both heavier and lighter-than-air.

In France, but more particularly in England, fears were persistently expressed that Germany was not keeping faith in the surrender of war aeronautical equipment, that she was building new military machines and engines and storing them in Holland and Switzerland, and above all, that she was ambitious to dominate the air.

Lord Northcliffe was quoted in the *London Daily Mail* as saying:—"*It is obvious from the writing of German military officers since the war, that they are pledging their faith in the future of the air.*"

G. Holt Thomas, one of the outstanding figures in British aeronautics, writing in the *London Times* in June, 1920, said: "*The German responds faithfully to an idea. Once the seed is in his mind,*

it grows and flourishes. The German, as a citizen, has always been genuinely interested in flying. The German citizen thirsts always for some rallying cry, some good imagination-stirring 'slogan.' What better than 'Germany's future is in the air'?

The French were nearer to the danger. Consequently they could speak with even plainer truth. In July, 1920, M. Flandin told the Chamber of Deputies:—“*Germany hopes without doubt to rebuild her air fleet, and this fleet will have the incontestable advantage of being composed of the very best and modern types. They will probably baptize it the 'commercial air fleet' or the 'civil aerial fleet.' but when one realizes the facility with which an airplane of peace can be turned into an airplane of war, it is easy to see at the bottom of this project only a menace and a warning for the other nations of Europe.*”

GERMAN PLANS

The international aeronautical situation was affected in a curious and entirely unforeseen manner by the application of Peace Treaty terms and rules as issued by the Allied Council.

The Allies provided for either the destruction or surrender of German aircraft material. In some instances, it is stated, the destruction was carried out by Allied forces and in others by the Germans themselves. The difference in results lay in the fact, as later disclosed by German aircraft manufacturers who visited America, that the Germans, on at least one notable instance, purposely wrecked their latest example of aeronautical design and construction, leaving intact for delivery to the Allies only the equipment already obsolete.

Whether or not this was the general practice, it is true that large quantities of German war aircraft and engines were confiscated and shipped to Great Britain, France and Italy. The purpose of such distribution was intended to aid in the study of the German art, but the practical effect was simply to enlarge the surplus stocks already in existence.

Now the Germans, freed from the perplexing problem of disposing of their surplus, and eager to put their new developments to practical use, cast about for the least unfriendly country in which to develop a market for their post-war aircraft and thus, at the expense of the manufacturers in the market chosen, to expand their own aeronautical industry and assure Germany the military protection which a strong civilian production reserve could provide.

And the Germans, too, chose America as their dumping ground!

At least two of the most powerful German aircraft firms sent officials or representatives to America. They were favored in their hopes by the low exchange rates and their movements were accel-

erated by the fear that the Allies would interfere and confiscate machines on hand before they could be exported.

On March 24, 1920, a German Junker type airplane appeared on Long Island. No public announcement of its origin and the plan to import and sell upon a commercial basis was made and for a time it occupied courtesy space in the American Flying Club's hangar at one of the U. S. Air Service's Long Island fields. As soon as the true status of the machine became known, the hospitality was withdrawn.

In spite of the fact that these German "ships" were reported to have made several remarkable flights and that their design and construction invited the serious attention of the industry, their origin, together with a series of fatal accidents, finally invited general hostility in the press.

Neither the American aircraft manufacturers nor officers of the Air Services of the Army and Navy were opposed to the importation of limited numbers of foreign aircraft of new design for study and experimentation, but both were opposed to saturation of the civilian market with cheap-priced craft which would build up a foreign industry, vital in time of war, at the expense of our own.

WHO SHALL DOMINATE THE AIR?

If Aircraft are to dominate the warfare of the future, is it unreasonable to believe that Germany hopes to dominate the air?

If England and France, fearful for their own safety, foresaw an unrepentant and dominant Germany on wings, were the officers of the United States Air Service, charged with the national security, to shut their eyes to any danger in the air, no matter from what direction it should come?

It was this responsibility that impelled the Air Service leaders to urge Congress for protection from aircraft dumping, irrespective of the country involved. Their protest was against Great Britain, not because of British ambitions as such, but because a "key" American industry was in peril.

Action in the Senate having failed, the Ways and Means Committee took up the subject, holding hearings May 28th and June 1st on a special aircraft anti-dumping bill, prepared by Representative John Q. Tilson of Connecticut along lines suggested by Senator Wadsworth, Senator New, Representative Kahn and other leaders in military affairs in Congress.

UNITED STATES AIR SERVICE PERCEIVES THE DANGER

Major General Charles T. Menoher, Chief of the Air Service,



Entire Personnel of Alaska Flying Expedition. *Left to right:* Sergeant Edmond Henriques, mechanic, plane No. 1; M. S. Joseph E. English, mechanic, plane No. 4; Sergeant James D. Long, mechanic, plane No. 3; Second Lieutenant Clarence C. Crumrine, pilot, plane No. 3; Second Lieutenant Erik H. Nelson, Engineer Officer, plane No. 2; Second Lieutenant Ross C. Kirkpatrick, pilot, plane No. 4; First Lieutenant Clifford C. Nutt, pilot, plane No. 2; First Lieutenant St. Clair Streett, pilot, plane No. 1, and commander of expedition.



General Pershing Congratulating Major-General Menoher, Chief of Air Service (in flying clothes), on conclusion of Alaska flight. Brigadier-General Mitchell, Assistant Chief of Air Service, in center.—Photo, U. & U.

who led the Rainbow Division through most of the war, and at the signing of the Armistice was in command of the 6th Army Corps, gave it as his personal opinion that the dumping of this surplus aircraft into the country would place in jeopardy the American aircraft industry. He said:

"I think I can say—and I think I am stating the attitude of the War Department also, on this particular thing,—that it is of vital importance to the national defense, to the Air Service directly, that there should be built up in this country an industry, an airplane manufacturing industry, so that in case of emergency we will have something to fall back upon. As to just how this is to be brought about, that is another thing of course, but I can state now, and would like to state now to emphasize it, that it is of vital importance that the airplane manufacturing industry be built up in this country so that we may have it to fall back upon in case of national emergency."

Brigadier General William Mitchell, Assistant Chief of the Air Service, who was in command of Air Service operations at the front in France, declared:

"I know as certainly as anyone can tell that if this market is flooded with this English equipment, it will practically knock out the possibility of our defending ourselves in the air in war. You will be turning over the key of the front door to some other nation."

Colonel W. L. Gillmore, Chief of Procurement and Supply, Army Air Service, said:

"As I look at this problem of bringing in perhaps 5,000 planes and 15,000 motors of foreign make, we are probably going to paralyze the American aircraft industry. Why, these planes and motors could be sold in this country at a price that no American manufacturer could meet. What would happen to our industry? They would not be able to continue on the small orders of the War Department. . . . I believe I can see where we are liable to put ourselves into the hands of the British on airplane production if our manufacturers quit and go out of business. Where are we going to turn to for the equipment we need?"

At these hearings, representatives of practically the entire American aircraft industry were present, and stated it as their unqualified conviction that, unless the dumping were prevented, the death of the industry would assuredly follow, or if not death, then tremendous burdens with a small source of supply would be placed upon the War and Navy Department.

EIGHT FEDERAL DEPARTMENTS PROTEST

Simultaneously with the hearings, the Sub-Committee on Commercial Aviation of the Economic Liaison Committee made a report urging prevention of the threatened dumping. The combined weight

of opinion of the State, War, Navy, Post Office, Commerce, Agriculture, Interior and Treasury Departments, was thus added to the Air Service argument. The special sub-committee, of which Lt. Col. Horace M. Hickam, chief of the Information Group, Air Service, was chairman, pointed out the necessity for building up and maintaining a civilian aerial reserve in the United States, with sources of supply wholly American. It was emphasized that these sources could not thus be kept wholly American if a foreign invasion with obsolete aircraft were to be permitted.

The Tilson bill was unanimously recommended by the Ways and Means Committee and was unanimously passed by the House. It was known to have the overwhelming support of the Senate, but it reached that body too late in the closing hours, so the second session of the 66th Congress ended without providing protection for an essential element in the national defense.

If the Congress failed to formulate a policy on aeronautics it was not because the country as a whole was indifferent to the necessity for action. On the contrary, the press of all parties, at a time when many other subjects were urged for consideration, came vigorously to the support of the Air Service. Scores of editorials appeared calling attention to the danger. There was little direct antagonism to the English, but there was insistent demand that we guard our own country and not be compelled to look to another for protection.

PRESS URGES "AMERICA FIRST!"

Said the *Washington Post* on May 30th:

"The Domestic aircraft industry is in a bad way enough at present. It is 95% liquidated. The statement has been authoritatively made that one company which formerly utilized the services of 20,000 persons has now only a little more than 1,000 employed and that there are not more than 2,500 mechanics in the entire country engaged in the production of aircraft. If these figures are even approximately correct, they show that there is ample room for the building up of a great national industry in the ever-widening field of aviation. The Government can afford to encourage domestic airplane invention and manufacturers for the sake of preparedness."

The serious condition in which the American aircraft industry found itself, due to the threatened invasion from abroad, was taken cognizance of in the editorial columns of the *New York Times*, June 21st, as follows:

"Now our airplane industry is on the very verge of succumbing to foreign rivalry and will be preserved for a lingering existence only if it gets immediate protection of the sort that only legislation can give."

On June 30th, the *New York Tribune* pointed out:

"There is no market for the material in Great Britain, and Canada and Australia and France have enacted laws prohibiting the import of any parts of it. America is the only country where the material can be disposed of. A large quantity is already here and more is on the way, to be sold at prices far lower than any American manufacturer can meet. The arrival of the entire consignment will strangle American aviation, already struggling for a bare existence and seriously prejudice the country's aerial defense by putting the few remaining manufacturers completely out of business."

A broad view, pro-American, rather than anti-British, was expressed by the *St. Paul Pioneer-Press*:

"Great Britain cannot be blamed for wanting to get rid of its old equipment, nor can it be blamed for seeking to sell in what undoubtedly will be its best market—the United States. But what can be said for this country's policy, or rather lack of policy, which will allow a foreign power to cripple our airplane industry?"

Floyd W. Parsons, writing in the *Saturday Evening Post* under the significant heading "Everybody's Business" said:

"England has closed its markets against French war surpluses, and France has done the same with respect to the English supplies of war aircraft. America, therefore, now affords the chief market for Europe's obsolete machines.

"Just as a great fleet of merchant vessels is essential to a nation that would command the seas in time of war, so must a country in the future have a large and modern fleet of commercial aircraft to supplement and strengthen its military air forces if it expects or even hopes to hold mastery of the air."

The *Chicago Daily News* on May 25th inquired:

"Are Americans about to suffer British Dominion from the Air?"

On the same day the *Chicago Tribune* apparently provided the answer:

"Already all but two American manufacturers of airplanes on a large scale during the war have gone out of business. With such competition from Great Britain as now impends it is evident that even these cannot continue successfully. . . . In the eighteenth century Joshua Gee, an English writer and government official, said: 'We ought always to keep a watchful eye over our colonies to restrain them from setting up any of the manufactures that are carried on in Great Britain, and any such attempt should be crushed in the beginning, for if they are suffered to grow up to maturity, it will be difficult to suppress them.' We are no longer colonies, but the British trade policy remains the same."

The *New York World* on June 6 declared:

"It is a question of national defense!"

So, too, the *New York Sun* on June 10th:

"America and Americans want the American airship industry in all its

branches encouraged, not for the profit of individuals, but for the defense of the nation."

AMERICAN PATENT RIGHTS PROVIDE PROTECTION

Although no legislative relief was obtained, the protection which so many men in responsible public positions regarded as imperative came by way of the United States Courts. The Wright Aeronautical Corporation, owner of the Wright patents in the United States, secured a decision, the world-wide effects of which were admirably pointed out by the press. The *New York Sun*, in its issue of July 10th, 1920, reported the decision as follows:

"The plan of British interests to flood this country with thousands of obsolete British war airplanes at practically junk prices, thus crippling American aircraft manufacturers and, which is more important, rendering this country helpless in the air, should war come, appears to be defeated by a decision handed down by Judge Thomas I. Chatfield, in the United States District Court, Brooklyn.

"Curiously enough the decree which may save the American manufacturers from ruin and the Air Service from dependence on foreign airplanes, was based upon the fact that the airplane in its present form is strictly an American invention.

"The decree was secured by the Wright Aeronautical Company of Paterson, N. J., holder of the patent rights of Orville and Wilbur Wright, and perpetually prohibits the Interallied Aircraft Corporation of New York from using or selling foreign airplanes in this country. . . .

"According to manufacturers here the patent involved in the Chatfield decree, No. 821,393, is the one covering the basic idea of stability in flight which is maintained by warping the wings or by use of ailerons on the wings. Rights to the invention in certain foreign countries have been disposed of.

"Judge Chatfield's decree," says a statement authorized by the Wright Aeronautical Corporation, "is interpreted to mean simply that the Wright patent in America is unimpaired by any privileges which may have been disposed of in other countries.

"Some British airplanes have already been used and sold here in disregard of the rights of American inventors and patentees, not only Orville and Wilbur Wright, but Glenn H. Curtiss, Grover C. Loening and Alexander Graham Bell. The British airplanes, although using these American inventions, are doing so for the most part without license or payment of royalty."

On December 7, 1920, Judge Mayer in the United States District Court in New York City granted to the Wright Aeronautical Corporation, plaintiff, a preliminary injunction against Handley Page, Ltd., and the Aircraft Disposal Company, Ltd., British corporations, and their American representative at that time prohibiting them from bringing to this country and selling here airplanes from the 10,000 sold by the British Government to the Aircraft Disposal Company, Ltd. It appeared that the first lot to be sold here was 2,365 planes.

Judge Mayer pointed out that there is no market for all these airplanes in Great Britain or elsewhere, unless a market is created here for these planes, which were, in the main, designed for war service and sold by the British Government, obviously, because they were no longer needed for Governmental purposes.

The injunction was granted because of infringement of the Wright patent No. 821,393, owned by the plaintiff. Judge Mayer stated that "its policy of licensing is fair and conducive to the development of the industry in this country. It has granted licenses to nearly all the manufacturers in the United States." The claim of the defendants that the British Government had been licensed under this patent was rejected by the Court. He further declared:

"The Wright patent has been adjudicated to be valid, a pioneer and of wide scope by Judge Learned Hand, by Judge Hazel, and by the Circuit Court of Appeals of this Circuit. The validity and broad scope of the patent are today universally recognized by the aircraft industry of this country, which has paid, and is paying, very substantial royalties. Practically every manufacturer of airplanes in this country is licensed, and various importers of British, French and Italian airplanes are also licensed. The defendants do not question these facts.

"The defendants do not now deny title, validity or infringement. On behalf of defendants, the argument is put forward that the introduction of these machines will educate the American public to the utility of the airplane as a commercial proposition, hence create a large demand, hence ultimately stimulate American industry to supply that demand.

"The American manufacturer may, however, be trusted to make up his mind as to what is best for him, and his bitter opposition shows that he considers that if these machines are brought here and, as defendant Workman states, are laid down, 'duty and heavy transportation charges paid, in New York City—or in fact, anywhere in the United States—at a price which is but a fraction of their actual value,' such importation will destroy or gravely impair American industry in this regard.

"Whatever may be the correct economic view, the fact is that plaintiff is the owner of the patent; that the patent has been adjudicated, that the courts have given it a high place, and that defendants have thus far brought into this country only a few planes, and have not, in any sense, established an industry here.

"Defendants acquired these planes from the British Government with their eyes wide open and took their chances on their legal rights. They state that they have allotted 2,365 planes for the American market. The selling price of these planes is said to be \$6,510,000, and defendants assert that the expense of storage and other expenses are mounting high and, if a preliminary injunction goes against them they will lose the market and thus suffer great loss.

"Yet, this was their hazard. They should have known that plaintiff would move expeditiously and diligently, as it has. There are, then, no equities in favor of defendants, and they must rely on their legal rights."

Judge Mayer then decided that they had no legal rights and granted the injunction, upon the plaintiff's filing a bond for \$35,000.

DUTY OF CONGRESS TO ACT

Notwithstanding the two court rulings which offer temporary protection, the final solution has yet to be provided and in the meantime the danger of dumping remains. Each year European nations may be expected to declare numbers of their Military craft obsolete and the temptation will persist to endeavor to throw them on the United States market. The situation, as revealed by Gen. Menoher and Gen. Mitchell, is unchanged in so far as a national policy is concerned, and must remain pregnant with danger to the national defense until Congress enacts anti-dumping legislation protecting the aircraft industry.

CHAPTER XII

CHRONOLOGY OF AERONAUTICS

January 1-December 31, 1920

(For Earlier Chronologies, see *Aircraft Year Book*, 1919 and 1920)

*See amplification at close of this chapter.

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| January 1 | British Air Ministry announces opening of Cape to Cairo air route. |
| *January 2 | Commander A. C. Read completes recruiting flight of 7,740 nautical miles in N.C.-4. |
| January 2 | James H. Knight flies airplane mail from Cleveland to Bellefonte, Pa., 215 miles, in 83 minutes. Average speed 156 m.p.h. |
| January 3 | M. Sadi Lecointe, in Nieuport machine, reported to have covered 190 kilometers in 42 minutes 53 $\frac{3}{4}$ seconds. Speed 166 miles an hour. |
| January 8-15 | Chicago Aeronautical Exposition under auspices of the Manufacturers Aircraft Association, Inc. (See Appendix.) |
| January 10 | H. S. flying boat from Naval Air Station, Coco Solo, C.Z. with Lieut. (jg) O. D. Williams and Ensign E. Chourre pursues runaway kite balloon and rescues crew of three. |
| January 12 | Mississippi Valley Aviation Clubs Association organizes in Chicago and adopts resolutions recommending concentration of all air activities, military, naval and civil, within single department of the Government. |
| *January 13 | Hamilton Club of Chicago passes resolution urging necessity for National Aeronautical Department. |
| January 19 | Aerial survey of Panama region begun by Naval Aviation. |
| January 21 | Geological Survey co-operates with Aviation Section Marine Corps, in mapping coastline of Haiti. |
| January 21 | Aircraft responsible for victory of British and Italian troops over forces of the "Mad Mullah" in Abyssinia. |
| February | C. J. Zimmerman, Keyport, N. J., takes off and lands Aeromarine 40-L Flying Boat on the ice at Raritan Bay. |
| February 4 | Consignment of Curtiss H.S.-2-Ls, Curtiss H.-16s, and several Aeromarine and Boeing flying boats, and parts, worth a half million dollars is shipped to aerial transport company in China. |
| February 7 | Aerial Post started between Helsingfors, Finland, and Reval, Russia. |

- February 7 Sadi Lecointe, flying Nieuport biplane at Villacoublay, reported to have made speed record under new regulations of the F. A. I. covering kilometer course in both directions at 171.3 m.p.h.
- ✓ *February 14 Lieuts. Ferrari and Masiero start Rome-Tokio flight.
- February 17 M. Casale, in Spad Herbemont biplane, with two passengers, attains reported height of 7300 meters (24,000 ft.).
- February 19 The American Embassy organizes weekly aerial service from Paris to Warsaw, via Coblenz and Berlin.
- February 21 Congressional Committee visits Air Station at Hampton Roads. Representatives Britten, Hicks, Oliver and Venable make short flight in airship F.-1.
- February 21 Fleet of five H.S.-2 and five H.-16 flying boats from Naval Air Station, Pensacola, Fla., participate in Mardi Gras festival at New Orleans and one H.S.-1 and twelve N.-9s participate in fete at Mobile.
- ✓ *February 26 Major R. W. Schroeder, flying 400 h.p. Liberty motored Packard Lepere biplane equipped with Moss turbo-compressor, establishes world's altitude record of 33,000 ft. at McCook Field, Dayton, O. Record calibrated by U. S. Bureau of Standards. F. A. I. method indicates 33,114 ft.
- March Radio messages from airplanes during maneuvers of 37th Inf., Ft. Mackintosh received over distance of 175 miles.
- March 5 Calcutta-Bombay Flight. Handley Page airplane, piloted by Capt. Clarke and carrying one servant, two mechanics, three passengers and three press representatives, arrives at Bombay 9 p.m., having flown from Calcutta. Distance of 1200 miles in 17 hours.
- ✗ March 6 Maj. Albert D. Smith flies reconstructed Boeing-De Haviland 1400 miles in one day from Camp Lewis, Wash., to San Diego, Cal. His course lay almost entirely over mountains 6000 to 7000 feet high.
- March 6-13 Second annual aeronautical exposition Manufacturers' Aircraft Association at 71st Regiment Armory, New York City. (See Appendix.)
- March 8 Dayton-Washington Flight. Lieut. H. R. Harris with Lieut. A. L. Smith, Lieut. E. B. Koger of Navy, and Clarence B. Coombs fly 12-passenger Martin Army Transport Airplane from McCook Field, Dayton, to Bolling Field, Washington, 385 miles, in 3 hrs., 63 min.
- March 8 First seaplane flight of Belgian mission establishes aerial transport in Congo, between Kinshasa and Bolobo, 200 miles in 2 hrs., 39 min.
- March 10 New York State Legislature adopts resolution urging Congress to enact federal laws for regulation of aerial traffic, instead of leaving it to individual states to pass conflicting legislation. (See Legislative Section, Appendix.)
- March 13 Edward Musick, Aeromarine pilot, with J. J. Boland, company engineer, glides over snow covered ice in

Aeromarine Flying Boat, takes off, and flies over steamship "Princess Ann," ashore off Rockaway Point. Finds that rescue work has been accomplished and returns, landing this time on snow covered landing field.

March 18

Air Mail service started between Barcelona and Las Palmas, Mallorca, 112 miles.

*March 20

First successful flight from Cairo to Capetown completed by Col. van Ryneveld and Major Brand.

March 22

C. J. Zimmerman, pilot, makes successful trial flight in new Aeromarine Model A. S. Ship's Scout at Keyport, N. J. Seaplane hops off after run of five seconds.

March 30

Air Mail pilot, James H. Knight, flies 340 miles from New York to Cleveland in 2 hrs., 10 min., average speed 157 m.p.h., with 16,000 letters.

March 30

Radio communication established between seaplane and Naval Air Station, Anacostia, and between seaplane and submarine in Navy Yard, demonstrating possible communication up to 70 miles between submarine and seaplane.

March 31-April 2

Capt. W. R. Lawson and Lieut. R. E. Davis make military reconnaissance flight of 900 miles between Langley Field, Va.—Camp Glenn, N. C.—Wilmington, N. C.—Fayetteville, N. C.—Charleston, S. C.—Fayetteville, N. C.—Langley Field, Va. Actual flying time 11 hrs., 23 min.; elapsed time 58 hours., 25 min.

April 1

Lieut. Everett Davis, 8th Aero Squadron, in D.H.-4-B flies from Kelly Field to McAllen, Texas, covering 256 miles in 100 min.

April 1

First Aero Conference of South Africa.

April 1

Air Mail service opened on Frejus-Toulouse-Rabat route, for Spanish mails between Barcelona, Alicante and Malaga.

April 4

Juan Leguia, son of Peruvian President, breaks local record for non-stop flight, covering 300 miles between Lima and Trujillo, Peru, in Curtiss "Oriole."

April 14

During railroad tie-up, Aeromarine Flying boat piloted by C. J. Zimmerman, carrying 500 copies of the Wall Street Edition of the N. Y. *Evening Post*, flies to Red Bank, N. J., delivering papers 30 minutes after leaving New York.

April 18-May 2

Seaplane races at Monaco, France. Grand Prix de Monaco is awarded to Sadi Lecoq.

April 21-28

San Francisco Aeronautical Exposition under auspices of Manufacturers' Aircraft Association. (See Appendix.)

April 22

Pacific Aeronautical Association at meeting, San Francisco, urges Congress to establish transcontinental air mail lines, air laws, regulate aviation in general, encourage cities to establish municipal landing fields and to aid development of commercial planes.

April 22

Two naval H.S.2-Ls commanded by Lieut. Commander R. D. Kirkpatrick and Lieut. W. R. Cobb, fly from

- Honolulu to Hilo and back, a distance of 210 miles each way.
- April 25 Pilot Clifford Webster flies Curtiss H.S.2-L flying boat with two passengers from Florida to New York, 1,345 miles, in 18 hrs., 27 min.
- April 26 Over a measured course at Naval Air Station, Rockaway, Curtiss "Wasp" piloted by Roland Rohlf, flies at a speed of 140 miles an hour, breaking former speed record by 14 miles an hour. Flight made under official cognizance of navy officials.
- April 27 First warrant in United States for reckless aerial driving is issued in Los Angeles against Omer Locklear, Aero Club of Southern California, complainant.
- April 30 Orenco "Tourister" at Hazelhurst Field, Mineola, piloted by Clarence Coombs, with three passengers, reaches altitude of 6,000 feet in 8 min., 750 feet a min.
- May Aircraft Exposition opens Groningen, Holland.
- May 1 Lieut. F. D. Hackett flies from Mather Field to Ream Field, 490 miles, in a D.H.-9 Liberty in 4 hrs. 1 min.
- May 2 Eclipse of the moon observed by Lieuts. J. H. Tilton and W. H. Cushing of the naval station, Rockaway Beach, L. I., at height of nearly $3\frac{1}{2}$ miles.
- May 4 Oregon, Washington, and Idaho Airplane Company, Curtiss distributors for Northwest, contract with Oregon *Journal* for delivery of 300 pounds of newspapers daily to Astoria and Seaside during summer months. This service enables readers to get their papers ten hours earlier than would have been possible otherwise.
- May 5-11 Two Curtiss K-6 motored Standard J-1 planes fly from New York to Minneapolis with consignment of dry goods.
- *May 7 First annual intercollegiate competition held by U. S. Army Air Service, the Intercollegiate Flying Association, and the American Flying Club at Mitchel Field, Mineola, L. I.
- May 7 Opening of aerial mail route between Peking and Tien Tsin.
- May 7 Clarence Coombs with three passengers in Orenco touring plane, ascends 16,000 feet.
- May 9 Bournemouth Police Court, London, fines Reginald Edmund Tollerfield, pilot, for flying at dangerously low altitude. First procedure of the kind in England.
- May 12 D.H.-4 plane piloted by Lieut. R. W. Blessley with Lieut. D. D. Watson, observer, flies over Panama Canal. Aerial photographic map made, saving engineering corps months of work on the ground.
- May 14 First inter-city flight on Pacific Coast in dirigible B-18, non-stop from San Diego to Los Angeles and return, 250 miles in $5\frac{1}{2}$ hours.
- May 14-16 First annual army air tournament held at Bolling Field, exhibition of aerobatics and combat flying by army pilots.
- May 15 First aerial mail plane arrives in Chicago from Omaha

- at 6:50 P. M. Plane, piloted by D. Wald, left Omaha at 1 o'clock. Ray Benedict makes flight from Chicago to Omaha on the same day, opening first westward extension of Air Mail Service from Chicago.
- *May 15 Thomas-Morse S.-6 makes remarkable flight from Ithaca to Washington, to Dayton and then back to Ithaca.
 - May 15 Maiden flight of first commercial dirigible (Goodyear), in America made from Commercial Airship Syndicate Field, Kansas City, Mo.
 - May 16 Curtiss "Wasp," first military machine owned by the Bolivian Government, makes successful flights from airdrome at La Paz, 13,000 feet above sea level.
 - May 17 Orenco "Tourister" reaches altitude of 17,150 feet with pilot and three passengers. Pilot, Clarence Coombs; engine, 150 h.p. Wright.
 - *May 22 Dayton Wright model O.W. "Aerial Coupè" reaches height of 19,710 feet, with pilot and three passengers, making altitude flight in 2 hrs. 31 min.
 - May 23-28 International Seaplane Meet at Barcelona, Spain.
 - May 26 Lieut. Harry Weddington, with three passengers at Kelly Field, reaches an altitude of 20,081 feet, a record.
 - May 29 First outdoor Aero Show on Pacific Coast opened at San Jose, California.
 - May 30 Dayton Wright model O.W. "Aerial Coupè" flies from Dayton to Cleveland, Pittsburgh, Washington, D. C., with ice cream for banquet of Retail Ice Cream Dealers' Association in Washington.
 - June 1 Curtiss airplanes and flying boats operate from flying stations at Manila, P. I.
 - June 1 Lieut. Fronval, chief test pilot for Morane-Saulnier Co., reported to have made 962 loops in 3 hrs. 52 min. at Villacoublay, a record.
 - June 3 Farman "Goliath" reported to have remained in the air 24 hours 19 min. 7 sec., a record.
 - June 6 Sweden's first Flying Show opens at Stockholm.
 - *June 7 Lieut. John H. Wilson of the 96th Aero Squadron, Kelly Field, Texas, leaps from De Haviland-B plane at altitude of 20,000 feet and lands safely.
 - June 12 Donald Hudson in Curtiss "Wasp" crosses Andes Mountains at 30,000 feet.
 - June 15 First photographs and motion pictures of Yosemite Valley National Park, taken from the air by Curtiss "Oriole."
 - June 16 Two cents a mile is fuel cost of Goodyear "Pony Blimp" in economy record on San Diego-Los Angeles flight of 138 miles in 3 hrs. 11 min. on 9 gallons gasoline and ½ gallon oil.
 - June 19 Municipal seaplane flying station opened by Mayor J. F. Hylan at 82nd Street and North River, New York City.
 - June 22 Aeromarine Flying Yacht christened by Governor Edwards of New Jersey at Keyport, N. J. (See Chapter 2 and Appendix.)

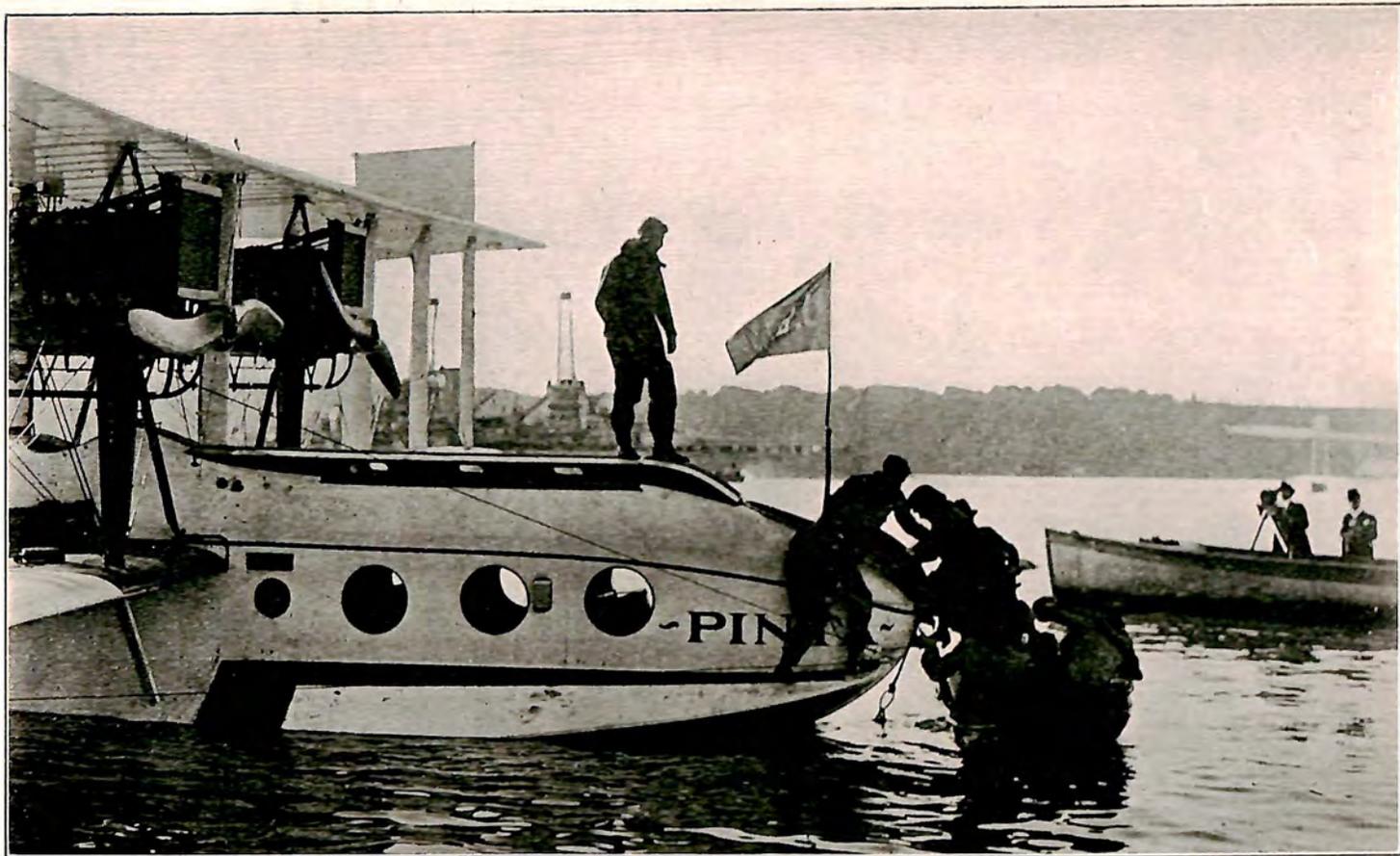
- June 27 German Junker monoplane attempting non-stop flight from Omaha, Neb., to New York City, lands at Lancaster, Pa.
- *June 28 Navy F.-5-L squadron completes 13,000-mile cruise with Atlantic Fleet through West Indian waters.
- June 30 Aeromarine "Navy Cruiser" makes night flight from Atlantic City to New York, carrying 14 passengers.
- June 30 Rice Bros. dairymen, Pasadena, Cal., make first delivery of milk on the Pacific Coast by airplane.
- July 1 Curtiss "Seagull" makes 1,100 mile demonstration flight to principal islands in Philippines, carrying mail, passengers and merchandise.
- July 1 Wright Aeronautical Corporation of Paterson, N. J., produces for the Army Air Service a Cannon Motor. 1½" shells are fired through propeller shaft while the plane is in flight.
- July 1 Aerial tour of the Atlantic Coast is made by Mr. and Mrs. Robert Ireland of Cleveland, Ohio, in Curtiss H.S.2-L piloted by C. L. Webster, of the America Transoceanic Company, including Bermuda, Savannah, Cuba, Palm Beach, New York, and Bar Harbor, Me.
- July 2 Attorney A. B. Reynolds of Sacramento flies from that city to Los Angeles and back in one day to get testimony of a witness in Los Angeles.
- July 2 Two thousand pounds of grape fruit reach New York from Miami, Fla., in hulls of two big flying boats of Aero Ltd. Make trip from Miami to New York in 16 hours, pilots, George Jay and George Cobb.
- July 4 German Air Mail service again started.
- July 7 Guided entirely by radio compass signals, naval seaplane F.-5-L flies from Norfolk ninety-five miles to pick up battleship Ohio at sea, with no knowledge of the vessel's location, then returns to Norfolk entirely by radio compass. Said to be the first time radio compass apparatus has been used to direct aircraft to a ship.
- July 9 Secretary of the Navy dedicates new airport at Seattle.
- July 9 International Aero Show opened at the Olympia, London.
- July 11 Ruth Kilpatrick, president of the Bridgeport, Mass., Woman's Club and Gracia Rice, treasurer of the National Federation of Business and Professional Women, fly from Bridgeport, Conn., to Springfield, Mass., for New England Convention of the Federation.
- July 14 Annual meeting of Manufacturers' Aircraft Association at its offices, No. 501 Fifth Avenue, New York City.
- July 16-24 International Yacht Races viewed for first time from air. Fleet of private planes besides the four H.S.2-L seaplanes of Aero Ltd.; Curtiss Aeroplane and Motor Corp. and America Transoceanic Co., with several Curtiss seaplanes, Aeromarine Plane & Motor Co.'s large "Navy Cruiser." All planes carried paying passengers. (See Chapter VII.)

- *July 17 Monument at Le Mans, France, designed by Paul Landowski, is dedicated by prominent French and Americans to Wilbur Wright commemorating his first public flight in Le Mans and the pioneer work of the Wright Brothers.
- *July 15-Aug. 24 New York-Alaska Flight. Four D.H.-4-B planes commanded by Capt. St. Clair Street, complete flight from Mineola, N. Y., to Nome, Alaska, in 55 hrs. actual flying time.
- July 24 Aerial Derby held at Hendon airdrome, London.
- July 30 Capitalists and bankers among 14 passengers in Aeromarine flying cruiser on flight to Southampton, L. I., from New York, 110 miles in 72 minutes.
- August 2 Omer Locklear, aerial acrobat, killed in night flight at Los Angeles, Calif.
- August 3 British Air Ministry Competition at Martlesham Heath, England.
- August 5 Daily air mail service organized between London and Amsterdam.
- August 8 Two German Junker monoplanes which left New York July 29th arrive at San Francisco, Cal.
- August 9 Gallaudet "Liberty Tourist" biplane flies to Franklin Roosevelt's notification ceremonies at Hyde Park, N. Y., delivering 1,000 copies of the New York *Evening Post* special airplane edition, containing full account, arriving a few minutes after speeches were made.
- August 12 Gallaudet "Liberty Tourist" flies from New York to Washington, with consignment of perfumes.
- *August 15 Laura Bromwell breaks world's loop-the-loop record for women at Curtiss Field with official total of 87 loops.
- *August 16 Board of Governors of Aero Club of America and the American Flying Club vote for amalgamation under name of the Aero Club of America.
- *August 21 Lt. A. G. Hamilton jumps 20,900 feet by parachute at Carlstrom Field and reaches ground in 12 minutes, a record.
- August 23 U. S. Army Air Service airplanes participate in National Rifle matches at Camp Perry, Ohio, with D.H.4-Bs, using both synchronized and flexible guns.
- September 1 Lt. Oakley, E. Kelley, and Serg. Stekel winners. British Air Ministry holds second competition for seaplanes and amphibians.
- September 2 Curtiss N.-9 seaplane flies 120 miles over Sierra Mountains from Sacramento to Lake Tahoe, Cal.
- September 3 A Martin bombing plane carrying crew of four men and 1000 pound torpedo flies from Washington to Yorktown, 125 miles, in 64 min.
- September 5 Successful experiments made by two Army planes making landing by using variable pitch propeller. Plane stopped 75 feet from point where landing gear first touched ground.
- September 7 Fish and Game Commissioner A. L. Monahan locates

- September 8-10 schools of fish from dirigible near San Diego, Calif. Federation Aeronautique Internationale conference held at Geneva.
- September 8 Transcontinental Air Mail Service from New York to San Francisco started.
- September 10 Survey of Southern Lake Michigan completed by Great Lakes Navy Station.
- September 11 Three dirigibles of the U. S. Army Air Service fly for two hours in formation at Langley Field, Va. radio communication directing them.
- September 15 Dayton Wright "K-T" "Cabin Cruiser" makes film delivery from Famous Players-Lasky Corp., flying from Dayton Wright Field to Cincinnati, Richmond, Indianapolis, Columbus and return.
- September 18-19 International Airplane Race at Venice for Schneider Cup won by Naval Lt. Chevalier Luigi Balogna, piloting a Savoia 12, Ansaldo motor, 375½ kilometers in 2 hrs., 35 min. at 152½ m.p.h.
- September 22 Eleven million marks subscribed for establishment of Air Post at Bremen, Germany.
- *September 25 National balloon race at Birmingham, Ala., under auspices of the Aero Club of America and F. A. I.
- September 27 The American Legion in National Convention at Cleveland, Ohio, adopts resolution urging Congress to enact laws regulating aerial transport, and reaffirming resolution of 1919 calling for separate departments of aeronautics. (See Aerial Law Section of Appendix.)
- *September 27 Gordon Bennett Cup Race held at Etampes near Paris under auspices of Aero Club of France.
- September 28 Airplane piloted by Paul Collins demonstrated fire-proof paint invented by Parker H. Bradley, at Hazelhurst Field, Garden City, L. I., New York. The flight, made at night and witnessed by Air Service officials.
- September 29 L.W.F. "Giant" 3 Liberty motored bomber accepted by Army Air Service after trials at Mitchel Field, L. I.
- October 8-10 Aero Club of France holds important flying meet at Buc.
- October 10 Sadi Lecointe beats speed record of Capt. De Romanet. Capt. De Romanet flew a kilometer in 12.3 seconds, or at the rate of 292.82 kilometers, or about 181.95 miles an hour. Lecointe covered the kilometer in 12.1 seconds or at the rate of 296.694 kilometers (about 185 miles per hour).
- October 10 Pioneer flight into isolated region of Northern Ontario. Capt. W. Roy Maxwell of Hamilton in a Curtiss seaplane flies to Moose Factory station of Hudson Bay Co.
- October 11 Airplane attached to Harding-Coolidge Campaign Committee of New Jersey leaves Lakewood, N. J., on a flight to take in every county in the State.
- October 12 Joseph Flannigan, Democratic candidate for Sheriff of Queens, N. Y. C., begins his campaign by airplane.

- October 15 Seattle-Victoria Air Mail starts on contract awarded by Post Office Department to Edward Hubbard operating two Boeing machines.
- October 16 Lt. Austin attempts flight from France Field, Panama, to Washington, but a hurricane forces him to return. (See Chapter III.)
- October 16 Fire destroys hangars, machine, fabric and woodworking shop, storeroom and other buildings with 15 planes, at Naval Air Station, Anacostia.
- *October 17 Canadian Air Board completes relay flight across Canada from Halifax, N. S., to Vancouver, B. C.
- *October 20 Four U. S. Army D.H.4-B airplanes complete return trip from Alaska, arriving at Mitchel Field with total round trip flying time of 112 hours for 9,000 miles.
- October 21 Preliminary to five year expedition by airplane to the Antarctic regions by a group of London scientists, a party headed by John L. Cope, F. R. G. S., leaves Norfolk, Va., on a two years' survey of the west coast of the Woodell Sea and Graham Land. (See Chapter VI.)
- *October 23 Gordon Bennett International Balloon race held at Birmingham, Alabama, under auspices of Aero Club of America and F. A. I.
- October 23-Nov. 9 International Aero Exhibition held at Prague, Czechoslovakia.
- October 23 The "Santa Maria" and "Pinta," two-passenger and mail-carrying Aeromarine flying boats leave New York City, each with eleven passengers, a pilot, and three mechanics on board, for Key West, Fla. (See Chaps. II, III, and Appendix.)
- October 28 Passenger-carrying record broken. Nine men and women, the largest number ever carried by a single-motored airplane, fly over New York City in tests of new Curtiss "Eagle." (See Chap. II and Appendix.)
- October 31 U. S. Army airship, D-2, completes test at Akron, O., and flies to Langley Field via Pittsburgh.
- October 31 Toledo, Ohio, is bombarded by airplanes carrying Socialistic literature in behalf of Eugene V. Debs.
- November 1 Airplanes entering United States from foreign countries subjected to same quarantine regulations as steamers coming from foreign ports.
- November 1 Test flight of smallest airplane in U. S. Air Service, the "Messenger."
- November 1 A Monoplane of the Mercury Aviation Company leaves De Mille Field, Los Angeles, at 12 noon and reaches San Diego an hour and 20 minutes later, on initial flight of regular passenger service.
- November 1 Air Mail Service starts between United States and Cuba with two Aeromarine flying cruisers. (See Chap. III.)
- November 4 Army Air Service co-operates with anti-aircraft guns at Fort Monroe. Radio telephone used in airplane and at battery commander's directions, the pilot properly

- reports operations. This is first time anti-aircraft battery commanders have been able to get accurate data on timing of anti-aircraft shells.
- November 7 The Army's largest dirigible, "Zodiac," flies to Washington, D. C., from Langley Field and return. Motion pictures made and dirigible is in constant radio communication with stations at Langley Field and Washington. Radio telephone used.
- November 10 Navy demonstrates that radio telephone can be used from aircraft 300 miles away.
- November 10 Frank Clarke, flying German Fokker equipped with Hall-Scott motor, flies from Oakland to Venice, Cal., in 3 hrs. 45 min.
- November 11 Second Annual Aviators Reunion Dinner held at Hotel Astor, New York City.
- November 11 Two big passenger seaplanes of the Aero Ltd. fleet, with several men and Edith Gordon and Rose McDonald, fly from New York to Florida.
- November 17 Two American commercial Standard-Wright airplanes, the first to enter Mexico, leave Chihuahua for Mexico City, with greetings from American to Mexican officials. Mark landing fields and advertise and sell airplanes.
- November 20 Aeromarine flying boat, the "Nina," third plane built for the Aeromarine West Indies Airways, Inc., leaves New York for Cuba with 14 passengers including I. M. Uppercu, President of the Aeromarine Plane & Motor Co.
- November 21 Dirigible passenger line establishes half hour service, using Goodyear "Pony Blimp," between Los Angeles and Catalina.
- November 24 Aviation Field at Camp Stotzenberg Tambango, Philippine Islands, named Clarke Field in honor of Major Harold M. Clarke, Air Service.
- *November 25 First Airplane Race for Pulitzer Trophy and Valentine Liberty Bond prizes held at Mitchel Field, Garden City, L. I.
- November 30 The National Aircraft Underwriters' Association holds annual meeting, New York City, and passes resolution urging Federal air laws. (See Appendix, Aerial Law Section.)
- December 2 Police of Winnipeg, Can., report airplanes used by organized band of bootleggers smuggling across the United States border.
- December 3 U. S. Air Mail sets new record, carrying 16,000 letters from Chicago to New York in 5 hrs., 56 min.
- December 4 James Means, a pioneer in aviation, whose writings inspired the Wright Bros., dies at his home in Boston, Mass.
- December 11 Aeromarine flying cruiser "Christopher Columbus" arrives at Miami, Fla., 16 hrs. 30 min. flying time from New York.
- December 14 U. S. Navy Free Balloon A-5598, with Lieuts. Louis A.



Flying Boat "*Pinta*" of Aeromarine West Indies Airways, Inc., taking on Passengers at New York City for Key West and Points in the West Indies.



Dedication of Aeromarine West Indies Airways, Key West to Havana Passenger and Mail Service, at Columbia Yacht Club, New York City. Rear-Admiral Glennon, U.S.N., presenting American flag to Major G. H. Bonnell. At the right of the Admiral are Hon. Cayetana de Quesada, Cuban Vice-Consul, Washington, D. C.; I. M. Uppercu, one of the founders of the line, and C. F. Redden, an official of the company.

- Kloor, Walter Hinton and Stephen A. Farrell lands near Moose Factory, on James Bay, Ontario, Canada, after 25 hours in the air, having drifted 852 miles from Rockaway Naval Station, Long Island, N. Y.
- December 25-26-27 Winter Air Tournament, Long Beach, Calif., under auspices of Aero Club of Southern California.
- December 28 Eduardo Chaves of Sao Paulo, Brazil, flies Curtiss "Oriole" 1,200 miles between Rio de Janeiro and Buenos Aires, winning \$25,000 prize offered by Brazilian Government.
- December 30 Twelve U. S. Navy F.-5-L and two N.C. flying boats leave San Diego, Calif., on long flight to Balboa, Panama Canal Zone.

N.C.-4's RECRUITING TRIP

The N.C.-4 (Navy-Curtiss) made a noteworthy series of flights from Sept. 22, 1919, to Jan. 2, 1920, recruiting for Naval Aviation. As when a few months before it had made the first flight across the Atlantic Ocean, Commander Albert C. Read was in charge. His report after the trip, which extended from Rockaway, L. I., N. Y., down the Atlantic Coast, along the Gulf Coast, and up the Mississippi River to Cairo, Ill., and return after hopping from New Orleans to Galveston, Texas, was of considerable value to commercial aviation.

The port, forward center and starboard engines, operated for 118 hours and 42 minutes with no trouble whatever except ignition. The rear engine operated for 82 hours and 15 minutes before adjustments or repairs were necessary. The same tractor propellers were used throughout and on the return to Rockaway were still in good condition. Although 900 starts were made, the starters remained operating, only one having been replaced. The spark plugs functioned for 40 hours without cleaning or resetting. The remarkable feature of the trip was that the Packard Liberties operated on the very difficult river flight very largely on commercial gasoline which was picked up from point to point. The average gasoline consumption per hour per engine at 1480 r.p.m. was 21 gallons. The oil consumption at first was 1 pint per hour but during the last 20 hours of the flight, it was 1/2 gallon per hour. Radio communication was kept up constantly for distances as great as 350 miles.

The ease with which the great flying boat is controlled was demonstrated when continuous flights were made by one pilot for almost 10 hours at a time, without strain. The Weather Bureau co-operated with Commander Read and gave valuable assistance. Great variation was found in the weather. It was so cold at St. Louis that the radiators had to be drained to prevent freezing. One of the

handicaps which Read experienced was the lack of maps.

The following table shows only the operations from city to city. Actually the N.C.-4 flew a total of 7,740 nautical miles in its 3½ months' cruise. It visited 43 cities, made 50 landings and was in the air 129 hours.

FLYING OPERATIONS OF N.C.-4 RECRUITING TRIP

		Hrs.		Nautical Stat.	
		Min.	Miles	Miles	
Rockaway to Atlantic City	Sept. 22, 1919	1	16	76	87
Rockaway to Portland, Me.	Sept. 25, 1919	4	6	246	276
Portland to Boston	Sept. 27, 1919	1	38	88	101
Boston to New Bedford	Oct. 1, 1919	...	44	44	51
New Bedford to Providence	Oct. 1, 1919	...	21	21	24
Providence to New Haven	Oct. 3, 1919	1	16	76	87
New Haven to Rockaway	Oct. 6, 1919	1	..	61	70
Rockaway to Atlantic City	Oct. 7, 1919	2	25	76	87
Atlantic City to Philadelphia	Oct. 7, 1919	2	10	49	56
Philadelphia to Baltimore	Oct. 11, 1919	1	18	78	90
Baltimore to Washington	Oct. 15, 1919	...	30	30	35
Washington to Norfolk	Oct. 18, 1919	...	50	127	146
Hampton Roads to Manteo, N. C.	Oct. 24, 1919	1	..	62	71
Manteo, N. C., to Charleston	Oct. 25, 1919	4	48	284	327
Charleston to Savannah	Oct. 28, 1919	1	15	72	83
Savannah to Jacksonville	Oct. 29, 1919	3	48	109	125
Jacksonville to Miami	Oct. 30, 1919	4	44	284	327
Miami to Pensacola	Nov. 2, 1919	7	44	464	535
Pensacola to New Orleans	Nov. 4, 1919	2	65	147	169
New Orleans to Memphis	Nov. 4, 1919	5	7	307	353
Memphis to Cincinnati	Nov. 6, 1919	5	50	361	415
Cincinnati to Louisville	Nov. 11, 1919	1	25	79	91
Louisville to Owensboro, Ky.	Nov. 13, 1919	1	15	72	83
Owensboro to Evansville, Ind.	Nov. 15, 1919	...	20	21	24
Evansville to Paducah, Ky.	Nov. 17, 1919	...	47	82	94
Paducah, Ky, to St. Louis, Mo.	Nov. 19, 1919	3	01	118	136
St. Louis to Hannibal, Mo.	Nov. 22, 1919	1	15	85	98
Hannibal to Cairo, Ill.	Nov. 25, 1919	3	15	191	220
Cairo to Memphis	Nov. 27, 1919	1	64	123	141
Memphis to Helena, Ark.	Nov. 30, 1919	3	35	38	44
Helena to Arkansas City	Dec. 1, 1919	1	10	62	71
Arkansas City to Greenville, Miss.	Dec. 3, 1919	...	41	15	17
Greenville to Vicksburg	Dec. 5, 1919	1	50	61	70
Vicksburg to Natchez, Miss.	Dec. 9, 1919	1	10	53	61
Natchez to Baton Rouge, La.	Dec. 10, 1919	1	45	78	90
Baton Rouge to New Orleans	Dec. 12, 1919	2	40	66	76
New Orleans to Galveston	Dec. 16, 1919	6	90	248	285
Galveston to Grand Island	Dec. 20, 1919	4	..	284	327
Grand Island to Mobile	Dec. 21, 1919	2	42	73	84
Mobile to Pensacola	Dec. 23, 1919	...	50	38	44
Pensacola to Panama City, Fla.	Dec. 31, 1919	1	..	88	101
Panama City to Charleston	Jan. 1, 1920	7	20	332	382
Charleston to Rockaway	Jan. 2, 1920	9	..	553	636
		113	19	5822	6690

HAMILTON CLUB OF CHICAGO URGES ESTABLISHMENT OF AERONAUTICAL DEPARTMENT

The members of the Hamilton Club of Chicago, at an aviation luncheon held in that city, Jan. 13, 1920, during Chicago's first National Commercial Aeronautical Exposition adopted the following resolution:

Whereas, the City of Chicago, because of its geographical location and natural advantages has become the center of transportation of the United States by land and water, and is destined for the same reasons to play an equally important part in the development of air transportation, and

Whereas, the first commercial aviation exhibition on this continent now in session in our city, has forcefully called attention to the need of immediate active co-operation on the part of all municipalities, and business men, as well as those holding positions of importance in public life, and

Whereas, we, the members of the Hamilton Club, assembled for the purpose of discussing the possibilities of aviation commercially, believe it to be our duty to give all the impetus to the development of the science which lies within our power, and

Whereas, this science, in its relation to national defense and commerce is bigger than party or local lines and therefore is not a party issue, now, therefore,

Be it Resolved: That we, the members of the Hamilton Club, communicate to the Representatives of Illinois in Congress, regardless of party affiliations, the fact that we believe the best interests of the City, State and Nation demand the establishment by Congress, at as early a date as is consistent with a thorough study of the needs of the Nation, of an Aeronautical Department of the Government, under a cabinet officer and with a sufficient appropriation to insure such development as will provide an adequate aerial force for the purpose of national defense, and

Be It Further Resolved: That the officers and directors of the Hamilton Club be directed to lend every assistance to the Aviation Commission of Chicago, or such other agency as is constituted for the purpose, in at once acquiring for Chicago the best, biggest and most convenient municipal landing field that can be laid out, in conformity with the specifications of the United States Government, and

Be it Further Resolved: that a copy of these resolutions be transmitted to each member of Congress from the State of Illinois.

ROME-TOKIO FLIGHT

The Italian Government detailed ten airplanes for the Rome-Tokio flight; two Caproni biplanes, as "pilot machines"—2 Caproni triplanes and 6 S.V.A. biplanes. The flight started February 2, 1920, and on May 31, Lieuts. Ferrari and Masiero, piloting S.V.A. machines, arrived at the capital of Japan. Several of the planes crashed en route and were eliminated. The flight of more than 10,000 miles was considered a remarkable triumph for Italian wings. The route was from Rome to Gioia del Colle 237 miles; Gioia del Colle to Salonica 313 miles; Salonica to Adalia 481 miles; Adalia to Aleppo 375 miles; Aleppo to Bagdad 469 miles; Bagdad to Bassora 302 miles; Bassora to Bender-Abbas 574 miles; Bender-Abbas to Charbor 351 miles; Charbor to Karachi 359 miles; Karachi to Delhi 668 miles; Delhi to Benares 402 miles; Benares to Calcutta 414 miles; Calcutta to Rangoon 643 miles; Rangoon to Bangkok 348 miles; Bangkok to Hanoi 643 miles; Hanoi to Canton 508 miles; Canton to Fuchau 442 miles; Fuchau to Shanghai 375 miles; Shanghai to Kiauchau 394 miles; Kiauchau to Peking 348 miles; Peking to Chifu 399 miles; Chifu to Fusan 419 miles; Fusan to Osaka 359 miles; Osaka to Tokio 270 miles; total 10,379 miles.

SCHROEDER'S RECORD ALTITUDE FLIGHT

Continuing experiments in developing the supercharger, the U. S. Air Service on Feb. 27, 1920, sent up a Packard built Lepere biplane which broke the world's altitude record held by Roland Rohlfs, chief test pilot for the Curtiss Aeroplane and Motor Corporation. The pilot of the Army plane was Maj. Rudolph W. Schroeder, chief test pilot at the army engineering experimental station, McCook Field, Dayton, O.

Schroeder battled upward through hurricane winds to a height which the Bureau of Standards, on calibrating his instruments, fixed officially at 33,000 feet, while by the rules of the Federation Aeronautique Internationale, under which world records are homologated, the figures were 33,114 feet.

The Bureau of Standards' method was sufficient, however, to transfer the record from Rohlfs to Schroeder, the former's record being 32,450 feet made with a Curtiss "Wasp" triplane, without a supercharger, at Garden City, Sept. 18, 1919.

Schroeder had reached 29,000 feet on Sept. 6, that year, consequently he and Rohlfs were friendly rivals for honors, and it was Rohlfs who was the first to wire congratulations to Schroeder for his remarkable exploit—an achievement particularly attractive to the public because of the thrilling incidents accompanying it.

Schroeder's plane was especially prepared to spend many hours in the unexplored atmosphere far out of sight of those who watched him ascend from McCook Field. Special fuel was provided through the efforts of Thomas Midgely, Jr., who had been developing "anti-knock" fuels for the Dayton Wright Company. Dressed in the warmest flying clothes obtainable, Schroeder was also provided with two tanks of oxygen, one a reserve, calculated to supply his lungs for three hours after leaving the zone of life-sustaining air within which the earth revolves. His principal object was to explore the trade winds sweeping from west to east at marvelous speed, though too high to sustain life without artificial aid.

At 18,000 feet Schroeder began "smoking" his oxygen. The temperature had fallen 67 degrees below zero (Fahrenheit). The center section of the sturdy Lepere was coated an inch thick with ice. Exhaust from the motor sprayed fumes of carbon-monoxide over the pilot.

The 400 h.p. Liberty motor maintained its climbing ability with the aid of the supercharger which provided just the right mixture even at the height of 33,000 feet. Schroeder had no idea how high it is possible to fly. He believed the ceiling to be about 48,000 feet. Finding that he was then higher than any human being had been before him, Schroeder examined his gauges and seeing that he still had fuel for an hour and a half, continued to push on, climbing steadily, meanwhile making notes of the performance of plane and motor, recording the temperature every 50 feet and, most important of all, observing the winds which had been driving against his machine and pushing it backward faster than the propeller could pull it forward during the climb.

He had found one series of these trade winds at 30,000 feet, ranging from 100 to 300 miles an hour in velocity. At the peak of his climb, 33,113 feet, he found the winds blowing eastward at 225 miles an hour. At this juncture he missed the oxygen and hurriedly investigated. He had been using the reserve tank, the first one having failed to function. He found the reserve tank empty and turned back to the first tank, which continued to fail him.

Tearing off his ice-encrusted goggles and gasping for want of air and inhaling the poisonous fumes of carbon-monoxide from the motor exhaust, Schroeder threw his machine nose down and leaned forward to cut the switch just as he fainted. It was found later that he had cut out the motor. This saved his life. Those on the field who had been scanning the sky for first sight of the daring flier, saw a thin wisp of vapor, like smoke, appear over the city. Moments later they made out the plane. It was spinning and out

of control. As it neared the ground they saw it straighten out and, after an anxious delay, circle about and glide into McCook Field. Limp and helpless, Schroeder's body was slouched in the cockpit, his head drooped over the side and, to the amazement of everyone, his eyes were frozen wide open. He looked like a dead man coated with the ice that made the machine a ghostly ship. Schroeder spent many days in the hospital nearly blinded and with a valvular disturbance of the heart. He asserted that his plane had been out of control from the peak of his climb till he regained consciousness sufficiently to recognize his danger a few hundred feet over the city.

The plane had fallen five miles and its pilot lived, promising the world that if opportunity afforded, he would go up in a glass enclosed, sealed, cabined machine amply fueled to fly to the ultimate roof of the world.

CAIRO-CAPETOWN FLIGHT

The Cairo-Capetown air route was difficult and no fewer than four expeditions endeavored to cover the 5206 miles. Col. P. Van Ryndveld and Maj. C. J. Q. Brand, in a D.H.-9, supplied by the Union of South Africa Government, completed the journey on the afternoon of March 20, 1920. The "Silver Queen" Vickers-Vimy machine in which this expedition started, had been wrecked so that none of the contestants completed the flight in the plane with which they started. The other three contestants also crashed en route and did not procure new machines.

The Vickers-Vimy "Silver Queen" in charge of Van Ryndveld and Brand, left Brooklands, England, for Cairo on February 4th and arrived in the Egyptian capital five days later. Setting out the following day they planned a non-stop flight to Khartoum, Egypt, but crashed at Wady Halfa. Returning to Cairo they made a fresh start on the 22nd and their machine crashed on the way to Bulawayo on March 5th. The Union government sent another machine to Bulawayo so that the fliers were able to resume their flight on the 17th. They arrived at Capetown March 20, 1920.

The country over which they flew was unfavorable in many places. The middle part of the route was littered at times with dense brush and tropical forests. Landing at other than the grounds prepared by the Government was dangerous. Ant hills, often twenty-five feet in height and between twenty-five and forty-five feet in diameter dotted the ground. In most of the southern sections, with the exception of Northern Rhodesia, conditions were better and forced landings could be made without mishap.

FIRST INTERCOLLEGIATE AIR MEET

Reserve flight officers, students at Yale, Harvard, Princeton, Columbia, Lehigh, Cornell, Pennsylvania, Pittsburgh, Wesleyan, Williams, and Rutgers, flew in five flying races held under the auspices of the Intercollegiate Flying Association, U. S. Air Service, and the American Flying Club, at Mitchel Field, Garden City, L. I., May 7, 1920. Yale won first place with a score of 9 points, Williams was second with 6 points, and Princeton and Columbia tied for third with 5 points each. Hundreds of spectators witnessed the races. In the long distance race, Henry Fawn of Yale was the winner, Knowle of Lehigh, second, Cornell, third and fourth. The alert contest: R. K. Perry of Williams, winner; Wesleyan, second; Yale, third. Acrobatic contest: Columbia first, Yale, second, Pennsylvania, third. Landing contest: Princeton, first; Pittsburgh, second; Williams, third.

Lacking privately owned aircraft, pilots representing the colleges applied to the Air Service and were granted the use of Curtiss J.N.-4 planes by reason of their status as reserve aviators. Despite the fact that many of the contestants had not flown in months, the races were completed without accident.

THOMAS-MORSE S.-6 FLIGHT

The Thomas-Morse model S-6 plane used on the Ithaca-Washington-Dayton-Ithaca trip had been flown constantly for a year and 4 months with practically no attention, and Paul Wilson started his trip without preparation, except for a general inspection. The start was made at 10:30 A. M. on April 30th. It was necessary to fly into the wind about 25 degrees in order to keep a straight course. Two hours and 10 minutes later Wilson landed in Middletown, having flown a distance of 160 miles. Only 14 gallons of gasoline and 3 gallons of oil were consumed. After a short inspection, the machine took off again for Washington, covering the 115 miles in 1 hour and 35 minutes.

The start for Dayton was made on Monday, May 10th, with 5 gallons of castor oil in the front seat. After two hours battling through a storm, Wilson landed in a field near Newark, Ohio. Shortly after 2 o'clock he was in the air again, taking off going up hill. McCook Field at Dayton was reached without delay.

Returning, he left McCook Field May 15th for Ithaca. A north-east wind made two more fuel stops necessary and forced the pilot to fly under 1000 feet altitude. A landing was made at New London for fuel and also at the Martin Field in Cleveland and Ripley,

New York. After passing over Buffalo, the plane landed at the Curtiss Field. At 8:30 P. M., just as the sun was dropping out of sight, Wilson took off again and followed the railroad tracks east from Buffalo. There was a moon and the night air was ideal for flying. Wilson reported that the machine practically flew itself over long periods. The flash from a lighthouse on Cayuga Lake informed him that he was over his own landing field. Flares were lighted, and at 10 minutes after ten he came down safely.

ALTITUDE FLIGHT OF DAYTON WRIGHT "AERIAL COUPÈ," WITH PILOT AND THREE PASSENGERS

Starting from McCook Field, Dayton, O., B. L. Whelan, pilot, and three passengers, arose to a height of 19,710 feet on May 22nd, 1920, making what was then an American altitude record for three passengers and pilot. While the Dayton Wright Coupè was a two-passenger-and-pilot airplane the test was made with three passengers and the pilot. The machine was powered with a 180 h.p. Wright engine. The four persons were comfortably seated in the upholstered cabin. Ordinarily when attempts are made for altitude records, pilot and passengers wear plenty of clothing, but in this case no special preparations were made and all the occupants wore street clothes. No discomfort was experienced at the peak of the climb where the temperature was 5° below zero.

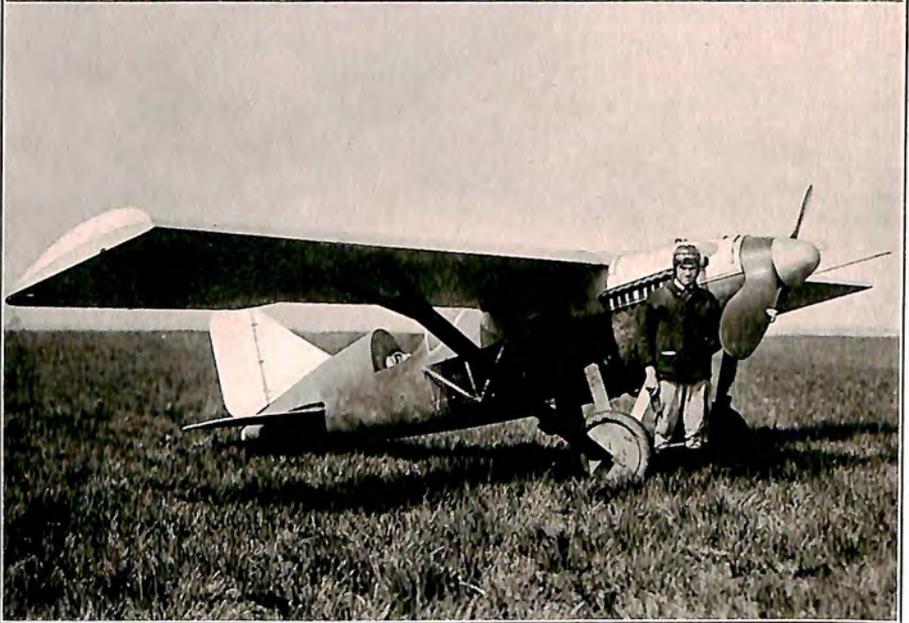
WEST INDIES CRUISE OF NAVY F.-5-L's

From New York to the West Indies and return, a distance of 13,000 miles without mishap, was the achievement of a fleet of six Navy F.-5-L flying boats commanded by Lieut. Commander Bruce G. Leighton. The cruise was made in connection with the maneuvers of the Atlantic Fleet. Climatic conditions which made surface travel hazardous and uncomfortable for those on board ships, did not delay the flying boats, which carried full equipment, including anchors, radio apparatus, food, water, etc., in addition to a crew of from six to ten men each.

The squadron left Philadelphia Nov. 12, 1919, and flew from Delaware Breakwater to Hampton Roads, Va.; Rockaway, Long Island; Hampton Roads, Va.; Charleston, S. C.; Savannah, Ga.; Tampa, Pensacola, and Key West, Fla.; Neuvas, Guantanamo, and Cape Maisi, Cuba; Cape Haitien, Samana Bay, and Sanchez, Haiti; San Juan, P. R.; St. Thomas, Virgin Islands; Ponce and Mayaguez, P. R.; Aquin Bay, Haiti; Kingston, Jamaica; Guantanamo, Guacanayabo Bay, Santa Cruz del Sur, Media Luna Cay, and Neuvas, Cuba; Turtle Harbor, Fla.; St. Marys, Ga.; Fernandina, Fla.;



Wright Memorial Dedicated at Le Mans, France.—Courtesy *Literary Digest*.



Gordon Bennett Entries. Dayton Wright Monoplane and Howard Rinehart, pilot.
Below—Curtiss "Wildcat" and Roland Rohlfs, pilot.

Southport, N. C.; Hampton Roads; completing the cruise at Philadelphia June 28, 1920.

The air squadron was accompanied on the voyage by the "Shawmut" as a mother ship, and the "Sandpiper," as a repair and fuel ship. The function of both ships was that of a movable base, lacking, however, the general facilities of a permanent base. It was found unnecessary to house the planes, and repairs of a kind which required hauling machines out of the water for any considerable period were few, the aviators themselves making all minor repairs en route. As all flying boats carried their anchors and lines, they were anchored out in the various ports of call in exactly the same manner as any other seagoing craft. In fact, they were often landed in the open seas in winds up to 35 or 40 knots an hour. These they rode with safety, even when the gale exceeded 80 knots an hour.

When the squadron was scheduled to leave Savannah for Cumberland Sound, storm warnings were displayed which promised a heavy northeast gale. Nevertheless the entire squadron put to sea, scudding through rough weather and making a safe landing at Cumberland Sound. A 1,100-ton destroyer was found at anchor in the roadstead. Its commanding officer, astonished at seeing six flying boats drop out of the gloom, told the aviators he had put into port on account of the storm at sea, and added, "Great Heavens, do you people fly in a northeaster like this?"

Another incident of the seaworthiness of flying boats occurred at Sanchez. The swell coming in from Samana Bay and beyond was so heavy that the "Shawmut" rolled all the breakfast dishes off her tables, while the seaplanes rode like ducks and "took off" with ease. While flying from Sanchez, Santo Domingo, to San Juan, P. R., the murk and rain cut off all sight from plane to plane at a distance of 500 feet. The darkness was so intense that the pilots in one machine were able to see only the flash of the motor exhaust. Yet through this driving rain and wind, which finally changed into shifting squalls, rough air, and negligible visibility, the squadron held its course, at mile a minute speed throughout the 90 miles to the Porto Rican coast, and most remarkable of all, skirted the land another 120 miles to San Juan, arriving on schedule time, there maneuvering to a safe anchorage in the harbor without mishap.

The performance of the squadron is given in the following summary:

Total number of flights, all machines 495. Average length of each flight, 2 hours 25 minutes. Flights in passage, 8,210 nautical miles. Other flights, incident to fleet operations, scouting, spotting for gunfire, etc., 4,521 nautical miles. Total distance flown by the squadron

as a whole, 12,731 nautical miles. Total mileage of all machines, 71,545 nautical miles. Total hours flown, 1,192 hours 25 minutes. Deaths or serious injuries incident to flying operations, none.

"Considering the above figures," Lieut. Commander Leighton, who commanded the squadron, reported, "it is fair to state that while not yet fully solved, the problems of long-distance practicable oceanic travel by flying boat are well on the road to solution."

THE WRIGHT MEMORIAL

On July 17, 1920, there was unveiled at LeMans, France, the first notable memorial to be erected in honor of Wilbur Wright, the American, who, with his brother Orville, made the first flights in the history of the world at Kitty Hawk, N. C.

The ceremony was of peculiar significance in that it provided recognition of the pioneer position which America occupies in aeronautics; but it also provided a rather remarkable commentary on European interest in flying as contrasted with the struggles which the art has undergone in the country of its birth.

Five years after Wilbur and Orville Wright flew at Kitty Hawk, Wilbur took an improved biplane of their manufacture to France and on September 21, 1908, before a distinguished gathering at LeMans, flew a distance of 61 miles. A month later he won the Michelin cup. The Wright brothers immediately found a personal friend — and the art a patron — in Léon Bollée, a citizen of LeMans, whose memory is also honored.

The monument, a slender shaft chiseled by the sculptor Landowski, stands on the Place des Jacobins, before the Cathedral of St. Julien. Photographs cannot portray the beauty of the work, the lines of which provide a conscious parallel to those of the cathedral. Surmounting the pedestal, kneels a human figure, arms upraised to heaven. The memorial thus symbolizes gratitude for and faith in man's power of scientific achievement, just as the cathedral pictures man's faith in the divine, and together, sculpture and church, visualize eternal aspiration for the infinite.

The monument, although primarily a testimonial to the Wrights, provides deserved honors for predecessors and associates. Upon the face of the left side of the column, the artist has represented Daedalus teaching his son Icarus how to fly. On the right face, under the names of thirty persons who gave their lives to the art in its early days, the sculptor has depicted Daedalus carrying the body of his son.

On the front face of the monument is seen Wilbur Wright in full flight and underneath the feats of his brother Orville and Léon Bollée are reproduced on two medallions. The inscriptions recall

the principal dates of the Wright flights and the co-operation, in France, of M. Bollée.

The peak of the pedestal supports the figure with arms raised in sublime ecstasy, and beneath the figure are Victor Hugo's verses:

You know that our soul is strong
And fears naught
When God's breath lifts it high;
Know you that I shall climb
To the stars above,
Undaunted in will, to the sky!

The first stone of the memorial was placed December 22, 1918. The ceremony was attended by American, Polish and French representatives. This was the day following a Franco-American demonstration, when Dayton, Ohio, the home of the Wrights, adopted one thousand French children orphaned by the war. M. d'Estournelles de Constant, president of the senatorial group on aviation, and Chairman of the Wilbur Wright Committee, had been successful in collecting a considerable sum by popular subscription, and further sums were immediately pledged on assurance of rapid completion of the work.

The unveiling took place in mid-summer. Admiral MacGruger represented the American embassy in Paris. Other Americans in attendance were Myron T. Herrick, former ambassador and now president of the Aero Club of America; Col. Jefferson deMont Thompson, and Commodore Louis D. Beaumont, whose generosity aided greatly in erecting the memorial. General Duménil represented the French War Office and there were in attendance such civilians as Lazare Weiller, senator from the Lower Rhine, and representatives from the Sarthe and the city of LeMans.

NEW YORK-ALASKA FLIGHT

The successful round trip flight between New York and Nome, Alaska, made by the Army Air Service with four Gallaudet reconstructed D.H.4-B. biplanes, was a remarkable demonstration of the skill of American pilots, efficiency of American mechanics and ingenuity of American designers and builders. It was an all-American expedition, even to the Liberty motors, the dependability of which may be summed up in the words of Capt. St. Clair Street, commanding. He said: "We did not have a missing cylinder on the entire flight, approximately 9,000 miles."

The Alaskan Flying Expedition, as it was officially known, left Mitchel Field, Long Island, N. Y., July 15, 1920, and arrived at

Nome August 25. It flew only sixteen days of that period. The others were spent waiting for the weather to clear, because no plane had flown over that route before and reports of weather conditions ahead were not always available because of delayed communication. During the sixteen days from New York to Nome, 56 hours were spent in the air. The aviators left Nome August 29, 1920, and arrived at Mitchel Field, October 20th. The return flight was practically the same as the outgoing, 15 days being spent flying, or 56 hours, aggregating for the round trip 31 flying days, or 112 hours at an average speed of 80 miles an hour.

Three months before the expedition set out from Mitchel Field, Capt. Howard T. Douglas went over the proposed route and prepared landing fields, some of which were cut in virgin forests, others laid out in small stump-littered clearings and on river beds. Often the four planes were compelled to land at designated spots unknown except through terse telegraphic instruction, these hastily made landing fields and service stations sometimes less than seven acres in area. They were the only places available after an all-day cruise over the wilds of the Northwest. Bad weather was the main handicap. All agreed that it caused the principal difficulties and hardships, including delays between flights.

Incessant rain, snow, hail and sleet, clouds, fog and mist prevailed. Maps of British Columbia and Alaska were of little value. The courtesy of the Dominion Air Board and its officers who provided all possible assistance wherever the fliers found themselves, did much to offset the natural handicaps, however. For nearly 2,000 miles Street and his companions flew over Canadian glaciers and unexplored mountain tracts. Had they crashed, they would have been from two to three hundred miles from the nearest human habitation.

Their route included long hops between these stations:

New York (Mitchel Field)	to Erie, Pa.	350 miles
Erie	to Grand Rapids, Mich. ...	300 "
Grand Rapids	to Winona, Minn.	310 "
Winona	to Fargo, N. D.	320 "
Fargo	to Portal, N. D.	290 "
Portal	to Saskatoon, Sask., Can.	280 "
Saskatoon	to Edmonton, Alberta ...	300 "
Edmonton	to Jasper, Alberta	200 "
Jasper	to Prince George, B. C. ...	200 "
Prince George	to Hazelton, B. C.	220 "
Hazelton	to Wrangell, Alaska	210 "
Wrangell	to White Horse, Yukon ...	300 "
White Horse	to Dawson, Yukon.	250 "
Dawson	to Fairbanks	275 "

Fairbanks	to Ruby	240	"
Ruby	to Nome	300	"
	Total	4345	"

It took Captain Douglas three months to travel by rail and boat between New York and Nome, preparing for the arrival of the planes. The Street expedition could have flown the entire distance within sixteen days had meteorological data, maps and landing fields been available prior to the start. In completing this flight, the Air Service accomplished the following:

1. Establishment of an effective aerial route to the northwestern corner of the American Continent and Asia.
2. Charting and photographing inaccessible areas in Alaska which had never been mapped.
3. Demonstration of the airplane as a means of transport, for mail, passengers and freight.
4. Pointing out necessity of landing fields and service supply stations throughout the United States and its territories.
5. Proving the durability of modern airplanes and motors.
6. Proving that flying is safe, even over territory where transport by railroad, automobile and wagon is considered dangerous.
7. Demonstrating the comparative ease and dispatch with which troops can be transported over long distances by air.
8. Practicability of aircraft for use in photographic and surveying, meteorological work and general observation.
9. Co-operation between the United States Air Service and the Canadian Air Board.

After their return to Mineola, the officers and men in the expedition flew on to Washington, D. C., where a reception was afforded them, befitting an occasion so notable in the history of aviation. Major General Charles T. Menoher, Chief of the Air Service, flew out and met the returning fliers in the air and escorted them to Bolling Field. General John J. Pershing headed the receiving party. Brigadier General Wm. Mitchell, Assistant Chief of the Air Service, was also a member of the party and commanded the three squadrons which went aloft. Each squadron consisted of 18 planes, flying in V formation, making a total of 54 representing the service, in addition to which there were a number of civilian aircraft. Colonel Wm. H. Hensley, Jr., commanding the U. S. "Zodiac," flew it from Langley Field with a full crew of 24 officers and men.

The personnel of the expedition included: plane No. 1 — Capt.

St. Clair Street, pilot and commanding officer, Sergt. Edmond Henriques, observer and mechanic and specialist in Liberty motors; plane No. 2 — First Lt. Clifford C. Nutt, second in command, pilot, 2nd Lt. Erick H. Nelson, engineering officer, pilot; plane No. 3 — 2nd Lt. C. H. Crumrine, photographic officer and pilot, Sergt. James Long, observer; plane No. 4 — 2nd Lt. Ross Kirkpatrick, information officer and pilot, M.E. Sergt. Joseph B. English, mechanic and observer. Capt. Douglas flew with Capt. Street from Hazelton, B. C., to Mineola, taking the place of Sergt. Henriques, who returned by train.

BREAKS WOMEN'S LOOP-THE-LOOP RECORD

Starting to drop when two miles up and turning over and over again like a tumbler pigeon, Miss Laura Bromwell, broke the world's loop-the-loop record for women, August 13th, 1920, at the Curtiss Airdrome, Garden City, L. I. Official observers from the American Flying Club credited her with 87 loops. She counted more than 100 loops during her descent, but drifted away from the field and was hidden from view for some time behind the clouds. The best previous record for women is said to have been held by a French woman who made 25 consecutive loops. Miss Bromwell flew a Curtiss Standard J.-1 plane with a Curtiss K.-6, 150 h.p. motor.

AMALGAMATION OF AERO AND FLYING CLUBS

The Aero Club of America and the American Flying Club, at separate meetings held on Aug. 16, 1920, voted to amalgamate. The new organization bears the name of the Aero Club of America. Under the terms of amalgamation, the Aero Club of America transferred its headquarters and club rooms to those of the American Flying Club at 11 East 38th Street, New York City.

The membership of the Aero Club of America was said to be about 800 and the American Flying Club approximately 1000.

Brigadier Gen. Wm. Mitchell, Assistant Chief of the Air Service, who came up from Washington to attend the meeting at the American Flying Club, issued a statement in which he said: "The Amalgamation of the Aero Club and the Flying Club marks an epoch in the development of national defense in the United States because the combined clubs will do for aviation what the Navy League has for the Navy, and the National Defense League for the Army. The Aero Club was started years ago to foster aeronautics as a sport and did a great deal of pioneering work in that direction. The officers that came back from the battlefields of Europe started the Flying Club essentially as an organization, the underlying object of which was to further aviation as a national asset. The combination

of these two elements that comes with the amalgamation of the two clubs, which will consolidate all the aeronautical clubs in the United States under one central direction, will put before the people of the country what aviation really means to America. Without a strong aviation organization, America is absolutely at the mercy of any well organized foe that may attack her. The combined clubs bring together all the best elements in aviation that this country possesses. There is nothing which has happened in the development of our whole national defense system which will have a greater effect than this consolidation."

Captain Maurice G. Cleary, a former Governor of the American Flying Club, and now Directing Governor of the Aero Club of America, stated:

"The amalgamation's psychological aftermath, is the obvious problem behind the Club's present condition. The development of aeronautics is the dominating stimulant, but the Club problem is not transitory and while it is made more or less intense by unfavorable and favorable influences, at the bottom of it remains a permanent responsibility for the entire club membership and those interested in the development of aviation.

"Now that the Clubs are united for one common purpose, the people of our Country will regard it as anxiously as it now does our National Defense League.

"The ultimate destiny of the Aero Club rests, of course, on the character of its members and the genuineness and strength of their determination to maintain the Club as a medium to foster and develop aeronautics.

"Ultimately, and the sooner the better, the Aero Club should be a unified, permanent branch of national defense, composed of men who will not think of themselves as individuals, but as air-men and servants to the cause of this Arm, which possibly, at no distant date, may be the dominating arm in our National Defense System."

The American Flying Club was formed by pilots of the Air Service in France at the time of the Armistice. Of the 650 American aviators who had flown over the lines during the war, more than 500 signed the constitution of the club. Its organization was largely the result of the work of Laurence L. Driggs, who served as President of the club until it was amalgamated with the older organization.

The Aero Club of America was incorporated in 1905. For many years it has played a prominent part in aeronautics and as the representative in the United States of the Federation Aeronautique Internationale it is empowered to homologate records and conduct contests. Hon. Myron T. Herrick of Cleveland, former governor of Ohio and formerly ambassador to France, was elected President.

RECORD PARACHUTE JUMPS

Members of the Army Air Service broke all records for testing life-belts of the air during 1920. Their work, which involved the initial trials of newly developed parachutes, proved of inestimable value to military and commercial aviation, and incidentally provided for the jumpers many thrilling experiences in effecting a safe and comfortable landing a few moments after being thrown from speeding planes miles in the air.

Lieut. A. G. Hamilton went aloft from Carlstrom Field, Arcadia, Fla., in a Lepere biplane piloted by Lieut. T. H. Downes, August 21, 1920. The air was bitter cold when Hamilton dropped from the edge of the cockpit at 20,900 feet, instead of taking the usual course of releasing his "chute" and letting it drag him off into space. After an interval he pulled his release cord but he dropped 2,000 feet more before the "chute" snapped open with a loud report. Looking aloft he saw the springs by which the "chute" could be opened or closed at will, were broken. Wide open, the chute received all the buffeting the high winds could give it; and Hamilton as he dropped felt like a pendulum jerked first one way, then the other. At times he swung through a hundred degree arc. Shooting through the lowest layer of clouds he found that he was due to land in the town of Arcadia. Side-slipping his chute he finally dropped between the branches of the trees along Joshua Creek. The rigging of the chute caught in the branches and broke his fall. He was extricated from the cordage 15 minutes later. His jump so far as known is a record.

Lieut. John H. Wilson, piloted by Lieut. Delmar Dunton, leaped from a D.H.-4-B plane over Kelly Field, Texas, June 7th, 1920, at a height of 19,861 feet.

Sergeant Ralph Bottrell had a thrilling experience over McCook Field, Dayton, Ohio, in August, 1920. Climbing out on the wing of a plane at an altitude of 20,000 feet, preparing to jump, the release ring of his chute accidentally caught on the side of the fuselage. The parachute opened prematurely, dragging the sergeant out across the tail of the machine. Bottrell's arm struck the rudder as he was whirled past, tearing the ligaments and his clothes. A strap of his chute harness caught the rudder and tore it off. Sergt. Madden who was piloting the plane maintained a straight flight until he could work the machine to a safe landing. Bottrell landed safely in a ploughed field.

GORDON BENNETT CUP AIRPLANE RACE

When Sadi Lecointe in a Nieuport type 29 (300 h.p. Hispano Suiza) airplane flashed past the finish line at Etampes, France, Sept.

27, he won the Gordon Bennett Cup Race and thus retained for the Aero Club of France the Gordon Bennett Cup. Lecointe's time over the course of 187½ miles, consisting of three laps on a straight line, out and home, beginning and ending at the village of Ville-sauvage near Etampes, was 1 hr. 6 min. 17½ sec., or an average speed of 168.26 miles an hour.

Captain DeRomanet, flying a French Spad, finished second. He crossed the line, turned and landed down wind at a terrific speed, the machine rolling hundreds of yards after alighting. His time for the full distance was 1 hr. 39 min. 6⅔ sec., though after the second lap he turned after crossing the line, and landed, and after a delay of nearly 45 minutes he went on again. This delay was included in his time.

All other entries, including the Americans, were withdrawn. The U. S. Air Service had entered a Verville-Packard machine and the Dayton Wright Company had entered a Dayton Wright monoplane. S. E. J. Cox of Texas entered two Curtiss machines built to his order by the Curtiss Aeroplane and Motor Corp., known respectively as the "Texas Wildcat" and the "Cactus Kitten" (for description of the Dayton Wright and Curtiss airplanes, see Dayton Wright and Curtiss Sections in Appendix).

The entries of Great Britain were a Martynside, piloted by F. T. Raynham, and a Nieuport 328 A.B.C. piloted by L. R. Tait-Cox. The third French entrant, who did not finish, was Kirsch, in a Nieuport.

TRANS-CANADA FLIGHT

The Canadian Air Board, in October, 1920, conducted an airplane relay flight across the Dominion from Halifax, N. S., to Vancouver, B. C. After exceedingly poor luck, with bad weather conditions and mechanical difficulties, the aerial pathfinding journey was completed Oct. 17. The Fairey Seaplane which set out on the first hop from Halifax October 7th was damaged in landing at Long Reach, Canada. The second seaplane, an H.S.-2-L, followed and picked up the commanding officer, Lt. Col. Leckie, and flew to Ottawa, where magneto trouble again delayed the flight. The hop from Ottawa to Sault Ste. Marie was through prevailing bad weather and poor visibility, which resulted in recommendations being made to change the course in future.

The H.S.-2-L then flew across Lake Superior to Port Arthur, on to Kenora, the last official stop before Winnipeg. The weather again intervened, however, and the party landed at Selkirk, proceeding by car to Winnipeg, where Commodore Tylee, commanding the second half of the flight, was handed the bag of Canadian

transcontinental mail. Lt. Col. Leckie was accompanied by Major Shearer, Major Hobbs and Capt. Fraser.

A British D.H.-9 land plane piloted by Capt. J. B. Horne-Hay took off from Winnipeg on the morning of the 11th and landed at Regina. Capt. A. E. Cudemore in another D.H.-9 machine came back from Moose Jaw, picked up the party in his machine and flew to Calgary. Another D.H.-9 machine piloted by Capt. J. A. Thompson flew the party from Calgary to Vancouver.

INTERNATIONAL GORDON-BENNETT BALLOON RACE

The International Balloon Race for the Gordon Bennett Trophy started from Birmingham, Alabama, on Oct. 23, 1920. The American entrants were Ralph H. Upson, H. E. Honeywell and Lieut. R. E. Thompson, U. S. A., winners of the National Elimination Race held at Birmingham September 25th. France, Belgium and Italy were represented by these noted aeronauts: *France*: Capt. Louis Hirschauer, pilot (Balloon "Lorraine"), Mons Nathan, Aide; *Belgium*: Lieut. Ernest DeMuyter, pilot (Balloon "Belgica"), Lieut. Mathieu Labrousse, Aide; *Italy*: Major Joseph Valle, pilot (Balloon "Audens"), Major Dominique Leone, Aide; Major Hugo Maderi, pilot (Balloon "Triumphale VI"), Lieut. Auselme Pirazzoli, Aide.

The American entrants, with their aides, were as follows: Ralph H. Upson, pilot (Balloon "Goodyear"), W. B. Van Orman, Aide; Lt. Richard E. Thompson, U. S. A., pilot (Balloon "U. S. Army I"), Capt. Harold E. Weeks, U. S. A., Aide; H. E. Honeywell, pilot (Balloon "Kansas City II"), Dr. Jerome Kingsbury, Aide.

On Monday morning, October 25th, at 8:30 A. M., the "Belgica" landed in the waters of Lake Champlain, N. Y., near North Hero Island, Vt., having covered approximately 1064 miles from Birmingham and winning the race.

Honeywell and Dr. Kingsbury, in the "Kansas City II" won second prize, alighting on Tongue Mountain, near Lake George, N. Y., a distance of 1001 miles.

The Italian entrant, Maj. Joseph Valle, and his aide, Major Leone, took third place in the "Audens," which landed one mile northwest of Homer, Cortland County, N. Y., approximately 855 miles.

The other Italian balloon, "Triumphale VI," piloted by Major Hugo Medori, with Lieut. Pirazzoli as aide, landed at Mt. Clemens, Michigan, a distance of almost 657 miles.

The "U. S. Army I," with Lieut. Thompson as its pilot and Capt.

Weeks as aide, came to earth near Charlotte, Mich., their official distance of 632 miles giving them fifth place.

Sixth place was won by Upson and in the "Goodyear II," which came down near Amherstburg, Ontario, near Detroit, approximately 630 miles from Birmingham, Ala.

The French entrants, encountered bad weather which carried them north-northwest, forcing them to land at Mason City, Ill., at 8:45 P. M., October 24th, after covering a distance of 487 miles.

PULITZER TROPHY RACE

Speeding through the air at almost three miles a minute or two hundred and sixty-four feet a second, Lieut. C. C. Mosley of the U. S. Air Service, piloting the American designed and built Verville-Packard plane, won the first contest for the Pulitzer Trophy at Mitchel Field, Garden City, L. I., held by the Aero Club of America, Thanksgiving Day. The Verville plane with a 600 h.p. Packard motor had been entered in the Gordon Bennett race in France. Mosley flew the Pulitzer course of slightly more than 132 miles in 44 minutes, 29.57 seconds, an average of approximately 178 miles an hour.

Another remarkable performance was that of Capt. H. E. Hartney's Thomas-Morse M.B.-3 single seater fighter, which, though powered with a Wright motor of only 300 h.p., won second place in 47 minutes, 0.03 seconds, about two and one-half minutes behind the winner, at a speed of $168\frac{1}{2}$ miles an hour. This machine is a stock pursuit plane used by the Army Air Service. Another machine of the same type in February, 1919, broke what was then the world's record with a speed of $163\frac{2}{3}$ miles an hour. Another excellent performance was that of Bert Acosta's civilian entered Ansaldo S.V.A. which arrived in third place in 51 minutes and 57.62 seconds, or an average of 154 miles an hour. Capt. St. Clair Street, in an Orenco (Wright motor) came in fourth in 52 minutes and 17.02 seconds. While the Army won three out of the first four positions, the other taken by a civilian, Naval Aviation made a good showing in fifth place, Lieut. A. Laverents in a Vought V.E.-7 with a 180 h.p. Wright engine, finishing in 55 minutes and 39.19 seconds.

The large number of persons witnessing the race — it is estimated there were more than 30,000 — and the enthusiasm and interest shown, led the pioneer, Glenn H. Curtiss, to exclaim:

"This is the most representative gathering from the viewpoint of popularity that I ever have seen at an aviation meet. The 1921 race will be a stupendous event. The public, at last, is interested in the airplane."

There were sixty-three entries in all, making the race the most successful aeronautical contest held in America. The 132 mile course lay over a 33 mile circuit, affording an opportunity to watch the machines roaring past the start and finish line at Mitchel Field four times. It extended from Mitchel Field to Lufbery Field near Wantagh, thence to Henry J. Damm Field near Babylon and back to Mitchel Field.

General John J. Pershing, Major General Charles T. Menoher, Chief of the Army Air Service, Brig. Gen. William Mitchel, Assistant Chief, Secretary of the Navy Josephus Daniels, and Capt. T. T. Craven, Director of Naval Aviation, were among officials in the grandstand which seated also many members of the diplomatic corps. Major Arthur Christie, Commanding Officer at Mitchel Field, was congratulated for the excellent arrangements made under his supervision. It was significant that thousands had watched so many planes racing in close formation without serious accident to planes, pilots or onlookers, while that same day at several especially prepared speedways in the United States motor cars crashed and hurled their drivers to instant death.

Besides the handsome trophy donated by Ralph Pulitzer of the *New York World*, there were the Valentine Liberty bonds, aggregating \$5,100, for class prizes. The first plane to hop off was the Thomas-Morse Scout, piloted by Capt. Hartney, which left the ground at 11:20 A. M., and finished second. A Loening special, piloted by Lt. C. G. Bradley of the Marine Corps, got away next and was followed by other machines in numerical order. In rapid succession the other contestants were given the signal to take off and by the time the last of the 34 machines had started the spectators were watching the first plane finish the first lap. Twelve of the contestants came to grief during the race; 11 on account of mechanical trouble, while one was disqualified for an infraction of regulations. When Lieut. Mosley brought his victorious machine to a stop, the crowd broke past the guards and surrounded it.

The following is taken from the Contest Committee's report:

Position	Airplane	Pilot	Racing Number
1st	Verville-Packard	C. C. Mosley 1st Lt., A. S.	63
2nd — 1st CC	Thomas-Morse	H. E. Hartney Capt., A. S.	41
3rd	Ansaldo	Albert Acosta	56
4th — 2nd CC	Ordnance (Curtiss)	St. Clair Street 1st Lt., A. S.	45
5th — 1st V	Vought V.E. 7 (Naval Airc't Factory)	A. Laverents Lt., U. S. N.	22

Position	Airplane	Pilot	Racing number
6th*	DeHaviland (Fisher Body)	J. P. Roullot 1st Lt., A. S.	14
7th — 1st DH	DeHaviland (Curtiss)	Carl Eliason 2nd Lt., A. S.	1
8th — 2nd DH	DeHaviland (Dayton-Wright)	J. B. Wright 2nd Lt., A. S.	2
9th	DeHaviland	C. M. Cummings 2nd Lt., A. S.	19
10th	DeHaviland	D. L. Conly Lt. (jg) U. S. N.	18
11th	DeHaviland	H. N. Heisen Capt., A. S.	17
12th	DeHaviland (Fisher Body)	V. C. Finch Lt. (jg) U. S. N.	3
**	Ansaldo	W. R. Taylor 2nd Lt., A. S.	54
13th — 1st SE	S. E. 5	Maxwell Kirby Capt., A. S.	35
14th — 2nd V	Vought V. E. 7	W. B. Gwyn Lt. (jg) U. S. N.	21
15th	DeHaviland (Fisher Body)	Lawrence Claude 2nd Lt., A. S.	12
16th	Vought V. E. 7	L. H. Sanderson 2nd Lt., U. S. M. C.	23
17th	DeHaviland (Fisher Body)	W. R. Lawson 1st Lt., A. S.	5
18th	DeHaviland (Curtiss)	H. B. Mims Capt., U. S. M. C.	6
19th	DeHaviland	Lucas V. Beau 2nd Lt., A. S.	11
20th	Vought V. E. 7	W. V. Brown 2nd Lt., U. S. M. C.	24
21st	DeHaviland (Curtiss)	R. C. Moffatt 2nd Lt., A. S.	15
22nd	Vought V.E. 7	J. K. Dunn Gy Sgt. U. S. M. C.	25
23rd	DeHaviland	Norbert Carolin Capt., A. S.	8
24th	Morane Saulnier	Charles Colt	57

TIME							
1st Lap	2nd Lap	3rd Lap	4th Lap	Time		Motor	H.P.
Time For		Total Elapsed		Min.	Sec.		
Min. Sec.	Min. Sec.	Min. Sec.	Min. Sec.	Min.	Sec.		
11 6.70	11 0.37	11 7.18	11 15.32	44	29.57	Packard	600
11 52.31	11 50.09	11 48.80	11 28.83	47	0.03	Wright	300
12 58.14	13 4.05	12 59.91	12 55.52	51	57.62	S. P. A.	225
13 13.10	13 16.67	13 3.21	12 44.04	52	17.02	Wright	300
13 57.50	13 55.64	13 51.38	13 54.67	55	39.19	Wright	180
14 35.33	14 15.95	13 48.37	13 26.93	56	6.58	Ford Liberty	400
14 11.73	13 53.87	14 0.11	14 3.68	56	9.39	Liberty	400

		TIME				Time			
1st Lap	2nd Lap	3rd Lap	4th Lap	Total Elapsed		Motor			
Min. Sec.	Min. Sec.			H.P.					
14 14.89	14 11.00	14 11.28	14 15.03	56	52.20	Ford Liberty		400	
14 18.03	14 18.63	14 15.85	14 15.61	57	8.12	Liberty		400	
14 29.84	14 25.47	14 22.31	14 23.14	57	40.76	Ford Liberty		400	
14 37.04	14 26.07	14 40.90	14 31.27	58	15.28	Liberty		400	
14 36.87	14 35.60	14 34.16	14 46.31	58	32.94	Lincoln Liberty		400	
14 54.64	15 1.57	14 43.36	14 56.02	59	35.59	S. P. A.		225	
15 14.47	14 46.04	14 45.43	14 56.73	59	42.67	Wright		180	
14 55.07	14 40.29	14 52.31	15 23.96	59	51.63	Wright		180	
15 21.04	14 49.04	14 47.54	14 59.11	59	56.73	Ford Liberty		400	
15 8.32	14 59.83	14 59.92	15 1.31	60	9.38	Wright		180	
14 57.35	15 19.15	15 14.54	15 17.47	60	48.46	Marmon Liberty		400	
15 23.19	15 28.69	15 4.33	14 53.13	60	49.34	Liberty		400	
15 66.96	14 57.86	14 59.30	14 57.50	61	1.62	Lincoln Liberty		400	
15 5.52	15 32.51	15 35.08	15 12.17	61	25.28	Wright		180	
15 29.02	15 20.37	15 49.23	15 8.83	61	47.45	Liberty		400	
16 2.39	15 36.25	15 7.26	15 4.48	61	50.38	Wright		180	
15 47.88	15 49.18	15 43.65	15 18.51	62	39.22	Liberty		400	
16 53.89	16 36.24	19 21.77	20 24.43	73	16.33	LeRhone		110	

1st CC— Winner Contest Committee's Invitation Class Prize.

2nd CC— Second Place in Contest Committee's Invitation Class Prize.

1st DH— Winner of DH Class Prize.

2nd DH— Second Place in DH Class Prize.

1st SE-5— Winner of SE-5 Class Prize.

1st V— Winner of Vought Class Prize.

2nd V— Winner second place in Vought Class Prize.

*— Special rigging, not eligible for DH Class Prize.

**— Disqualified for cutting pylon at Lufbery Field on last lap.

The Contest Committee believes this report to be accurate, but, as much of the information contained therein had to be obtained from the contestants, mechanics, etc., there may be some errors.

The Contest Committee of the Aero Club of America included Benjamin F. Castle, Chairman, Caleb S. Bragg, H. S. Brown, Douglas Campbell, Maurice G. Cleary, W. Redmond Cross, Harry Guggenheim, Richard F. Hoyt, Alan R. Hawley, Albert B. Lambert, William A. Larned, David McCulloch, Edward O. McDonnell, Charles E. Merrill, George M. Myers, Howard A. Scholle.

CHAPTER XIII

TECHNICAL DEVELOPMENTS IN AIRCRAFT CONSTRUCTION IN 1920; SURVEY OF SITUATION DURING PRECEDING SIX YEARS

THE PRE-WAR PERIOD

BY August 1914, the construction of airplanes had progressed from the pioneer efforts of Wright and Curtiss to a point where practical machines were produced which could be depended upon to fly in satisfactory balance and control. The construction was to a large extent still empirical and based upon the methods of the more successful builders, but at the same time the theory of design had been established on a sound engineering basis.

The aerodynamic foundations of the art rest upon wind tunnel testing of models and by 1914, the properties of aerofoils and the general problem of balance, stability and control had been stripped of mystery. The theory of flight was ready for use.

Similarly, the structural design of airplanes had received engineering attention, and the principles of governing strength were understood.

In other words, at the beginning of the World War, airplane design and construction had emerged from the phase of *invention* into that of *engineering*. The freak arrangements had been tried and rejected and the world had settled upon four fundamental types; the tractor land plane and seaplane (with pontoons) and the pusher land plane and flying boat. All were single engined machines,¹ some biplanes (England and United States), some monoplanes (France and Germany).

The performance in the air at that time was, of course, limited by the engines and materials of construction available and, in different countries, the national types were further differentiated by the stimulus which had been given to obtaining excellence in particular features. For example, the French airplanes of 1914 were much the fastest in the world, due in part to the effect of racing for handsome prizes. The world's record for speed was held by Prevost at 125 miles per hour.²

¹ Except the Russian Sikorski with 4 engines.

² Deperdussin — 100 Gnome, Rheims, Sept. 29, 1913.

The Germans had also stimulated development by prize competitions, but while the French competitions were sporting affairs, the German competitions were purely military. The German premium was placed on reliability and endurance. The world's record for non-stop flight was held by Boehm¹ at 24 hours, 12 minutes, and the altitude record by Oelrich² at 26,730 ft. The German airplanes were slow, rugged affairs that carried two men and were easy to fly.

In England less attention seems to have been given to world's records, but the theoretical and engineering side of the subject had probably received the soundest treatment. British airplanes were faster than the German, and better load carriers than the French. The great achievement of British designers before 1914 consisted in the practical application of the theory of stability to a stable airplane that could be flown "hands off." The British went into the war with a good two-seater general utility machine in the B. E.-2c.

In 1914, the United States had neither a really good engine nor an airplane that could compare favorably with foreign designs. The fundamental cause of this obvious lack of progress was, no doubt, absence of military pressure; in other words "preparedness." Government appropriations for aeronautics were trifling, and the commercial demand was satisfied by a few exhibition machines for county fairs and amusement purposes. The activities of small groups of sportsmen, Aero Clubs, etc., failed to arouse any real public interest and some of these activities took such a form that the general public became skeptical.

Airships in 1914, had reached their greatest development in Germany in the Zeppelin, Schütte-Lanz, and Parseval. No other country had rigid airships. The French and British had non-rigid types and the Italians a semi-rigid which were fairly useful craft. The United States had none of any type.

Strangely enough, in 1914 the flying boat was less advanced in Europe than here. This situation was due to the work of one man, Glenn H. Curtiss.

THE WAR PERIOD

During the progress of the War, the national airplane types were modified and adapted to meet the constantly changing military demands. The French racing machines were made more reliable and slowed down. The British two-seaters were speeded up and made into single-seaters. The slow German general utility machines were relegated to schools, and a single-seater developed for fighting.

At first no planes carried anything more offensive than a camera.

¹ Albatross — 100 h.p. Mercedes, Johannisthal, July 10-11, 1914.

² D.F.W. — 100 h.p. Mercedes, Leipsig, July 14, 1914.

Then came pistols, hand rifles, machine guns, radio, bombs, etc. With the addition of equipment the design changed. The fighting was carried up beyond the clouds and design was further changed by the provision of higher compression for the engine, and low wing loading.

This led to specialization by types, a form of differentiation which developed types for one purpose only. The German development is indicated in the following table which may be considered as forced by the growing ascendancy of the Allies.

GERMAN AIRPLANE PRODUCTION BY TYPES ¹

Designation	TYPE	1914	1915	1916	1917	1918
A	Taube (Pre-War) 100 h.p.....	294	13	22	.....	.....
B	School 2-seater (Pre-War) 100 h.p.	1,054	1,312	440	2,993	25
C	Observation 2-seater 180/260 h.p....	.....	2,674	4,726	10,337	7,320
D	Biplane single-seater fighter 180 h.p.	.....	1	2,126	4,945	5,132
Dr	Triplane single-seater fighter 100/160 h.p.....	.....	.....	.....	338	1
E	Monoplane single-seater fighter 100/160 h.p.....	.....	347	300	.....	381
G	Day Bomber 2 x 260 h.p.....	.....	185	465	589	789
J	Armored Plane 200 h.p.....	.....	.....	.....	450	463
N	Night Bomber 2 x 200 h.p.....	.....	.....	100	94	10
S	Ground Fighter 260 h.p.....	.....	.....	.....	.....	2
R	Giant Planes 4 or 5 x 260 h.p.....	.....	.....	.....	.....	.....
		1,348	4,532	8,179	19,746	14,123

The excessive specialization of the military airplane was the outstanding result of the pressure of military necessity and has rendered military airplanes practically useless for civil aviation.

AT THE TIME OF THE ARMISTICE

At the time of the Armistice, the single place combat machine was an acrobatic freak of no commercial value. To a less degree the two-seater observation plane had excessive power and speed, rendering its operation uneconomical. The large bombers required perfect landing fields, such as could only be provided by military appropriations in war time.

In general, all of the war planes had costly high strung engines, landing speed too high for ordinary landing fields and, finally, their construction too complicated and fragile. Two unfortunate effects of the war on airplane development were apparent: first, designers had formed the habit of designing for maximum performance mak-

¹ Hoff, "Zeit. Vereines deutscher Ingenieure." 1920, p. 493. Baumann, *ibid.*, 1919, p. 497.

ing use of special materials and delicate and complicated details of construction, regardless of building cost; and second, since the war planes never lasted long enough on the front to deteriorate from the action of the weather, constructors had formed the habit of disregarding maintenance costs.

NAVAL AIRCRAFT

The development of seaplanes and flying boats during the war paralleled that of the land planes and in a similar manner became highly specialized. The great naval problem for the Allies was anti-submarine operations and for this purpose large flying boats of great endurance were produced. In Germany, the naval requirement was to attack and drive off Allied flying boats. Consequently, the Germans specialized in small seaplanes for fighting, to the neglect of flying boats.

The torpedo plane and the ship plane to be flown from men-of-war were in an experimental stage in England at the time of the Armistice; other countries had not yet taken up this development. In large flying boats the United States had the lead in 1914 and retained it at the time of the Armistice.

In 1914 the United States had no airships, but during the war several American designs of non-rigid were brought out and at the time of the Armistice the United States was abreast of the foreign countries in this field.

FIRST YEAR AFTER ARMISTICE

The first year after the Armistice, so far as visible progress in aeronautics is concerned, was lost. The manufacturers were engaged in closing out war contracts, adjusting claims against the government, and opposing the dumping on the market of foreign surplus aircraft. It was a period of readjustment and contraction.

Technically, 1919 was a fallow year, but the readjustment had to be got over and the unfounded optimism of certain enthusiasts given a chance to cool off. There were, of course, some splendid records of performance made in 1919, such as the crossing of the Atlantic by the N. C.-4, the demonstration of several high speed fighting airplanes, the Martin Bomber, Hart variable pitch propeller, Moss supercharger, etc., but these are really carry-overs from the momentum of projects started before the Armistice.

SIMPLIFIED AND CHEAPER CONSTRUCTION

Progress in simplifying and cheapening construction during 1920 has not been marked. Designs demonstrated during the year continue to adhere to the conventional construction and, in some cases,

are rendered even more complicated by new accessories and special features. For example: there have been introduced on various Naval and Military planes variable pitch propellers, parachutes, superchargers, gyro turn indicators, radio direction finders, flotation gear, doped fuel, etc. The new features are uniformly complications. Proposed variable camber wings (Dayton-Wright) variable area wings (Handley-Page, Levavasseur) retractable stabilizers and adjustable fins are all devices of the designer to improve performance and, as such, may be justified, but in general the structure is rendered more complicated and expensive.

The necessity for a lower first cost is beginning to be realized abroad, probably most in Germany, and the importation of samples of Fokker and Junkers planes during the year is sure to influence American designers. The results of such influence will, of course, not be noticeable until next year.

Fokker is responsible for two features of construction which materially reduce construction cost;—the veneer wing and the welded tube fuselage. During the war, Fokker brought out his airplanes with the fuselage structure made up by welding thin walled soft steel tubes. Veneer fuselages, either a plywood box or a wrapped "monocoque," likewise eliminate metal fittings and alignment expense. American designers have largely adopted veneer fuselages but this construction, while cheap, is not permanent and is unsuitable for tropical service.

The other Fokker feature is the single panel internally braced wing. In the latest Fokker commercial plane, the wing is made of one continuous veneer covered panel, without internal drag wires or hinges. The wing furthermore is made so thick that external fittings with lift and landing wires can be omitted. The result is a substantial saving in manufacturing cost. The aerodynamic gain is likewise important.

All-metal construction has many advocates both here and abroad, but the advantages claimed are not, at the present time, based on first cost. Unless quantity production methods are justified, metal construction may run to twice the cost of veneer and wood construction.

In the United States, experimental planes are being built which are expected to mark a step toward a cheaper and simpler construction but the results will not be demonstrated until next year.

REDUCTION OF MAINTENANCE COST

Reduction of maintenance cost is the fundamental upon which civil aviation depends. Likewise, the military and naval value of a machine is increased in proportion as the care and attention necessary to maintain it is reduced.

During the past year more attention has been given to the accessibility for inspection or removal of the engine and its accessories, and some improvement is noted.

A great many flying hours in service are lost while wings are being recovered. The ordinary doped fabric wing covering has a short life. Various schemes for protecting this covering from the actinic action of sunlight have recently been developed and a marked increase in life has resulted. To retard such action an "anti-actinic" coating of pigmented dopes has been generally used as well as a pigmented spar varnish. The latter gives somewhat the better protection, but is heavier and more costly. Recent experiments with rubberized balloon fabrics, which are even more rapidly impaired by light, have shown that aluminum powder not only shuts out actinic light but reflects heat and keeps the surface cooler.

However much the life of fabric is increased by scientific treatment, the improvement is only relative, and fabric ought to be abandoned. The veneer covered wing is better so far as deterioration from light is concerned, but introduces other troubles; viz., buckling and warping in damp storage, attack by fungus and insects in the tropics, and deterioration of the glue.

A metal covering for airplane wings is an answer to most of these questions but introduces new technical difficulties, which it is premature to speculate upon at this time. It is generally admitted, however, that the present doped fabric will certainly not cover the wings of the airplane of the future.

One of the practices inherited from war times is the excessive use of glued splices and laminations. The introduction of a water resisting glue, and special and laminated wing beams and struts was then hailed as a great advance in the art, and so it was, from the production man's point of view. But to withstand damp storage and for tropical service, glue joints are dangerous, besides forming a starting point for fungus growth. During 1920 the Forest Products Laboratory of the Department of Agriculture has added poison to their casein glue formula to render the glue fungus resisting. However, the effect of hot damp weather on the best of glued joints and plywoods is unfortunate, and in Panama, for example, the wood itself is attacked by rot producing fungus.

During the year 1920, an important though inconspicuous step in advance has been the adoption by aircraft constructors generally of the standard Navy practice of galvanizing steel parts in the structure of the airplane. During the war, an army plane was not expected to last long enough to need galvanized fittings but the condition of material returned from overseas, especially that bought

in France where rust prevention was not attempted, gave convincing evidence of the necessity for preventing rust.

METAL CONSTRUCTION

The best solution of the deterioration problem is the radical one of abandoning a wood structure entirely in favor of metal. Steel and duralumin are being used abroad and while it is too early to judge with certainty, experimental planes built of either material seem to have proved successful.

In Germany, steel tube is used by Fokker for fuselages and the Zeppelin-Lindau flying boats have wing spars made of rolled steel shapes with ribs, fuselage and boat hull of duralumin plate. The wings are fabric covered. The Zeppelin-Staaken plane is built entirely of duralumin plate. In England there are some all-duralumin experimental planes and a few of steel construction with fabric covering.

Steel construction in the United States is not entirely new if we consider the Sturtevant steel plane of 1915. This design was not a success, however, due to cracks caused by engine vibration.

It is evident that the future of the airplane could be profoundly influenced by a practical metal construction. Six avenues of attack present themselves:—first, heat treated alloy steel tubing using fittings; second, welded mild steel tubing; third, rolled and stamped sections made from heat treated alloy steel strip riveted together; fourth, duralumin tubing with fittings; fifth, rolled and stamped sections made from duralumin strip riveted together; and sixth, a riveted construction of duralumin plates and shapes.

Heat treated alloy steel tubing has been produced in this country by Ohio Seamless and Sneed of astonishingly high strength but very special equipment is needed to heat treat the long lengths. Such tubing cannot be welded with safety, which is a great disadvantage in fuselage construction, but for struts and compression members generally the weight of the necessary fittings may not be serious.

Mild steel tubing can be welded into a very cheap and strong fuselage, but for wing construction such relatively low strength material is uneconomical. For very long struts which are designed against an Euler crippling load, the strength depends on the modulus of elasticity, and for such members mild steel tubes are quite as good as alloy steel. The advantage of alloy steels is only realized in cases where local crinkling is to be feared.

The most promising alloy steel for general airplane construction is a special cold rolled strip of the following approximate composition and physical properties:—

Carbon	0.28 to 0.35 per cent
Manganese	0.35 to 0.60 per cent
Nickel	3.75 to 4.75 per cent
Chromium	0.80 to 1.30 per cent
Vanadium	0.07 to 0.15 per cent
Ultimate.....	165,000 lbs. per sq. in.
Cold bend... 180°	around a radius 3.2 times thickness

Such strip is supplied in the form of a coil already heat treated and the airplane constructor rolls the strip into angles, channels or such structural shapes as he desires without further heat treatment. Short pieces, such as lattices for wing beams would be stamped out. The structure of the airplane is then made up of latticed girders assembled by riveting up simple parts.

THE USE OF DURALUMIN

The construction of airplanes from duralumin tubing is as difficult a problem as that involved in the use of alloy tubing. The duralumin tubing is exceedingly difficult to manufacture, must be heat treated in a very special manner, and cannot be welded.

Fabrication from duralumin strip is an identical problem with fabrication from alloy steel strip except that all rolling and stamping operations are easier on account of the softer metal. There remain, however, some tricks in heat treatment to look after. The manufacture of duralumin strip and its fabrication are better understood than the other materials discussed here on account of its extensive use in rigid airship construction. Starting in Germany with the Zeppelins, then developed in England, the making of duralumin shapes has now been undertaken in the United States in connection with the Navy's rigid airship construction program.

One of the important technical landmarks passed this year, of potential influence on the future of American aircraft construction, is the satisfactory production of duralumin on a commercial scale in the form of strip, sheet and forgings by the Aluminum Company of America at Pittsburgh and the Baush Machine Tool Company of Springfield, Mass. These concerns are licensed by the Chemical Foundation under the German patents sold by the Alien Property Custodian during the war.

Duralumin is an alloy of Aluminum of the following approximate composition:—

Copper	3.5 to 4.5 per cent
Manganese	0.4 to 1.0 per cent
Magnesium	0.2 to 0.75 per cent
Aluminum .....	.92 (min)
Specific Gravity.....	2.75 (max)
Tensile strength.....	55,000 lbs. per sq. in. (heat treated)
Elongation	18 per cent

Duralumin has the valuable property of remaining soft and ductile for several hours after heat treatment and while "fresh" can be worked cold. The hardening due to heat treatment is not fully attained until the metal has been allowed to age or season for a day or more. For equal weight and strength, duralumin compares with the alloy steels, but has the advantage of being used in thicker sections. For small planes this should be an important point.

However, duralumin has disadvantages, some of which may prove to be imaginary. It is believed to be more easily injured by slight errors in manufacturing process; less uniform and hence less trustworthy. There is also evidence of cracking under vibration. Alloy steels, on the other hand, are more uniform and able to stand considerable abuse in fabrication.

DIFFICULTIES IN METAL CONSTRUCTION

Metal construction for airplanes eliminates a whole cloud of troubles inherent in wooden construction, but introduces new difficulties of its own: corrosion and fatigue.

Duralumin in the heat treated condition is very resistant to corrosion but in the annealed state is as bad as ordinary aluminum. Badly heat treated material will prove unsafe from pitting. The steels now available must be galvanized or otherwise protected against rust. It is hoped that soon the high chromium "stainless steels," or some other rustless alloy steel may be perfected for aircraft use.

The fatigue of metals or progressive failure from incipient cracking is the greatest bugbear of the designer and, to a large extent, the success of metal aircraft will depend on the skill with which fatigue cracking can be eliminated by careful design. In wood construction there never has been any worry on this score, but several foreign designs of metal airplane have passed rigid static tests only to fail in service from cracking induced by engine vibration.

FIRE AND SAFETY

The fire risk in airplanes is due primarily to the presence of gasoline and is aggravated by a wood and doped fabric construction. Cellulose acetate dope is somewhat less dangerous than cellulose nitrate, but the clear doped fabric burns merrily enough with either coating. Various fireproof dopes have been put on the market, most of them consisting of ordinary dope containing ammonium or other salts. Such dopes are fairly fire-resisting, but as a rule are very poor as dopes and have not been generally used. The most practical way to reduce the inflammability of the wing

covering is to wet the fabric with a solution of ammonium phosphate before doping.

The fires on the Junkers all-metal planes of the Post Office Department when the planes were first put in service as imported, show clearly that the real fire risk lies in the gasoline system. Obvious precautions can be taken to provide for back fires, carburetor leaks, and broken gasoline leads, but the gasoline is always a risk, especially in a crash.

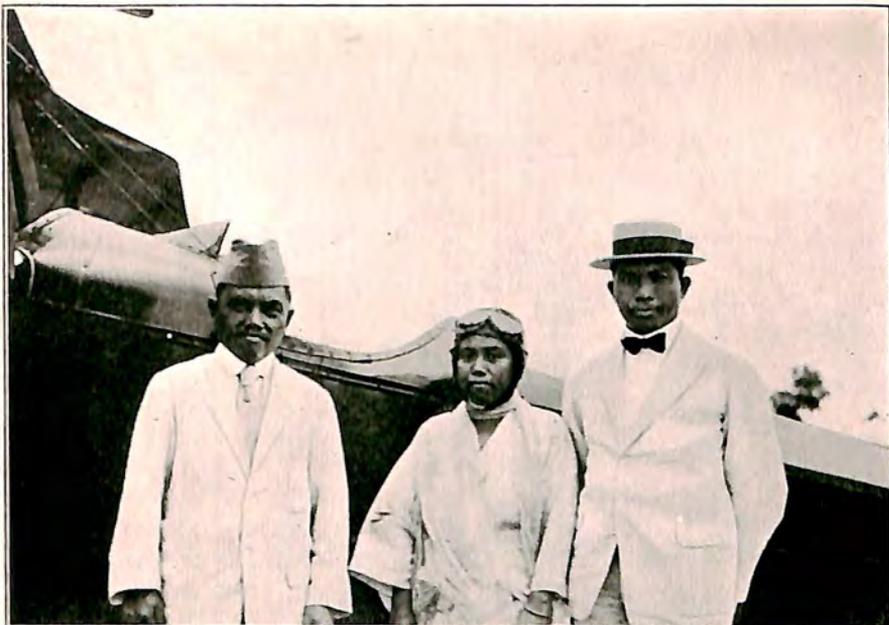
The final solution is again the radical one: eliminate gasoline in favor of a heavier fuel. Research leading toward the development of a heavy oil engine for aviation has been started in all countries. To use a heavy oil two solutions are being attempted: a steam engine with flash boiler or a modified Diesel engine. In the meantime, research is being prosecuted using direct injection of gasoline. If a spray nozzle can be produced to replace the carburetor, a part of the fire risk will be done away with. It is expected that eventually the spray nozzle can be made to use a heavy fuel.

While not a consideration in the general question of fire risk, the matter of parachutes should not be overlooked. While the risk of fire is present even remotely, many pilots feel safer with a parachute available. During the past year the Army, at McCook Field, has developed a pack type of parachute which has been very successfully demonstrated. With such a parachute, a man must get clear of his plane while he still has altitude enough for the parachute to function. Parachutes could be useful in case of fire, but have little or no bearing on the majority of flying accidents which involve crashes due to loss of control at low altitude.

RIGID AIRSHIPS

At the close of the war, the rigid airship had been demonstrated both by the German and the British Navies as a practical vessel for long flights. The development of this type of craft in the United States was placed in the hands of the Navy Department, and funds were appropriated in 1919 for two ships; one to be purchased abroad and one to be designed and built in this country. During 1920 the ship ordered abroad, the British R-38, now designated Z.R.-2, has been constructed. R.-38 is the largest rigid airship ever laid down, being 695 ft. long with a volume of 2,724,000 cu. ft. The designed speed is 70 miles per hour on six 350 h.p. engines.

The airship shed building for the Navy at Lakehurst, N. J., is nearing completion. This shed will be the largest in the world and is designed to take care of any probable size of future airships, being 172 ft. high and 250 ft. wide, clear opening, and 800



Sultan of Sulu and his Princess and the Governor of Jolo Island Visit Manila by Curtiss Airplane. *Below*—Field No. 2, Mercury Aviation Co., Los Angeles.



The Modern Farmer Discards the Flail for the Threshing Machine and Forsakes the Horse for the Flying Machine. George Kuck, proprietor of several farms near Decatur, Illinois, inspects holdings in his Curtiss Airplane.—Photo, Wasson, Decatur.

ft. long, with arrangements to extend to 1,000 ft. when needed. In addition to the Lakehurst shed, another shed at Cape May, is building to house R.-38.

The other rigid airship of the 1919 program is designated as Z.R.-1 and parts are being fabricated at the Naval Aircraft Factory, Philadelphia, to the designs of the Bureau of Construction and Repair. This ship will be intermediate in size between Z.R.-2 and the German L.-49 class, and fitted with Liberty engines, with special carburetors adjusted for extreme economy at 300 b.h.p. The Liberty engine has proved on tests to be a very versatile creature and at 300 h.p. makes a very good airship engine.

The gas bags of a rigid airship are lined with goldbeater's skins, the best known hydrogen tight film. For a 2,000,000 cu. ft. airship, the blind gut linings from 500,000 cattle are required. The process for curing and handling these skins has been perfected during the year, but simultaneously experiments have been continued to find a cheap synthetic substitute. Such a substitute made from a drying oil has now passed all tests and if confirmed by service use will materially cheapen and simplify this feature of airship building.

REDUCTION OF POWER: AERODYNAMIC EFFICIENCY

In aerodynamics, there appear to be general shifts of opinion which are manifested by "styles" just as in the millinery trade. In 1920, the "style" appears to be unbraced monoplanes. The inference is that something new has been discovered.

As a matter of fact, the German monoplanes of this type did make in 1919 a remarkable performance record due in part to the aerodynamic efficiency of the monoplane wings, but just as much to a benzol doped super-compressed B.M.W. engine rated very conservatively. There is, however, nothing new in principle either about monoplanes or unbraced cantilever wings. German planes showed cantilever wings on the western front in 1918, but Allied combat planes were faster and no sensation was caused. In the United States several inventors had proposed such wings during the War and experimental planes were actually built.

A biplane structure is aerodynamically less efficient than a monoplane and if it did not offer a real structural advantage, monoplanes would always have been used. However, the monoplane wing is difficult to support if the span is great. The monoplane now comes again to the front and with thicker wings evidently can be braced internally. However, we may expect a limit again to be reached as the span becomes great, and we shall revert to the biplane, but this time at first to a cantilever biplane.

As machines are made larger, structural reasons will again domi-

nate and biplane bracing will reappear, and no doubt for the largest of all, triplane construction will prove necessary.

AIR COOLED ENGINES

The obvious advantages of air cooled engines in weight and simplicity have not been realized in the past because of high fuel consumption and unreliability. Progress has, however, been consistent. The development in the United States of the 3-cylinder air cooled 60 h.p. Lawrance engine is an important step. This engine compares well in economy with good water cooled engines. Larger engines using 9-cylinders of the 60 h.p. type are building by Lawrance and several experimental air cooled engines are under construction by others. The year 1921 should see American air cooled engines of high power.

HIGH ALTITUDES

During the war there was a great demand for flight at extreme altitudes. Three methods were advocated to permit this:—excessively high compression engines, an engine excessively large and powerful for the plane, or a supercharger to supply air to the engine at ground pressure. All methods were used by all countries, but the perfection of the supercharger has come since the Armistice.

The "super compressed" engine is the cheapest and simplest means to preserve engine power as well as to gain in thermal efficiency, but requires a special fuel to prevent bad knocks. During the past year, experiments have brought out a suitable fuel.

The German B.M.W. engine is a striking example of both super compression and over size. The compression ratio is 6.4 and the engine is rated at 185 b.h.p. At ground level more than 230 b.h.p. can be developed, but at the expense of reliability. As installed, the engine is so adjusted that it will develop only 185 b.h.p., but will maintain this power beyond 8,000 feet.

The Moss supercharger used by Major Schroeder in his world record altitude flight of 33,114 feet is an outstanding accomplishment of the year and as a technical achievement is one the country may well feel satisfied with. Foreign superchargers seem to be still in the development stage.

When engines maintain their power to high altitudes by means of a supercharger, the torque remains constant. The propeller, however, due to the less dense air, is easier to turn. Consequently, the propeller should have a gear shift to increase its revolutions, or a variable pitch. The latter solution has been brought out in the Hart propeller perfected at McCook Field. Here again foreign variable pitch propellers appear to be still matters of speculation

and experiment. The variable pitch propeller has been further developed to provide a complete reversal of pitch. This opens up new possibilities for brake effect on the ground and for use on airships in place of reverse gears. Variable pitch propellers have been tried on the Naval Airship C-10 and have proved very useful approaching a landing. One notable demonstration was made by the Army in California.

NEW ENGINES

New engines brought out in 1920 include improvements and refinements in existing standardized engines and a few entirely new designs. Under the first classification come the 180 and 300 h.p. Wright engines which virtually complete the Americanization of the Hispano-Suiza which has been going on for the last three years, and under the latter come the new Aeromarine 120, Aeromarine 180, Packard 300, and Packard 600 h.p. types. The Lawrance 60 and 200 h.p. air cooled engines have been mentioned.

The Wright 180 and 300 h.p. models are essentially developed engines, and the changes made from the French designs are in the nature of simplification to give longer operating life and easier maintenance: V magneto brackets, dry sump, gasoline gear pump, thicker heads, more accessible connections, etc.

The Packard 300 h.p. is a new engine of 12 small cylinders and has given a very good account of itself as an economical smooth running engine. The Packard 600 h.p., however, is still an experimental engine. It failed to run in the Gordon Bennett race, but won the Pulitzer Race running at reduced power. The engine, however, is of a type much needed for larger planes which are now equipped with two engines, and it is hoped that 1921 will show the development stage passed.

The Aeromarine six cylinder 120 and eight cylinder 180 h.p. types are among the first engines that appear to be designed for commercial use. Both have been thoroughly tested on the block and give every promise of being sturdy dependable engines as nearly fool-proof as possible. Removable heads are a feature that appeals to the man in the field.

New engines under construction which should be heard from in 1921 are an eighteen cylinder engine of 700 h.p. building at McCook Field, and a special six cylinder heavy duty airship engine of over 300 h.p., for which the Bureau of Engineering at the Navy Department has let contracts with three separate manufacturers. The same Bureau has a large number of Liberty engines being rebuilt to incorporate a reduction gear.

"DOPED FUEL"

One of the outstanding technical accomplishments of the year is the culmination of the work of Kettering and Midgley on doped fuels. It has long been known that high compression engines knock badly on Pennsylvania gasoline, and that such engines knock less with California gasoline. It has now been determined that the addition of very small quantities of any one of several aniline derivatives to gasoline eliminates knock, that the pinking or knocking is not due to preignition but to detonation during combustion, and that higher compressions may be employed in aviation engines than were heretofore considered practicable.

A plausible and useful theory of knocking has been explained and practical use is already being made of it. If engines are run on benzol-gasoline mixtures, there is danger of freezing in cold weather and the benzol attacks rubber connections in the fuel leads. About 20% of benzol does stop knocking and makes a good fuel, but as little as 2% of aniline is claimed to be equally effective without the bad effects found in benzol. The Germans introduced blending with benzol during the war on account of the shortage of gasoline, but quickly discovered that with benzol-gasoline mixtures higher compression was permissible. The B.M.W. and later Maybach engines show the influence of this idea.

PROPELLERS

During the year further data for the design of propellers was furnished by the publication by the National Advisory Committee for Aeronautics of another report on Profs. Durand and Leslie's comprehensive research. So far as propeller performance in free air is concerned, the information available is now very complete. Unfortunately the mutual influence of a tractor propeller and a fuselage with a blunt entrance (or a nose radiator) is not known and evidence is accumulating that a good propeller design will give an abnormally poor performance when used with certain blunt fuselage forms.

Experiments during the year on the construction of propellers have led to improvements. The Forest Products Laboratory has developed improved methods of selecting, drying, and gluing propeller woods and an aluminum leaf coating to prevent change of moisture content.

Propellers have been covered with linen and with leather in efforts to reduce erosion from rain drops and molded propellers of a bakelite preparation have been used with success. Metal propellers have not yet been proved practical but there is great promise in future developments along this line.

TORPEDO PLANES

The problem of the torpedo plane has been active during the year. The first torpedo carrying plane was a makeshift made up at the Naval Aircraft Factory from a lot of old Curtiss R.-6 seaplanes rebuilt with a Liberty engine and larger pontoons. These were used for practice drops in the schools.

Next, Glenn L. Martin built his well known Bomber with a divided landing gear so that a torpedo could be carried under the fuselage. The useful load was not sufficient and a further change was made by adopting an "Albatross" profile for the wings. To make up for the greater drag of this high lift wing, streamline wires were introduced. The result is that with the same power the modified torpedo carrier, I.M.T., has a high speed one mile in excess of the standard bomber, carries 1,600 lbs. more load and has a landing speed 2 miles lower.

SHIP PLANES

During the year the Naval Aircraft Factory has fitted hydrovanes and flotation bags on a number of land planes to adapt them for shipboard work. Experiments have been carried out with Hanriot, Nieuport, Sopwith, Vought and Loening planes. Parnall ship planes have been imported for test purposes, as well as Fokker and Macchi types. The problem is to develop a handy plane which can fly from a ship's deck, land again upon the deck, or in case of engine trouble, alight on the water and remain afloat. Experiments will continue with the collier "Jupiter" converted into an airplane carrier and renamed "Langley."

THE HELICOPTER

It can hardly be said that any great progress has been shown toward the development of a successful helicopter or direct lift machine, although there has been a surprising amount of interest evidenced. The technical journals have carried articles "proving" the practicability of direct lift with screws and several experimental machines have been built.

The Hewitt-Crocker scheme has been tested on the ground and showed a good lift from the screws. But it has not flown. The Damblanc machine in France has had similar tests, but again no flight is recorded. It is reported that during the war, a helicopter was tried in Austria by Prof. Karman which did attain a considerable altitude while attached to the ground by several wires. So long as the machine kept a good tension in the wires, the equilibrium was maintained, but no free flight was attempted, as no means were pro-

vided for steering and control. The idea was to replace the kite balloon at the front with a small direct lift machine. The advantages seem obvious but the experiments were abandoned.

A most interesting helicopter is that of Emile Berliner of Washington. With an 80 h.p. Le Rhone engine, H. A. Berliner has made several actual flights at an altitude of six feet or so. These were really sporting events, as the transverse motion was a crab-like scuttle in random directions depending on the inclination of the machine. A circle of swift footed friends assisted in the control of the machine at critical times. However, the problem of control has now been shown up clearly, and various devices are proposed to solve it.

RACING

The year 1920 has seen the revival of racing, with the Gordon Bennett contest in France and the Pulitzer Trophy Race in this country. Both competitions were purely speed affairs but, fortunately, were over courses long enough to require some degree of reliability.

The Gordon Bennett race was naturally a great disappointment to American aeronautical engineers on account of the failure of the three American entries, each of which possessed new features of obvious interest. However, if any lesson can be drawn it is that a speed race is a gamble on whether any given machine can start and hold together long enough to finish. The French could have won the Cup this year with a training plane.

Technically, the French winner showed no advance in design over their best of 1918, but that best is still an object lesson to the world in harmony of form and superb finish.

The Sopwith entry was to have shown the 450 h.p. Jupiter and the British Nieuport the 300 h.p. A.B.C., both air cooled engines. It is of the greatest technical interest to know whether the additional head resistance of such radial engines is made up for by the saving in weight over, say, the 300 Hispano as installed in the winning French entry.

The Curtiss and Dayton Wright entries were monoplanes in which every artifice had been resorted to in the effort to obtain aerodynamic efficiency. The Curtiss reduced the landing gear to a most rudimentary type without shock absorbers, while the Dayton Wright had mechanism completely to retract the landing gear into the fuselage. The Curtiss scheme is light and simple, but demands a perfect landing field. The Dayton Wright scheme obviously saves an important amount of resistance.

The most novel and interesting feature of any entry was the variable camber device in the wing of the Dayton Wright. The theo-

retical advantages of variable camber are well recognized and its adoption has been deferred only by mechanical difficulties. With regard to the Dayton Wright design, the question remains to be answered from experience: Does the aerodynamic advantage compensate for the mechanical complication and risk of breakdown? The resistance of operating mechanism on top of the wing does not seem to be inherent in such gear and should be eliminated in a perfected design.

The U. S. Army entry mounted for the first time the new Packard 600 h.p. engine and was by far the most powerful machine in the competition. The design of the plane was clean, but conventional.

The American entries in the Gordon Bennett Race failed from an excess of optimism. Each was frankly experimental and untried. The Curtiss plane smashed up in landing before the race, the Dayton Wright entry quit because of control or stability troubles and the big Packard engine of the Verville Army plane misbehaved. There was no real race, as the only British starter quit with a broken oil pump and two French entries also had oil troubles.

THE PULITZER RACE

The Pulitzer Race was really a race, with 37 planes to start and 24 to finish. Again, it was demonstrated that experimental planes and engines have small chance to keep up a long grind at full power. True, the Verville Packard won the race, but the engine had to be run at less than 500 b.h.p. instead of its rated 600 b.h.p., and finished but two and one-half minutes ahead of the Thomas-Morse which had but 320 h.p. The experimental engines in the Curtiss-Kirkham triplanes both failed. Both Loenings failed because of cooling system troubles, known to exist in the type and thought to be taken care of. In all there were 13 unlucky planes which failed to finish.

It appears that only one plane quit because of a defect in the airplane proper, while ten had power plant trouble. Two contestants were disqualified for reasons of piloting and have no bearing in a technical discussion.

Of the ten planes in power plant trouble, only two broke a main engine part: a Liberty and a Curtiss-Kirkham engine. The rest were forced to abandon the race because of defects in engine accessories, cooling, ignition, oiling, etc. It is discouraging to have the lesson repeated time and time again that it is the accessories that let the plane down.

However, there was not one single propeller failure or gasoline fire, no case of loss of control, no burst wing fabric, and best of all nobody was hurt. This is certainly encouraging and no such record could have been expected two years ago.

Of the thirteen "lame ducks" that abandoned the race, there were but five forced landings and only two planes damaged. Credit for this is due less to good luck than to the good management of the Contest Committee in laying out a course over excellent country.

The following table is of some significance:

Engine	Liberty	S. P. A.	180 Wright	300 Wright
Started	16	3	10	5
Finished	13	2	6	2
Ratio	81%	67%	60%	40%

Which is simply interpreted to mean that the Liberty is a fully developed engine flown in the D.H. plane, also fully developed. A return of 81% may be taken as standard. The S.P.A. engine in the Ansaldo plane is another developed combination. The 180 Wright in S.E.-5 and Vought planes is not at all experimental, but has not had the benefit of extensive service experience. The S.E.-5 and Vought were originally designed and used with the 150 Hispano engine. The 180 Wright seems to be a little too much for the cooling system provided.

The 300 Wright as installed in Thomas-Morse, Ordnance and Loening planes is still somewhat unfamiliar. The engine itself has had thorough block tests, the planes have had extensive test flights, but the installed engine in the planes has not been subjected to severe duty. This engine at ground level is too strong for the cooling system provided. Even the Thomas-Morse, which won second prize, and the Ordnance, fourth prize winner, ran the race under a handicap of cooling trouble.

The winner of the race, strangely enough, was a disappointment because it did not show more speed with its stupendous engine. The engine, however, never developed its rated power. Technically, the greatest interest lies in the Thomas-Morse, the Ansaldo, and the Vought.

The Thomas-Morse ran away from the Ordnance with the same engine, which might be accounted for from the fact that it is a somewhat lighter and smaller plane. However, there is a suspicion that the blunt ended fuselage and nose radiator of the Ordnance may have been largely responsible.

This suspicion is strengthened by the discrepancy between the times made by the Vought and S.E.-5, each equipped with the 180 Wright engine and identical propellers. The Vought is a two-seater training plane, flown as a single-seater for the race, with large wings of 30 ft. span and eight struts. The S.E.-5 is a single combat plane

with wings of 27 ft. span and only four struts. Yet the Vought beat the S.E.-5 by over four minutes. Obviously, the Vought has more wing drag to overcome. But it is significant that the Vought fuselage has an easy entrance and the circular nose radiator is symmetrical round the propeller axis, while the S.E.-5 has a blunt fuselage with a nose radiator projecting high above the propeller axis into the slip stream.

On the other hand, the Ansaldo made a fine record and its nose radiator resembles the S.E.-5. However, this plane is smaller than S.E.-5, has greater power, and can hardly serve for comparison.

The evidence is accumulating that blunt bodies shaped like S.E.-5, D.H.-4, and even the Ordnance and Verville to some degree, choke the propeller. If nose radiators are used in spite of many objections, it would seem desirable to use a small deep circular radiator and, if possible, a geared down propeller of large diameter. The combination of a large nose radiator and a small diameter propeller as in D.H.-4 has nothing to recommend it.

Another interesting point about the race is the use of benzol-gasoline blends by several of the prize winners. No power was gained but the knocking feared from running full power at ground level was eliminated and the engine eased. It seems reasonable to believe that the blended fuel permitted engines to run wide open which otherwise would have come to grief.

CHAPTER XIV

FOREIGN AERONAUTICS; REVIEW OF ACTIVITY, NATION BY NATION, THROUGHOUT THE WORLD

SUBSTANTIAL progress in the development of aeronautics was made by many nations in 1920. The greatest development was attained in those countries having centralized government control. This national support, whether moral or financial, or both, is establishing commercial aeronautics on a firm and permanent basis. The respective governments following out a definite aeronautical policy are doing so with the avowed purpose of securing a peace-time position in the air which will be their chief defense in war.

. Through the courtesy of European air attachés and diplomatic representatives in Washington, and through the co-operation of the Air Service and the Bureau of Foreign and Domestic Commerce, as well as by direct investigation abroad, the Manufacturers' Aircraft Association is able to present the following review of aeronautical activity, nation by nation, throughout the world:

ARGENTINA

Argentina is officially interested in developing its aeronautical resources, and the government is studying the regulations of the International Aerial Convention with the idea of formulating an aerial code. Meanwhile Federal aviation is under jurisdiction of the military. The Curtiss Aeroplane & Motor Corporation is demonstrating American built aircraft and maintains an aerial taxi service at San Fernando, 15 miles from Buenos Aires. There are also French and British companies co-operating with local financial interests.

AUSTRALIA

Australia is organizing an air force which, with civilian aviation activities, will be under the control of a board including in its personnel representatives of the Army, Navy and commercial interests. During 1921 the government hopes to map all possible air routes, make appropriations to encourage civil aviation and provide in this a civilian reserve and assure an operating aircraft industry,

able to supply planes and motors in case of war. For this the budget appropriates £500,000 (about \$2,500,000 at normal exchange) for military and £100,000 for civilian aviation in 1921. An air mail service is being operated by the government between Lismore and Tenterfield, 101 miles apart.

AUSTRIA

Austria has an aeronautics department under the State Secretary of Transport. Provisional regulations for aerial navigation, pending the publication of Austria's signature to the International Aerial Convention, have been issued.

BELGIUM

Belgian aeronautical activity is under the jurisdiction of the premier group of the Minister of National Defense, who has under his supervision a department headed by a Director of Aeronautics. The development of civil aviation is under this Director. Commercial, passenger, freight and mail lines are being operated between Brussels and Paris and Brussels and London. Belgium has assigned air attachés to all important capitals of the world. Their duties are to aeronautics what those of the military and naval attachés are to the military and naval branches of the government.

BOLIVIA

When Bolivia completes government and civil aviation plans, both branches will be under the jurisdiction of the Minister of the Interior. Bolivia presents a problem for aeronautical engineers. The extremely high altitude of the country makes it imperative that high-powered special high-altitude planes be employed. Bolivia first saw an airplane flight in June, 1920, when a Curtiss triplane purchased by the War Department was placed in operation.

BRAZIL

Brazil is developing an air force, and has formulated certain rules and regulations concerning civilian flying. Representatives of the Curtiss corporation, continually flying over Rio de Janeiro and other cities, created much enthusiasm in aeronautics. Practically the only restriction on flying to date has been the rule that a pilot must have a government permit.

CANADA

Canada has an Air Board which supervises all federal and civilian aeronautics. It was established by an act of Parliament, June 6,

lin and Copenhagen; Hamburg-Amsterdam-London. This air service is conducted by private Danish firms, but the government assists in every way possible.

ECUADOR

All aviation in Ecuador is under the jurisdiction of the War Department. Late in 1920 it was planned to establish a military aviation school.

FRANCE

French aviation is divided into three branches: military, naval and civilian, the last under the Under Secretary of State for Aeronautics. It is a branch of the Ministry of Public Works. The common point between these three branches of French aviation lies in the technical section of aeronautics. During 1920 it was found that a great deal of money was saved, by having in the same organization all the aeronautical engineers of the Army and Navy. This was based on the experience that any improvement in the mechanical branch of the art necessarily must be of benefit to all aviation activities.

The Under Secretary of State for Aeronautics is M. Flandin. Late in 1920 General Dumesnil was Chief of Military Aeronautics and Captain Valdenaire, Chief of Naval Aviation. M. Fortante was Chief of the Technical Section, involving the other three branches. Aerial attachés have been appointed to the important countries of the world. The French Aerial Attaché in Washington is Captain de Lavergne. France has sent temporary or permanent aviation missions to other countries, including those in South America and Asia, for the purposes of supporting French manufacturers, surveying markets, establishing air transportation under the respective governments and in some cases acting as temporary military missions, instructing foreign governments in organizing their aviation departments.

Late in 1920 there was a project to establish an aerial arm of national defense, which was to be brought before the Chamber of Deputies for ratification. This aerial arm would be similar in operation to infantry, artillery and cavalry. It would double the flying pay, promotions would be more rapid and retirement after twenty years of service, with the same pay as in the others after thirty years. A special school of aeronautics was to have been organized at Fontainebleau. A scientific school for aeronautical engineering has already been created at Versailles.

France has established an air mail service through civilian companies. The organizations operating the mail lines include: Messageries Aeriennes, between Paris and London; Grands Express

Aeriens, Paris and London and Paris and Brussels; Latezoere and Company, between Toulouse, Spain, Morocco, Rabat; Franco-Roumaine, between Paris and Bucharest, and also the Company Paris-Pragen, between Warsaw, Poland and Paris. Approximately 40,000 letters a month have been carried by the French lines operating between Paris and London. The air mail postage in Europe is slightly in excess of ordinary postage. All landing fields are in charge of the Office of Aerial Navigation. These fields are bought, established and equipped at the expense of the government. The civil plane finds there a shelter as well as gasoline, oil, repair facilities and mechanics, all for a small fee. All communications, wireless stations, meteorological posts, are installed by the government Office of Communications.

For each trip undertaken by a company recognized by the government, certain bonuses are given. The sum of various bonuses covers, for instance, for the trip from Paris to London a total of almost 700 francs or \$140. During the next ten years the government will continue to award these bonuses in order to support civilian aeronautics and to help develop it. The budget for the next fiscal year includes 60,000,000 francs for civilian aeronautics alone. In return for this government assistance, private companies are required to accept the control and supervision of the government, according to the rules and regulations laid down. The planes must have certain characteristics, which permit of their being transformed immediately into war craft. They must be kept in perfect condition and the government may have a plane condemned and discarded.

French aviation officials are convinced that within ten years the public will use aircraft as much as the railways. More than 1,000 persons have flown from Paris to London. With the opening of the new lines, the government has planned to create another aerial landing field at Orly, 60 kilometres from Paris. At Nice will be located the official junction point between Paris and Rome and Paris and Bucharest. Strasburg will be the junction of all lines coming from Germany, Czecho-Slovakia, Poland, and in the future from Russia. Radio stations have been erected, special telephoning posts built and meteorological observations are sent every hour to every landing field.

GERMANY

Germany has a Ministry of Air and Transport. Immediately after its creation early in 1920 several new transport and aerial manufacturing companies were formed. Liberal subsidies have been granted to manufacturing and passenger carrying companies.

GREAT BRITAIN

All aviation in the United Kingdom of Great Britain and Ireland is under the Air Ministry. Military and naval aviation is included in the Royal Air Force operating under the Air Ministry, as does the American Air Service under the War Department. The Ministry also has jurisdiction over civilian aviation—control of fields, inspection and licensing of machines and pilots. Many air lines operate daily between Great Britain and the Continent. While the Royal Air Force is the dominating scheme of the government organization, the Air Council of the Ministry includes Winston Spencer Churchill, Secretary of State for Air, the Marquis of Londonderry, under-Secretary of State for Air, Air Marshal Sir Hugh M. Trenchard, Chief of the Air Staff, Major General Sir Frederick H. Sykes, Controller-General of Civil Aviation, Air Vice-Marshal Sir E. L. Ellington, Director-General of Supply and Research, W. F. Nicholson, Secretary of the Air Ministry.

The ministry is divided into departments, the Department of the Secretary including the air historical branch, a directorate of contracts, a finance department and a directorate of lands. The Department of the Chief of the Air Staff handles all operations and intelligence, training and organization, personnel, equipment, medical services, works and buildings. The department of the Controller General of Civil Aviation has charge of all commercial aerial navigation and enforcement of aerial laws, information, communications, licensing of airdromes and pilots and meteorological data, all co-operating with officials assigned from the Royal Air Force. The Department of the Director-General of Supply and Research has charge of all research, designs, armament, instruments, aircraft supplies and aeronautical inspection.

Active committees include those on airdromes, advisory committee on civil aviation, research, awards to inventors and patents, medical advisory board, meteorology, industrials, etc.

Then there are these inter-departmental committees on which the Air Ministry is represented: cadets' regulations, navy and army canteen board, ex-service organizations, radio research, etc.

The United Kingdom is divided into area commands—the inland area, in which is also included the Irish wing; the Coastal area, which includes all airships and seaplane stations and flying craft operating with the Fleet.

Royal Air Force Headquarters for cadet and boy training are located at Cranwell and at Halton, England.

Late in 1920 Great Britain had air attachés in all important cap-

itals. Air Commodore L. E. O. Charlton is air attaché at Washington.

The Air Council has established a prize fund for improvements in design and performance of both commercial and military aircraft. The government also assumes responsibility for organization of airdromes, wireless and meteorological services, adjustment of international questions, research and experiments. At the Air Conference held in October, 1920, under the auspices of the Air Council, and in which all aeronautical interests, commercial and military, participated, reports on all angles of aviation were distributed. Preliminary work is under way toward linking all Colonies with England by means of commercial aerial routes. The Air Council is co-operating with the Canadian, Indian and New Zealand Air Boards.

In response to an interpolation in Parliament November 24th, the Prime Minister stated that there was a distinct separate future for the Air Service, apart from its co-operation with either sea or land forces. He stated that the expense of the Royal Air Force, as at present constituted, had been justified by results.

On November 23rd, the Secretary of State for Air, Mr. Churchill, in response to interpellations, gave the following facts: The Air Force in Constantinople is maintained at a monthly expenditure of approximately £4,000. The Air Force in Egypt is maintained at a monthly expenditure of approximately £80,500. The Air Force in Palestine is maintained at a monthly expenditure of approximately £18,250.

Mr. Churchill stated that on October 1st, 1920, the total strength of the Royal Air Force was: officers, 2,812; other ranks, 23,862. The numbers authorized in the Air Estimates for the year 1920-1921 were as follows: officers 3,059; other ranks, 26,519.

Three commercial air routes are operating between England and the Continent—London to Paris, 223 miles; London to Brussels, 210 miles; London to Amsterdam, 258 miles. The Government grants a bonus equal to about 25% of the operating receipts of companies engaged in commercial flying.

The Government airdrome at Croydon and the private commercial airdrome at Cricklewood are arrival and departure stations for aircraft from abroad. Pilots arriving from a place outside the United Kingdom take their airplane to the examination station, where a report is made and the prescribed form filled out. Log books, manifests and declaration of goods on board the aircraft are turned over for inspection.

Strict rules are enforced regarding importations into the United Kingdom. From May 1, 1919, till October 1, 1920, 100,285 passen-

gers and 266,000 pounds of freight were carried in aircraft flying approximately 1,381,500 miles. Imports worth £512,722 were flown into the United Kingdom in twelve months. Exports for the year aggregated £235,045 in value. Aircraft departing for the Continent in twelve months totalled 1,455, and 1,325 arrived in England; 51,535 letters left the United Kingdom for Paris, Brussels and Amsterdam, and 45,077 letters arrived from those cities between November, 1919, and October, 1920. Unlike the U. S. Air Mail Service which transports mail thousands of miles at ordinary rates of 2¢ an ounce, European air mail costs more.

The three commercial air routes from England to the Continent connect with other air lines running all over Europe and to Africa. Train service is augmented, and international travel facilitated by simplified customs regulations. On the London-Brussels air-line, passengers can transfer to craft flying between Antwerp and Brussels, Spa and Brussels, or Paris and Brussels.

On the London-Amsterdam route, connections can be made to Hamburg, Berlin, Bremen and Copenhagen.

Passengers flying from London to Paris may connect with airlines running from Paris to Bordeaux, Toulouse, Rabat (Casa blanca), Tangier, Montpellier, Bayonne, Bilbao, Nimes and Nice, via Avignon.

ITALY

Since July 1st, 1920, commercial aviation in Italy has been under the jurisdiction of the Permanent Board of Aeronautics, which, broadly speaking, controls the development of both military and naval aviation. Army Air Service operations are controlled by the Inspector of Army Aeronautics, and naval aerial operations by an Inspector of Naval Aeronautics. These are Gen. Moris and Admiral Orsini, respectively, while Professors Volterra and Panetti comprise the other members of the Board.

All military and naval aircraft are developed and produced by the Army Air Service, assisted by technical officers from Naval Aviation when the planes are to be used by the latter branch. Operations are conducted separately by both land and sea aerial forces, while the aviators are trained in separately conducted schools.

The Army Air Service, beginning January 1, 1921, will include four divisions, that dealing with commercial aeronautics, the operating division, the technical and administrative divisions. Technical sections under the jurisdiction of the War Department include experimental branches for both heavier and lighter than air craft all in the technical division, also an ordnance bureau, radio office, aerological and photographic services.

The chief of the Army Air Service is Major Gen. Amedeo de Siebert. Lt. Col. Ferrari commands the technical division, Col. Rossi the planning division, Lt. Col. Lapolla, operations; Lt. Col. Verduzio, experimental.

Italy has assigned aerial attachés to France, England, the United States and Sweden. Lt. Col. A. Guidoni is attaché at Washington.

The commercial aeronautics branch of the Army Air Service is continuing the work of preparing aerial routes and establishing landing fields throughout the kingdom.

Several commercial companies are endeavoring to maintain regular services. They are assisted by the Government, which maintains the landing fields and defrays the expenses incident to charting air routes. The Government also nourishes the industry by buying all its machines from manufacturers with two results: machines and equipment can be secured more economically from private factories operating on a competitive basis than if built in Government owned and operated factories; also, the maintenance of a civilian industry provides the country with a nucleus for quantity production in case of war.

Aerial laws have been made in accordance with the International Aerial Convention and local regulations are based on those provisions.

JAPAN

Aviation in Japan is under the supervision of the government, military and naval aviation being part of the army and navy establishments and the air mail service now being organized under the supervision of the Department of Communications — all, however, co-operating in conferences for the development of machines, routes and the training of pilots.

NORWAY

Norway has an Air Force under direct government supervision, which is co-operating with commercial companies in establishing routes and air terminals throughout the country. Under the War Department operations are divided by the Army and Navy directorates.

PERU

All aviation in Peru is under the War Department. Air mail lines have been established from Lima to Callao, Ancon, Huaclico, Trujillo, Supe, Chorrillos, Lurin and Pisco.

POLAND

The Polish Government is encouraging the establishment of air mail services between Warsaw, Prague, Strasburg and Paris. Military Aviation is under direction of the general staff and consists of aviators recruited from many countries, including the United States.

ROUMANIA

All aviation in Roumania is under Government supervision, the civilian flying being handled by a directorate of aviation in the Ministry of Communications. This bureau is now organizing airways and helping to organize factories, at the same time regulating aerial navigation. Plans have been made to organize permanent aerial passenger routes in 1922.

All public aircraft facilities, such as air ports, radio telegraph, radio direction finding, supplies and repairs, are being organized under the direct supervision of the Government. These facilities are let to private companies obtaining State contracts. The Government also has tendered to all sports and touring activities assistance similar to that given the commercial services.

SPAIN

The Spanish Government late in 1920 announced its plans to maintain jurisdiction over all aerial traffic, according to the regulations of the International Aerial Convention. Mail and passenger lines have been organized for operation in Spain, France and Northern Africa.

SWITZERLAND

Two directing bureaus, operating under the Swiss Federal Council, control all aviation, military and commercial, respectively. Many training schools for pilots have been established and private companies have been encouraged by law and government support to establish air lines, which are now operating between Dubendorf, Zurich, Berne, Lausanne and Geneva.

SWEDEN

Sweden is reorganizing her army air service which heretofore has been under the jurisdiction of one of the three aeronautical heads — the army, navy and waterpower administration. The last named has established aerial routes from Porjus to the electrical waterpower sites in Northern Lapland. Daily service is maintained, with seaplanes in summer and land machines mounted on skis in winter. The Postoffice Department in 1920 started air

mail services to Malmo-Copenhagen, Warnemunde and Berlin. The government has granted a liberal subsidy to the Swedish Air Traffic Company for 1921. The Aero Club of Sweden also receives a subsidy from the government.

URUGUAY

Military aviation is under the authority of the Minister of War and Marine. There is a military aviation school at Montevideo, which also has an aviation club. The capital city is the western terminal of a civilian airplane line from Buenos Aires.

HISTORICAL DESIGN SECTION

HISTORICAL DESIGN SECTION

IN the following pages the progress of American aircraft design is illustrated.

It has been the aim to trace significant phases in the development of the art from the time the Wright Brothers made the first flight.

Even in so new an industry, records of early achievements have been scattered, but with the assistance of Orville Wright, Glenn H. Curtiss, Glen L. Martin, Edson Gallaudet and other pioneers, the compilers of this volume are able to present what is believed to be a fair graphic history of our development.

The gliders built and demonstrated by the Wrights are illustrated as the final steps preparatory to the historic flights at Kitty Hawk, N. C.

Langley's "Aerodrome" is given a place of honor, as it was built the same year the Wrights flew, but was not demonstrated until eleven years later, when Mr. Curtiss attached pontoons and took it up at Lake Keuka. Prof. Samuel Pierpont Langley, the designer, who died amid the ridicule of the undiscerning mind of his day, was thus vindicated.

But nothing, of course, can diminish the obligations which the art owes to Wilbur and Orville Wright. It was Orville Wright who made the first flight on the morning of December 17, 1903. He describes it as follows:

"The course of the flight up and down was exceedingly erratic, partly due to the irregularity of the air, and partly to lack of experience in handling this machine. The control of the front rudder was difficult on account of its being balanced too near the center. This gave it a tendency to turn itself when started, so that it turned too far on one side and then too far on the other. As a result, the machine would rise suddenly to about ten feet and then as suddenly dart for the ground. A sudden dart when a little over a hundred feet from the end of the track or a little over 120 feet from the point at which it rose into the air, ended the flight. As the velocity of the wind was over 35 feet per second and the speed of the machine over the ground against this wind ten feet per second, the speed of the machine relative to the air was over 45 feet per second, and the length of the flight was equivalent to a flight of 540 feet made in the calm air. The flight lasted only twelve seconds, but it was nevertheless the first in the history of the world in which a machine carrying a man had raised itself by its own power into the air in full flight, had sailed forward without reduction of speed, and had finally landed at a point as high as that from which it started."

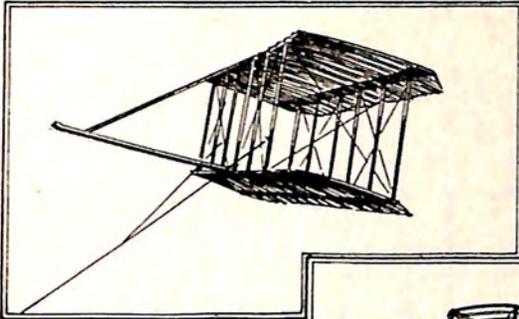
It was not until five or six years afterward that the United States government became sufficiently interested to call for the design and construction of an airplane. The one thus built was flown, as the first American military machine, at Fort Myer, near Washington, Sept. 9, 1909.

In the meantime Glenn H. Curtiss, alone and through the Aerial Experiment Association, had been carrying on his work with airplanes and engines, and on July 4, 1908, made the first publicly announced flight in the history of the art. This was made at Hammondsport, N. Y., in the "June Bug," which was destined to be the first of a long line of practical machines bearing Mr. Curtiss' name, one of which made the first flight across the Atlantic. Mr. Curtiss describes this famous flight as follows:

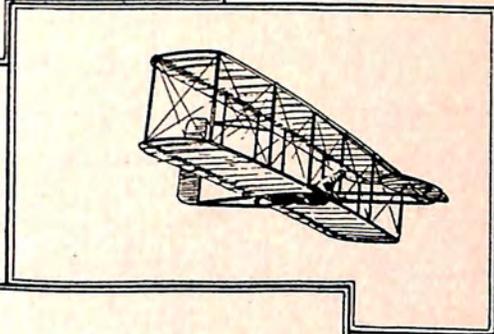
"The 'June Bug' was brought out of its tent and the motor given a try-out. It worked all right. The course was measured and a flag put up to mark the end. Everything was ready and about seven o'clock in the evening the motor was started and I climbed into the seat. When I gave the word to 'let go' the 'June Bug' skimmed along over the old race track for perhaps two hundred feet and then rose gracefully into the air. The crowd set up a hearty cheer, as I was told later — for I could hear nothing but the roar of the motor and I saw nothing except the course and the flag marking a distance of one kilometer. The flag was quickly reached and passed and still I kept the airplane up, flying as far as the open fields would permit, and finally coming down safely in a meadow, fully a mile from the starting place. I had thus exceeded the requirements and had won the *Scientific American* Trophy for the first time. I might have gone a great deal farther, as the motor was working beautifully and I had the machine under perfect control, but to have prolonged the flight would have meant to turn in the air or passing over a number of large trees. The speed of this first official flight was closely computed at thirty-nine miles an hour."

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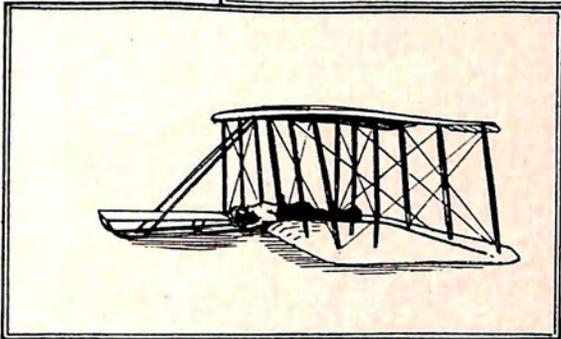
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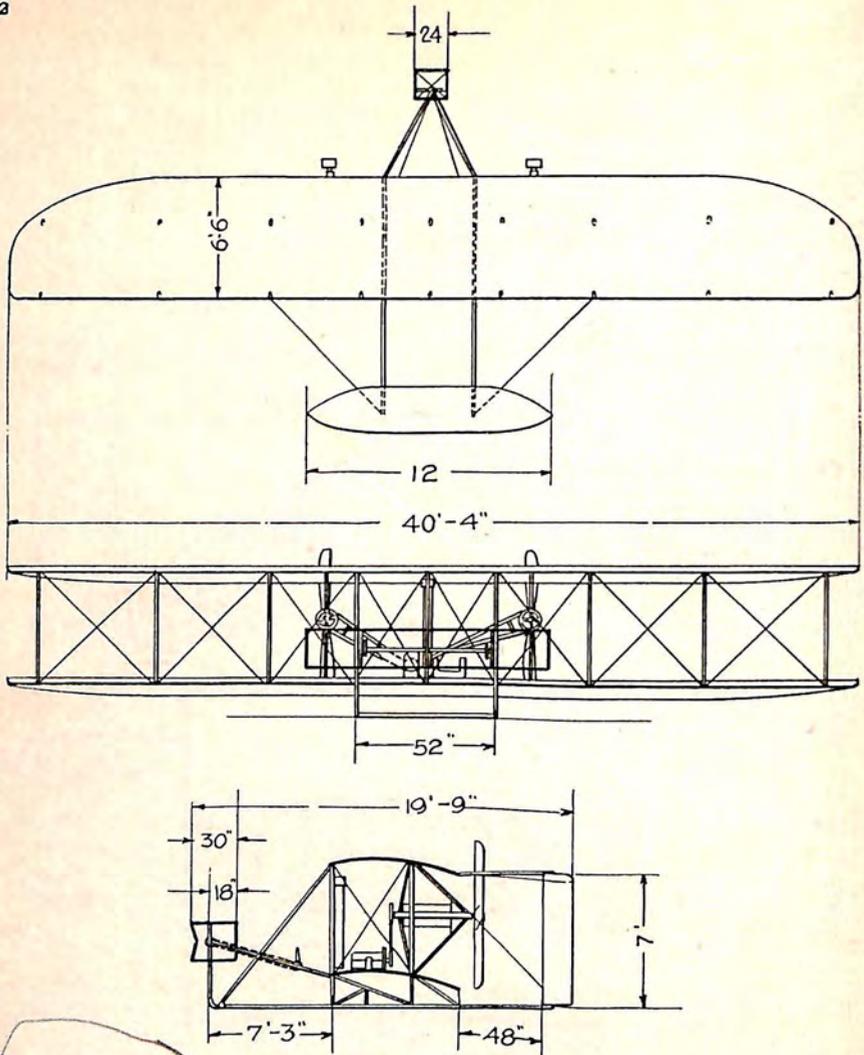
THE WRIGHT BROTHERS' KITE USED IN MAKING EXPERIMENTS WITH HEAVIER-THAN-AIR CRAFT



THE ORIGINAL WRIGHT GLIDER 1900

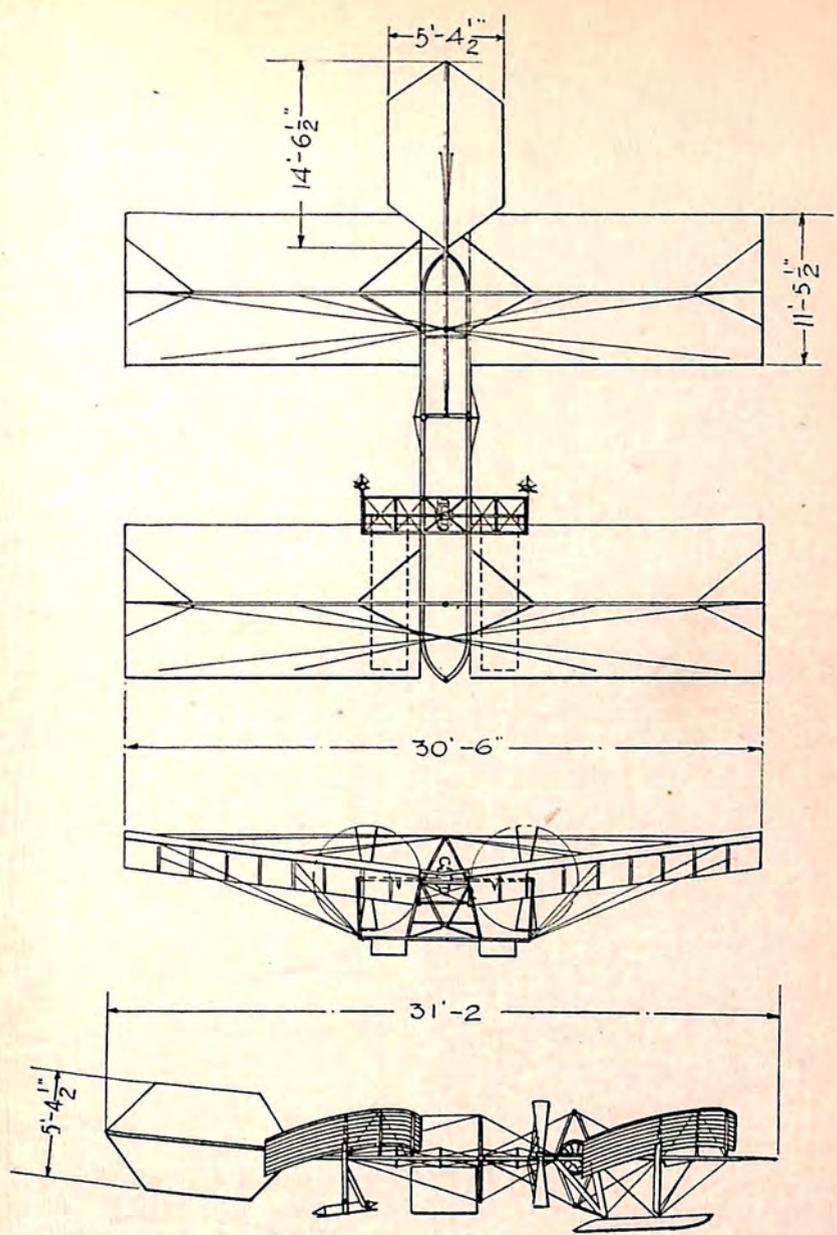


MAKING A LANDING WITH THE ORIGINAL GLIDER.



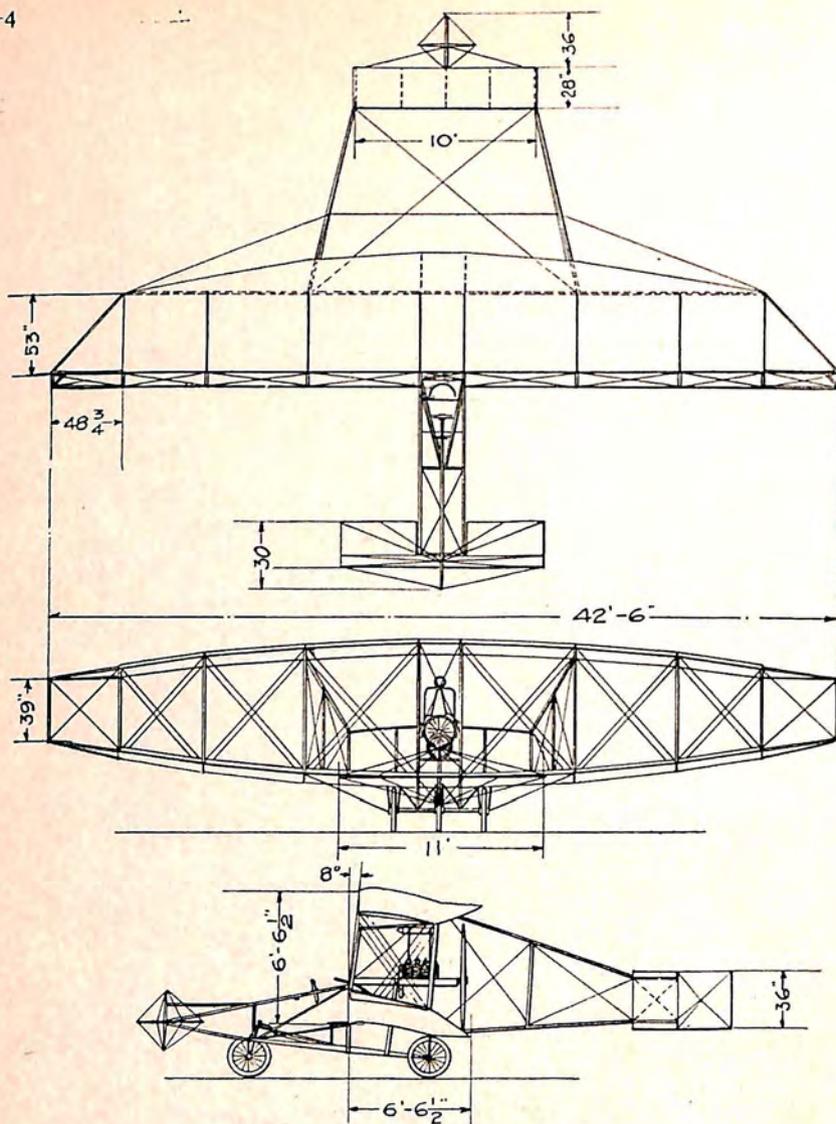
ORVILLE & WILBUR WRIGHT
 "KITTY HAWK" ORIGINAL WRIGHT BROS. BIPLANE-DEC.
 17, 1903- FIRST MACHINE TO MAKE SUCCESSFUL FLIGHT
 WRIGHT BROS 12 H.P. MOTOR.

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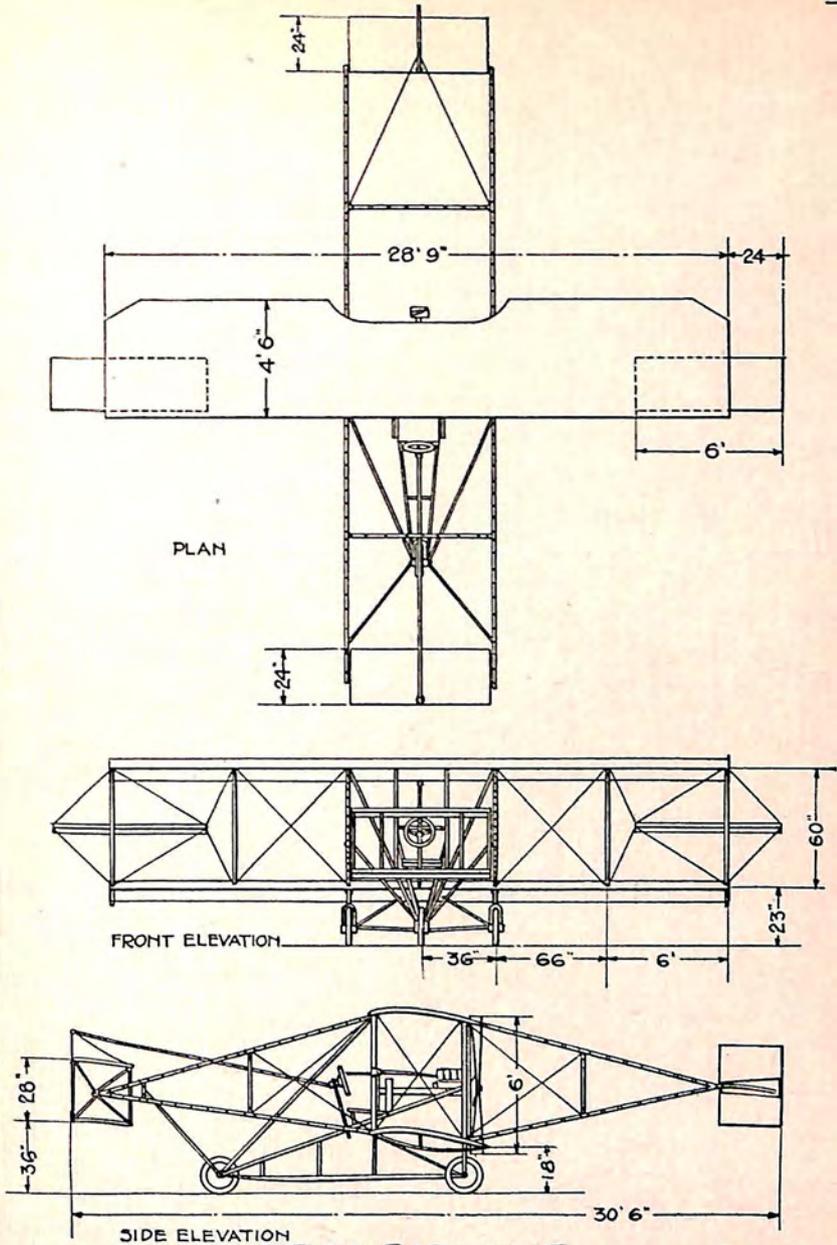
LANGLEY AERODROME

BUILT BY PROF. SAMUEL PIERPONT LANGLEY, OF SMITHSONIAN INSTITUTION, IN 1903 - NOT FLOWN UNTIL AFTER HIS DEATH WHEN GLENN H. CURTISS ATTACHED PONTOONS AND TOOK IT UP AT LAKE KEUKA N.Y. MAY 28, 1914



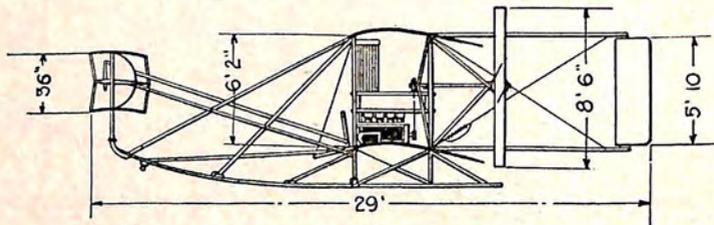
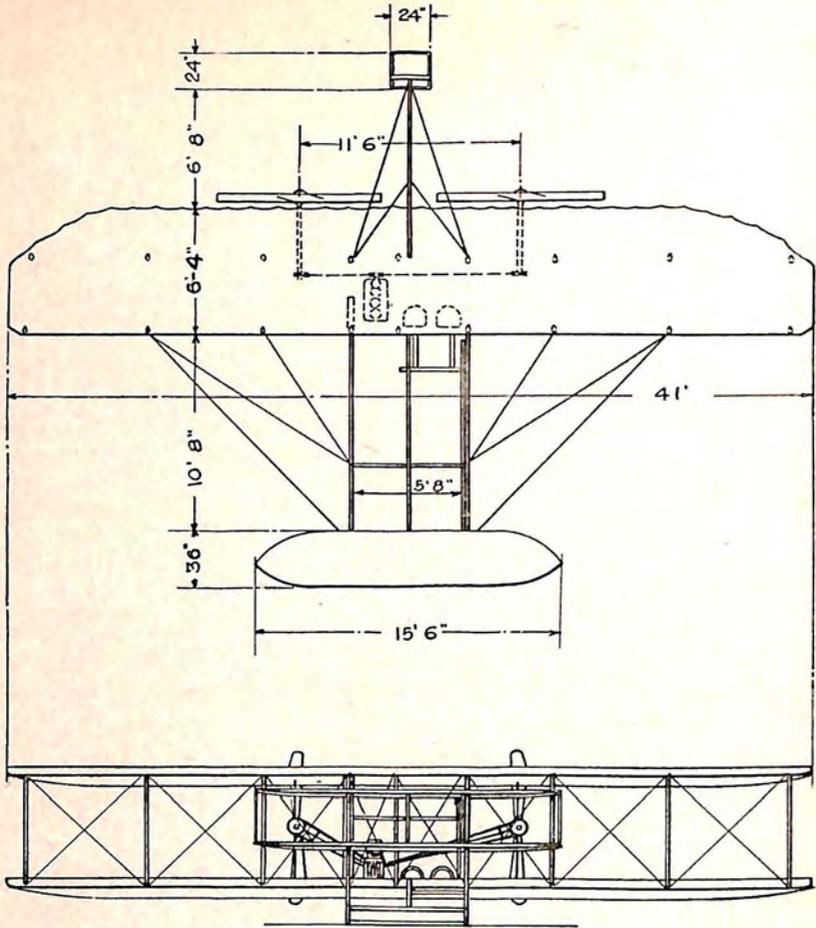
"JUNE BUG"

THE FIRST MACHINE IN AMERICA TO MAKE A PREVIOUSLY ANNOUNCED PUBLIC FLIGHT-WINNER OF SCIENTIFIC AMERICAN TROPHY FOR FLIGHT OF 1. Km., JULY 4, 1908. DESIGNED BY DR. A. G. BELL, LT. SELFRIDGE, F. W. BALDWIN, J. A. MURPHY & G. H. CURTISS-AERIAL EXPERIMENT ASSOCIATION. CURTISS 8 CYL. AIR COOLED MOTOR.

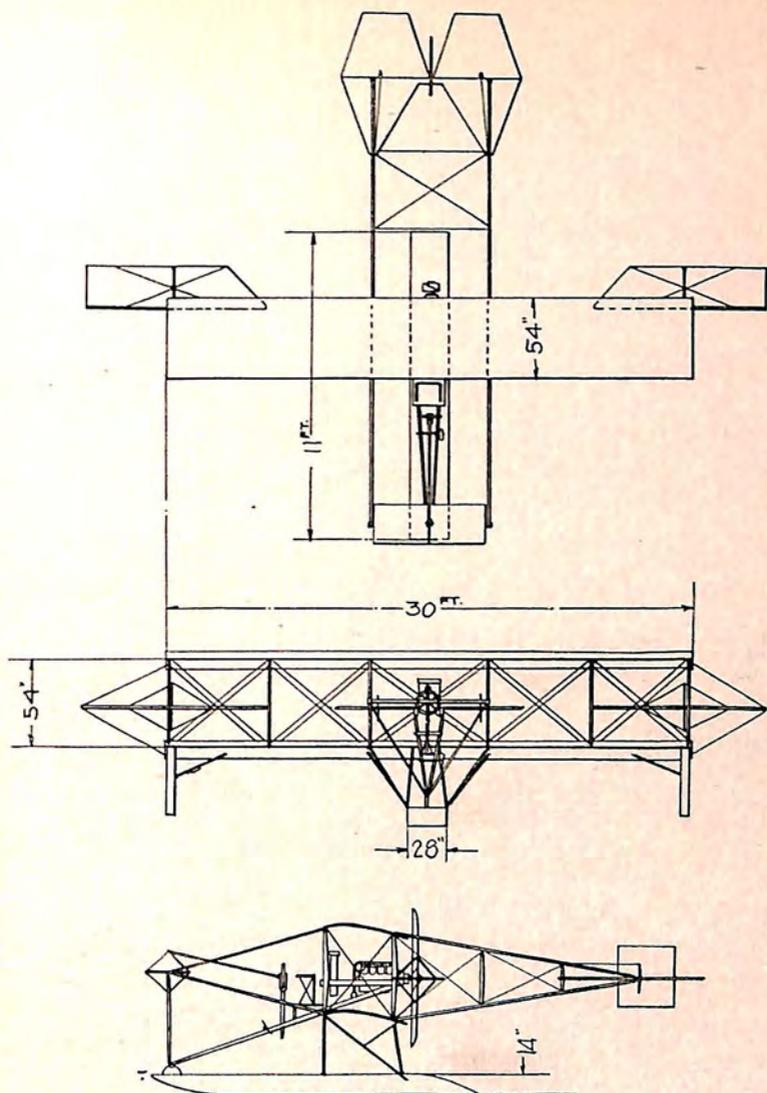


CURTISS BIPLANE

THE FIRST WINNER OF GORDON-BENNETT SPEED TROPHY 46 1/2 M.P.H. AT RHEIMS, FRANCE AUG. 29, 1909. DESIGNED AND FLOWN BY G. H. CURTISS—CURTISS 8 CYL. 50 H.P. WATER COOLED MOTOR.

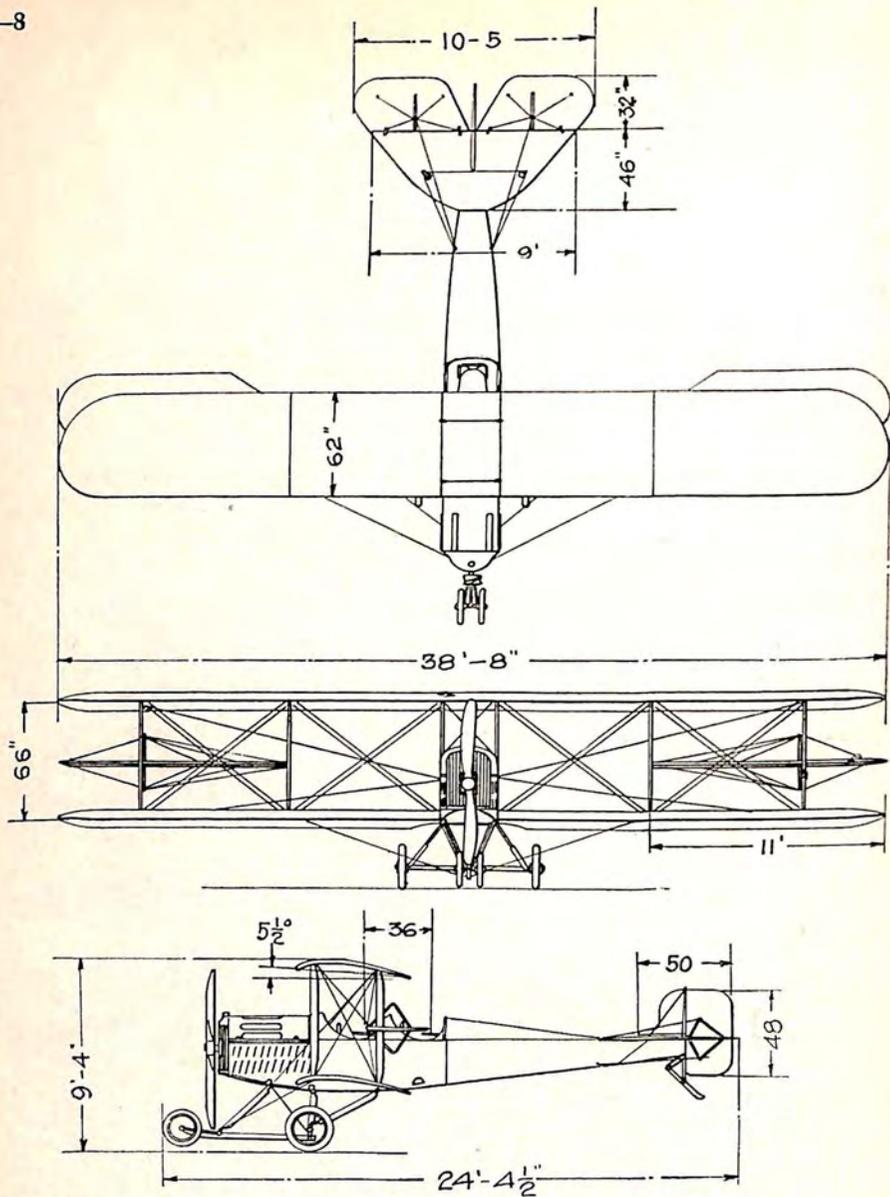


ORVILLE & WILBUR WRIGHT
EARLY WRIGHT BIPLANE MODEL "B"—FLOWN
AT FORT MYER VA. SEPT. 9, 1909



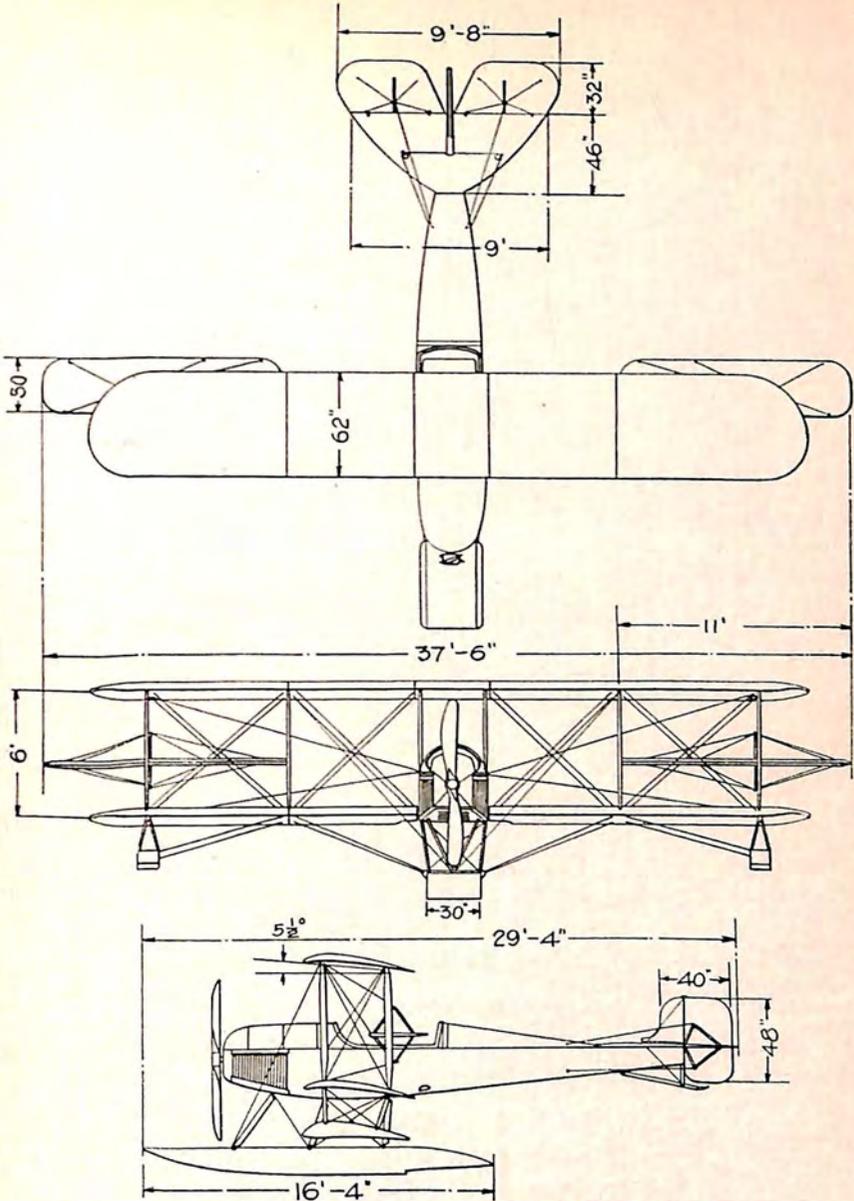
CURTISS SEAPLANE
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EXPERIMENTAL MODEL BUILT IN 1910 - FIRST SUCCESSFUL FLIGHT JAN. 1911 - DEMONSTRATIONS TO ARMY & NAVY & MANY PUBLIC FLIGHTS IN JAN. & FEB. 1911.

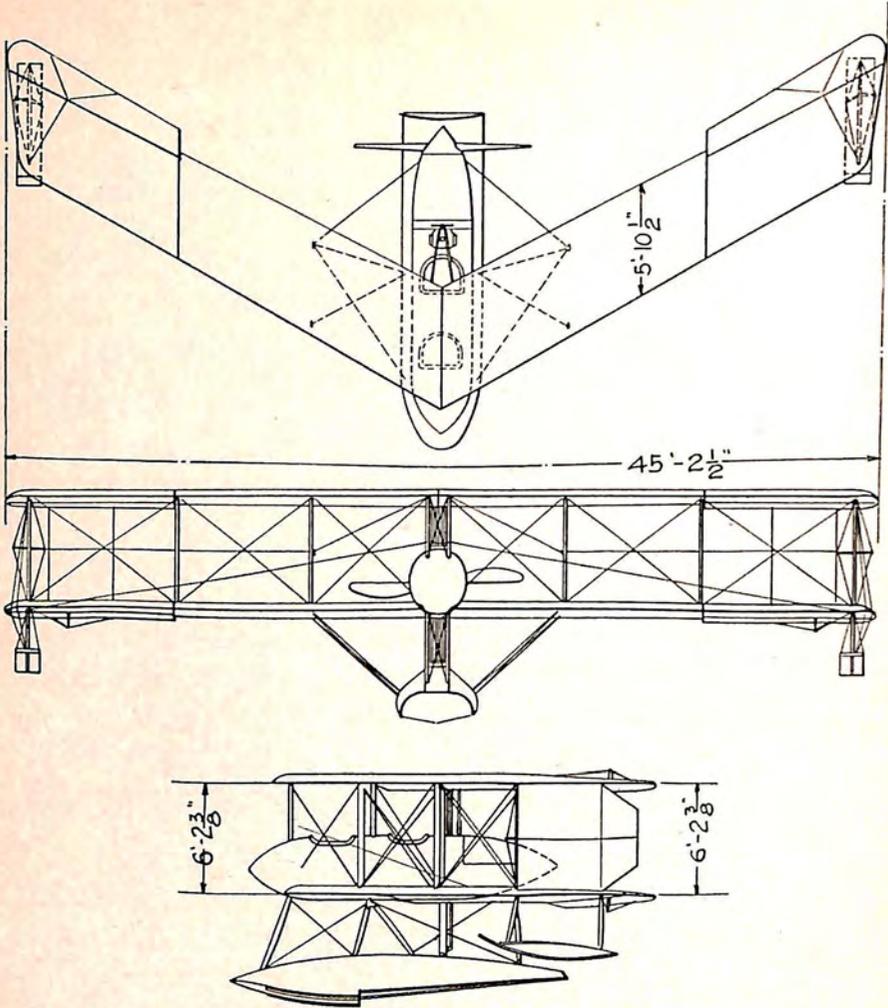


THE GLENN L. MARTIN COMPANY
CLEVELAND, OHIO.

MODEL "TT" 1913 - CURTIS 50 X 2" 80 H.P. 100 M.P.H.
TRAINING PLANE IN WHICH MANY OLDER U.S. AIR
SERVICE OFFICERS RECEIVED INSTRUCTION

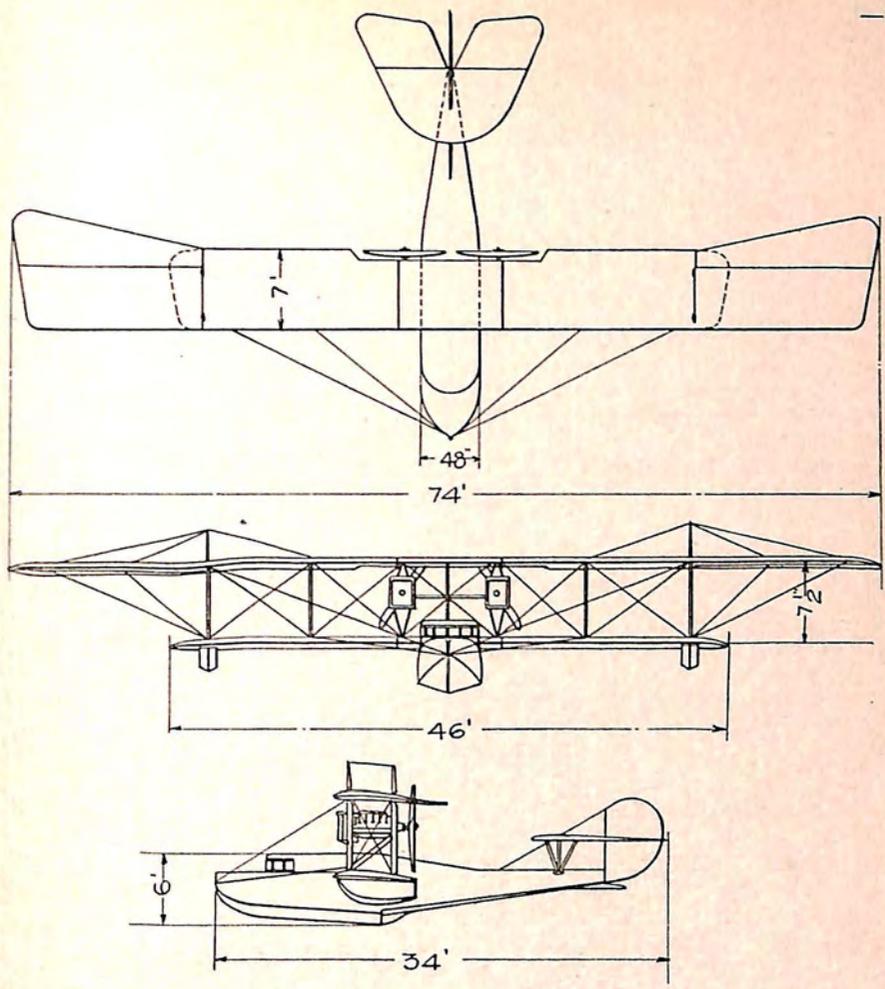


THE GLENN L. MARTIN COMPANY
CLEVELAND, OHIO.
MODEL "T.T." HYDROAIRPLANE-1913- CURTISS 80 H.P. OX. MOTOR
65 M.P.H. WON CURTISS MARINE TROPHY

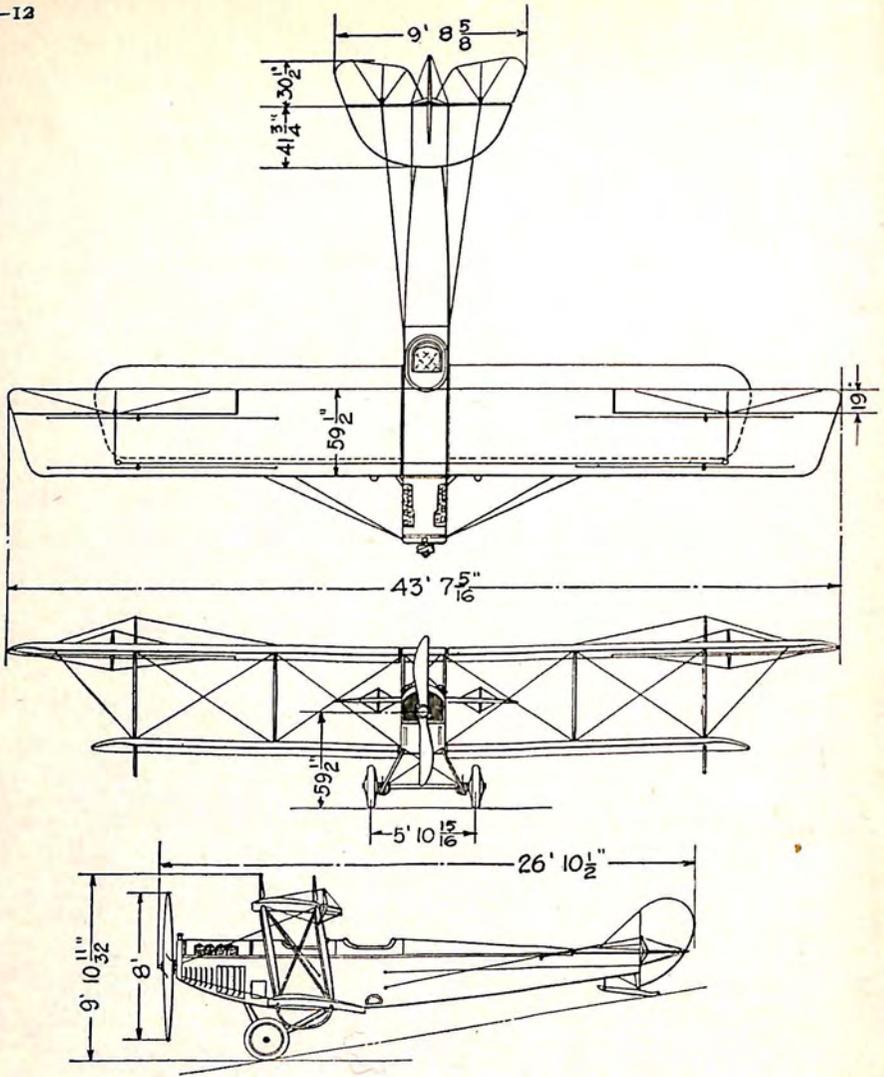


THE BURGESS COMPANY
MARBLEHEAD, MASS.

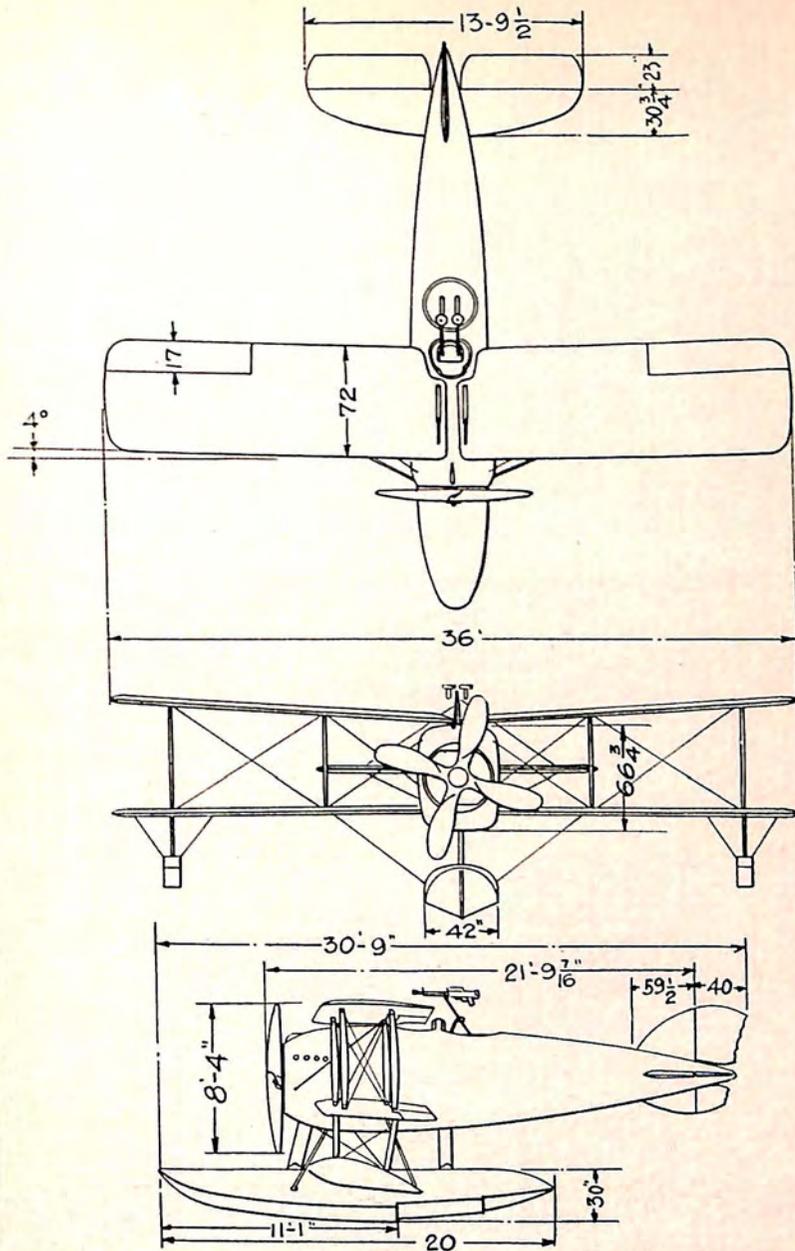
BURGESS-DUNNE SEAPLANE 1914-CURTISS VX
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U.S. NAVY.



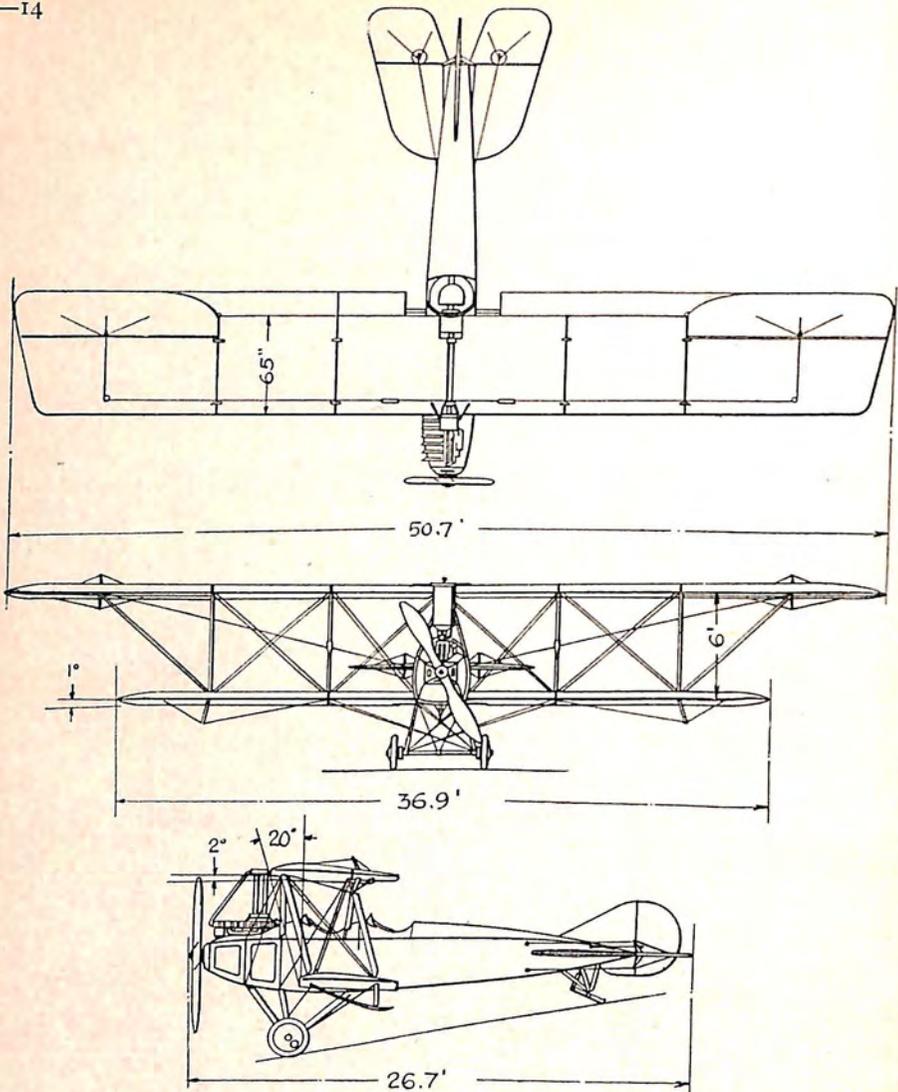
THE CURTISS AEROPLANE COMPANY
HAMMONDS PORT, N.Y.
FLYING BOAT "AMERICA" 1914-2 CURTISS "OX. 90"
H.P. MOTORS



THE CURTISS AEROPLANE AND MOTOR CORPORATION
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MODEL JN-4 'JENNIE' - 1916 - 8 CYL. MOTOR 'OX-5' 90 H.P. - 70 M.P.H.

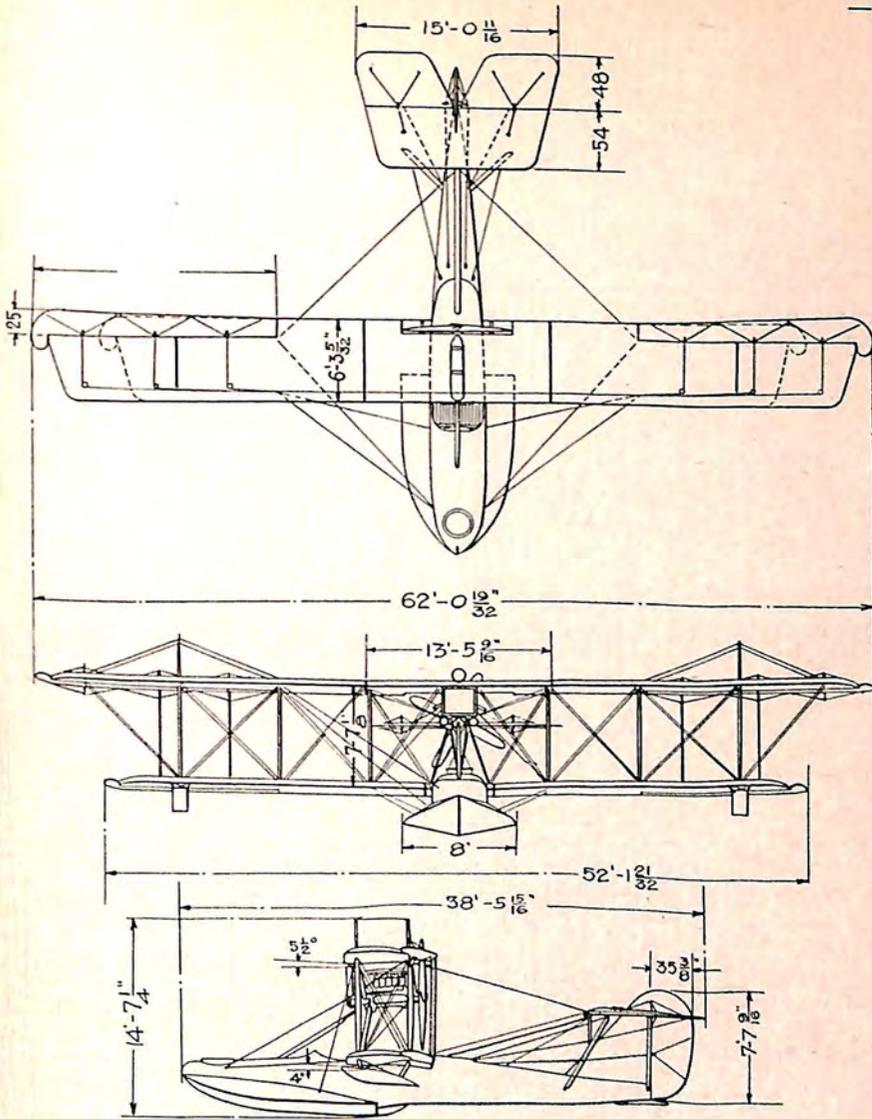


THE CURTISS AEROPLANE AND MOTOR CORPORATION
GARDEN CITY, L.I.N.Y.
MODEL "H.A." NAVY BATTLE PLANE-1916-LIBERTY 12 CYL. 400
H.P. MOTOR-130 M.P.H.

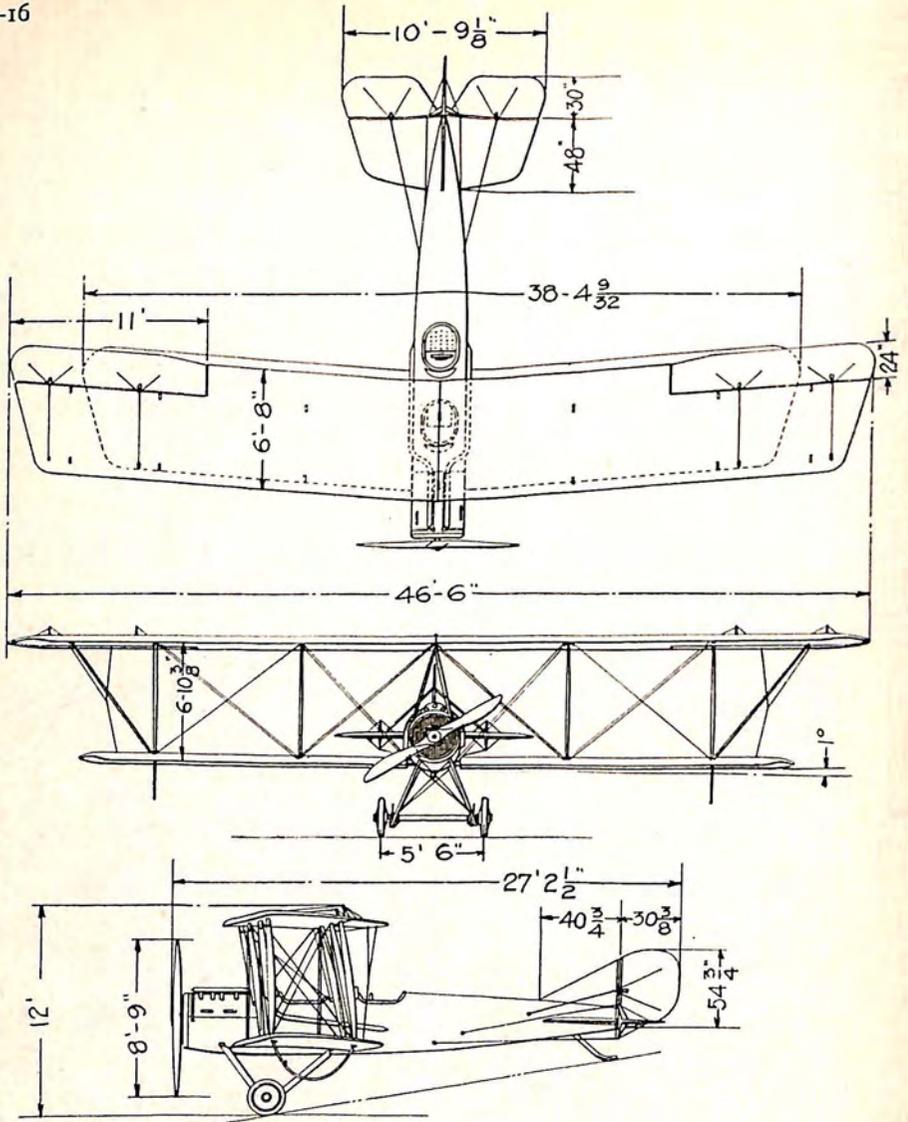


THE GLENN L. MARTIN COMPANY
CLEVELAND, OHIO.

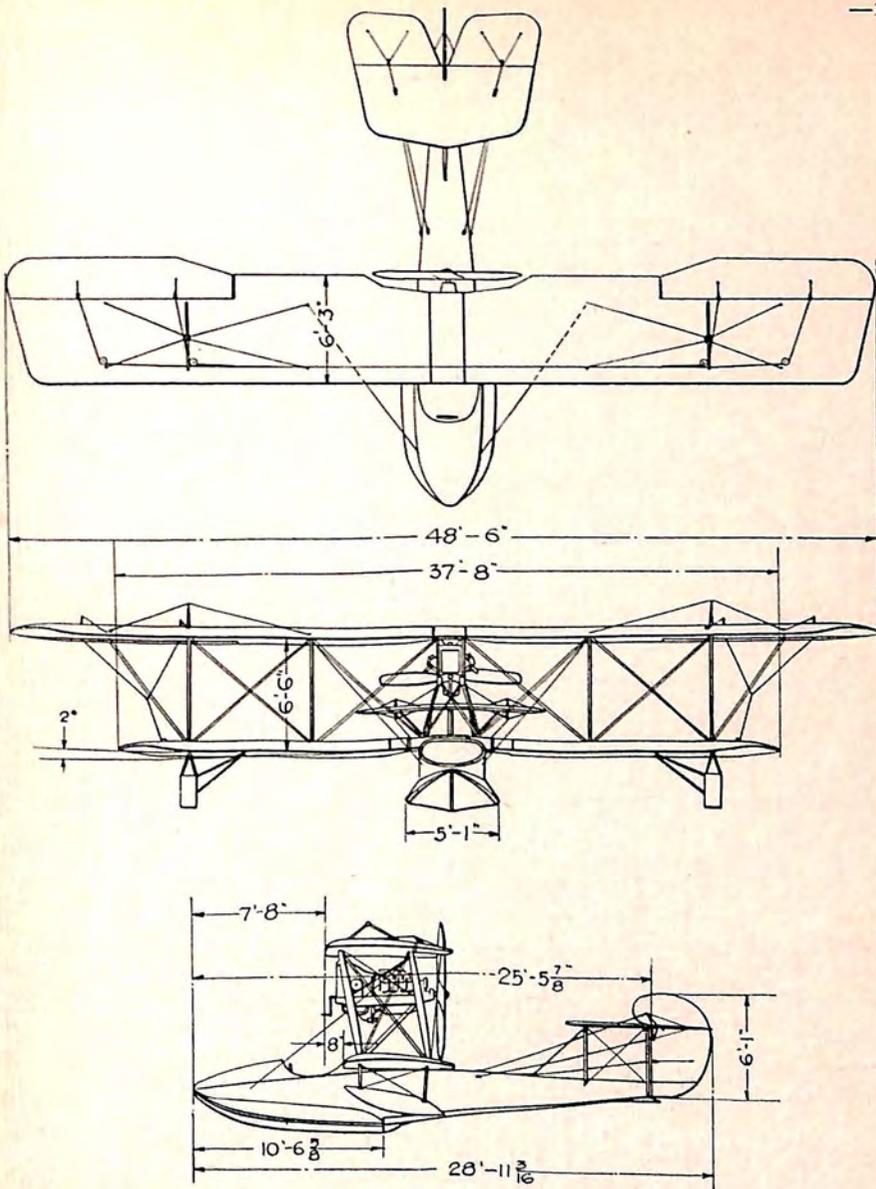
MODEL "R" 1916 - HALL-SCOTT A.5-A 150 H.P. MOTOR
88 M.P.H.



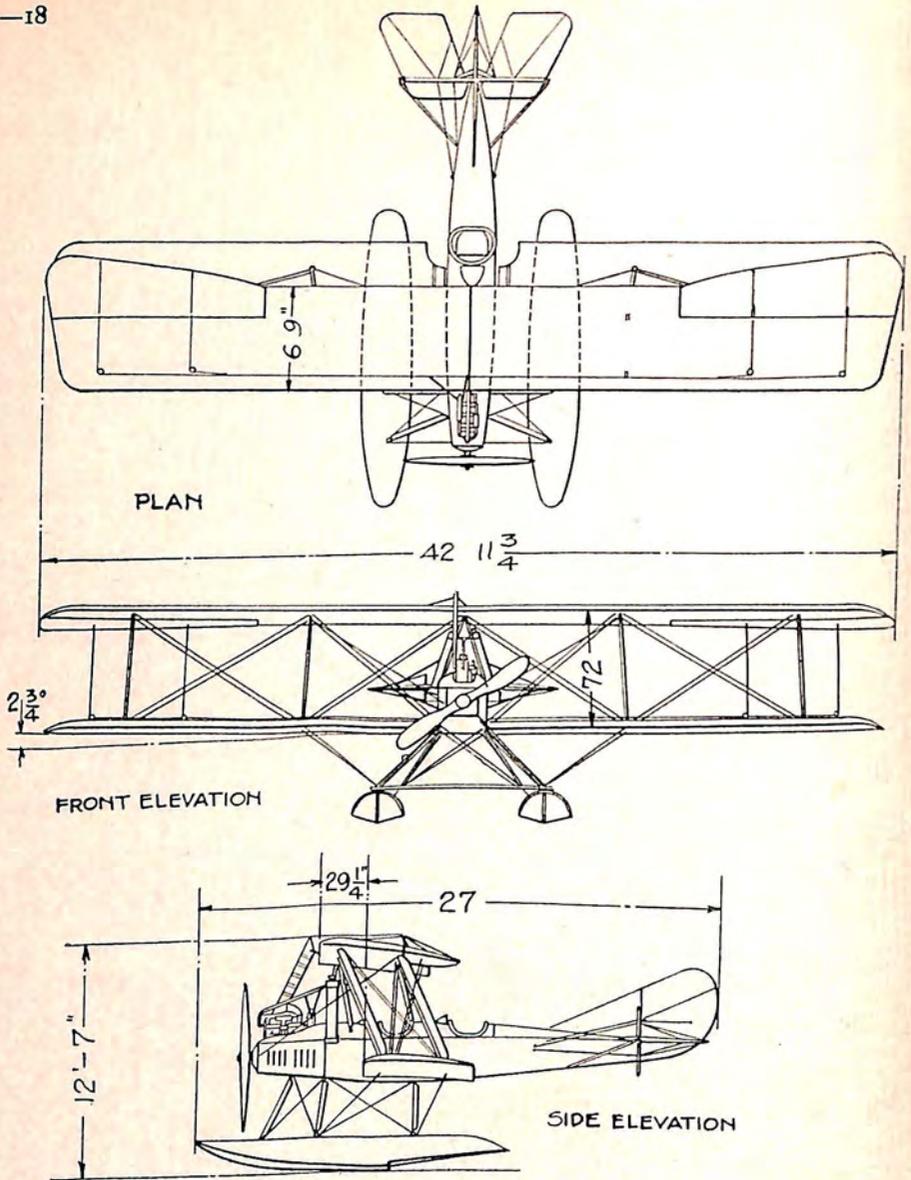
THE CURTISS AEROPLANE & MOTOR CORPORATION
GARDEN CITY L.I.N.Y.
MODEL H.5.1-L.1917 "LIBERTY 12" 400 H.P. MOTOR-80 M.P.H.



L.W.F. ENGINEERING COMPANY.
NEW YORK - COLLEGE POINT, L.I.N.Y.
MODEL "V" 1917 - THOMAS 8 CYL 135 H.P. MOTOR

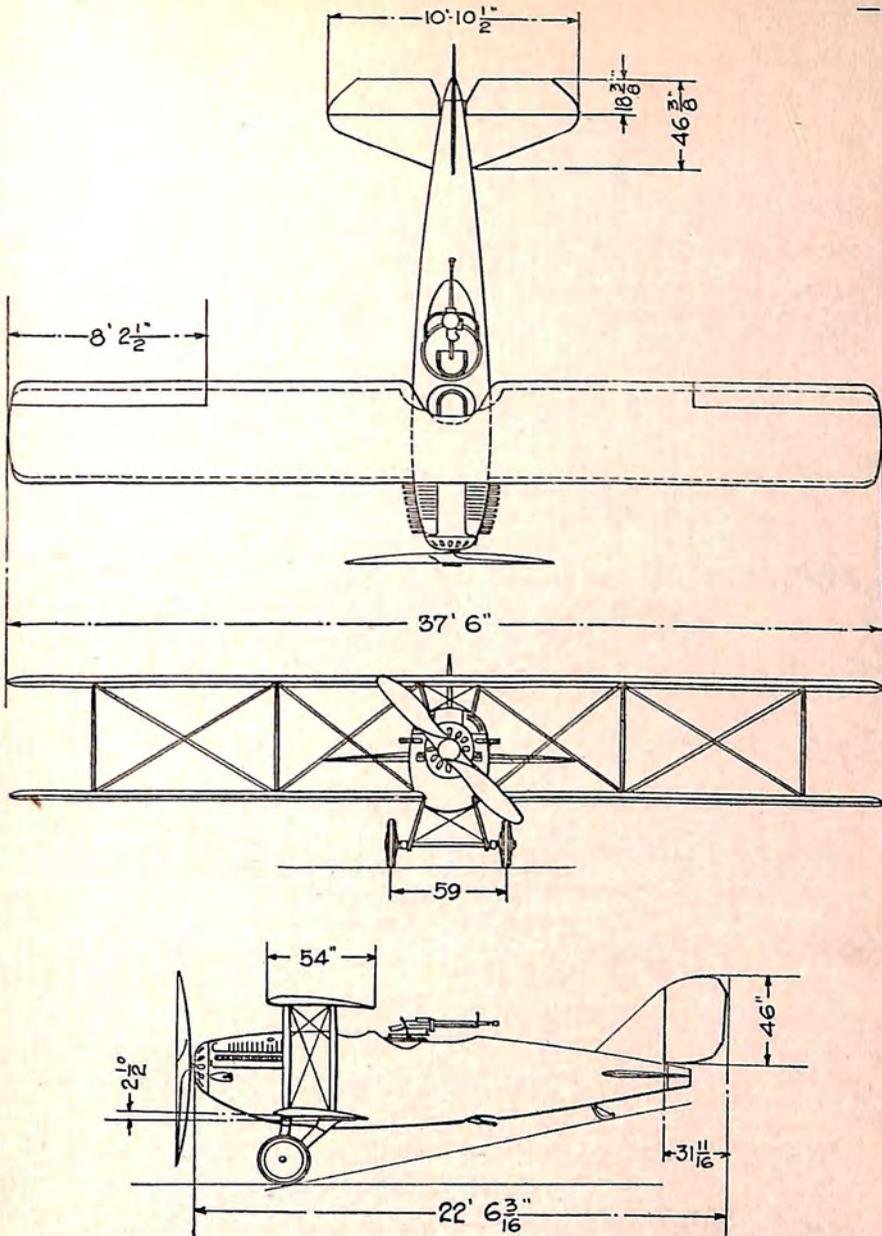


AEROMARINE PLANE & MOTOR COMPANY
KEYPORT, N. J.
MODEL "40-C"-1918-AEROMARINE "U-6. 150 H.P.
MOTOR 75 M.P.H.



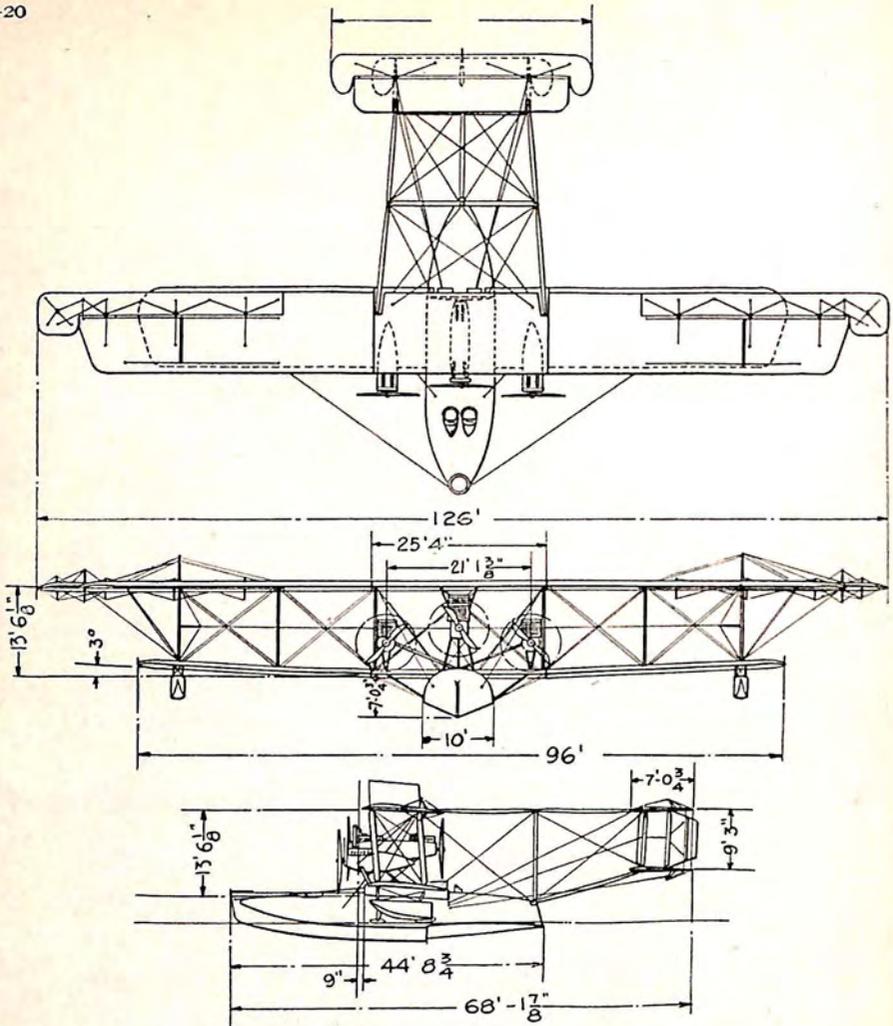
BOEING AIRPLANE COMPANY
SEATTLE, WASH.

MODEL "C" 1918-HALL-SCOTT "A.7-A" 4 CYL. MOTOR
100 H.P.-73 M.P.H.

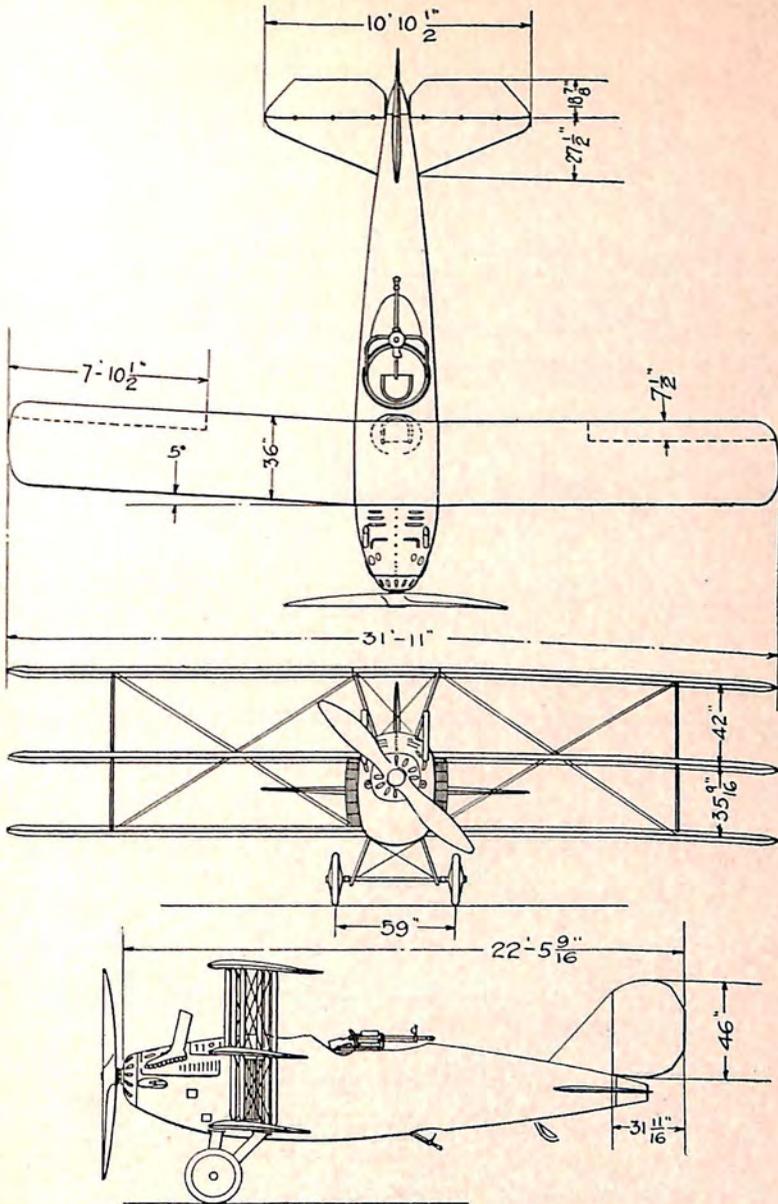


THE CURTISS AEROPLANE AND MOTOR CORPORATION
GARDEN CITY, L.I.N.Y.

THE CURTISS BATTLE PLANE "HORNET" 1918—CURTISS
"K-12" 400 H.P. MOTOR 162 M.P.H.

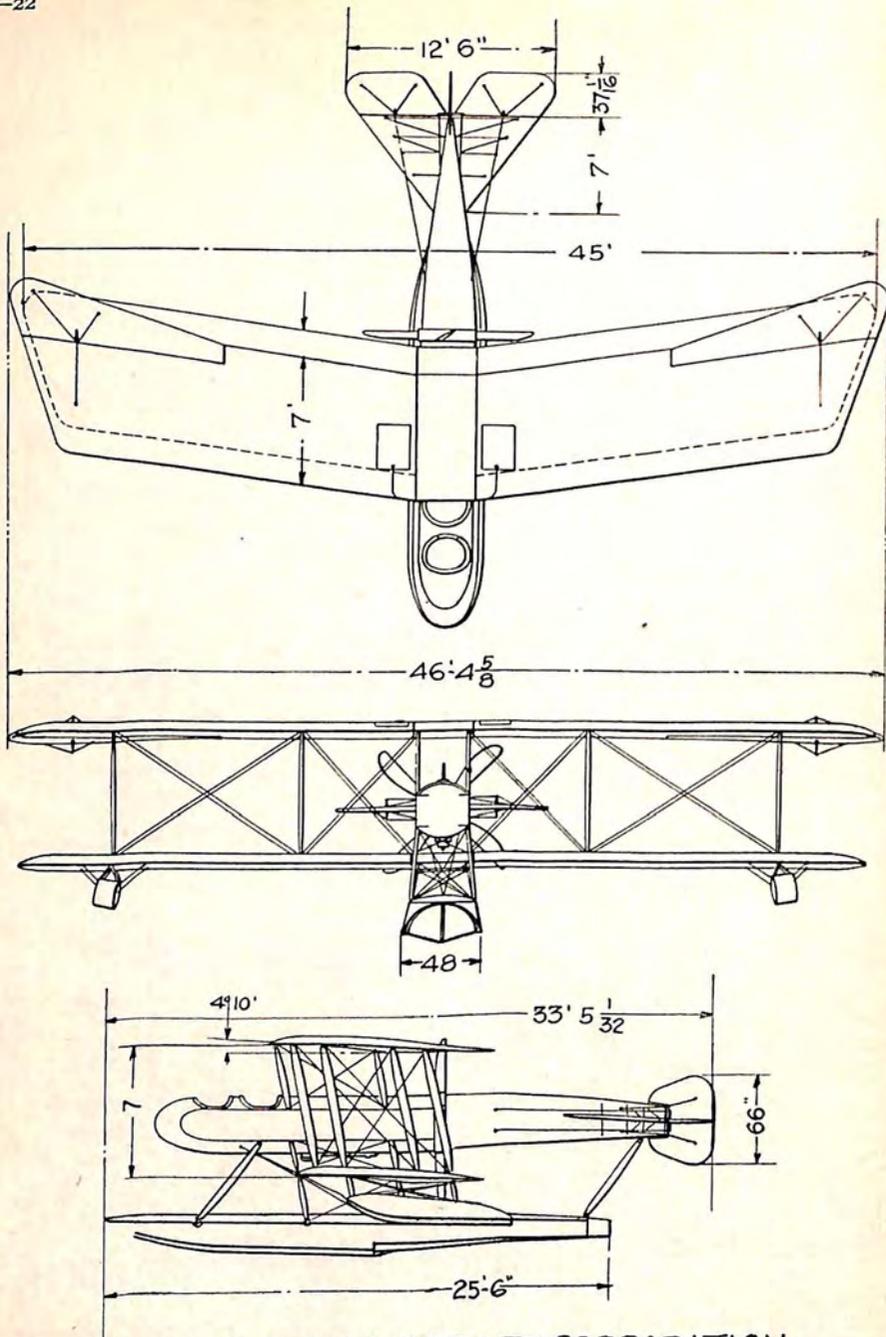


THE CURTISS AEROPLANE AND MOTOR CORPORATION
GARDEN CITY, L. I. N. Y.
MODEL N. C. 4-F-1919 - 4 LIBERTY 12 CYL. MOTORS 5-400 H. P. EACH.
95 M. P. H.
FIRST TO FLY ACROSS THE ATLANTIC.

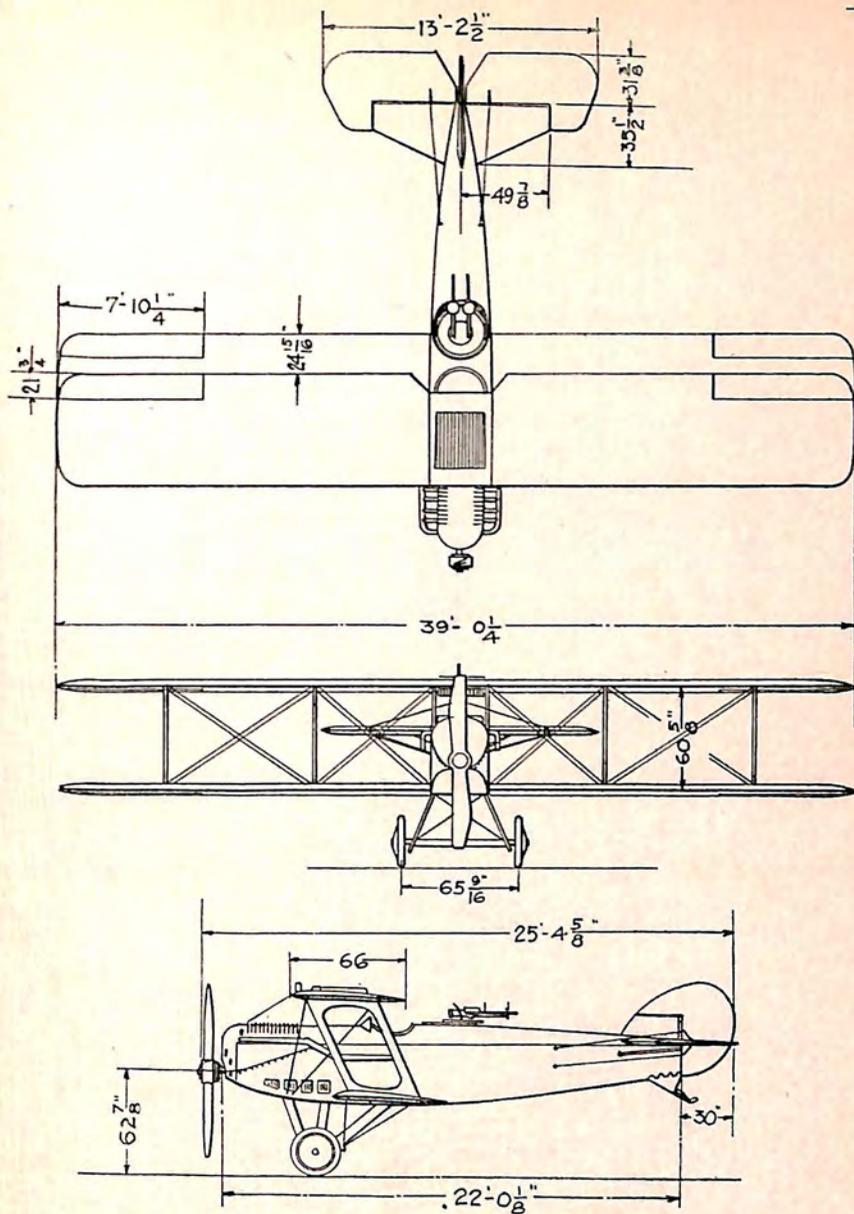


THE CURTISS AEROPLANE AND MOTOR CORPORATION.
GARDEN CITY, L.I.N.Y.

THE CURTISS BATTLE PLANE 'WASP' 1918-CURTISS
'K-12' 400 H.P. MOTOR-162 M.P.H.

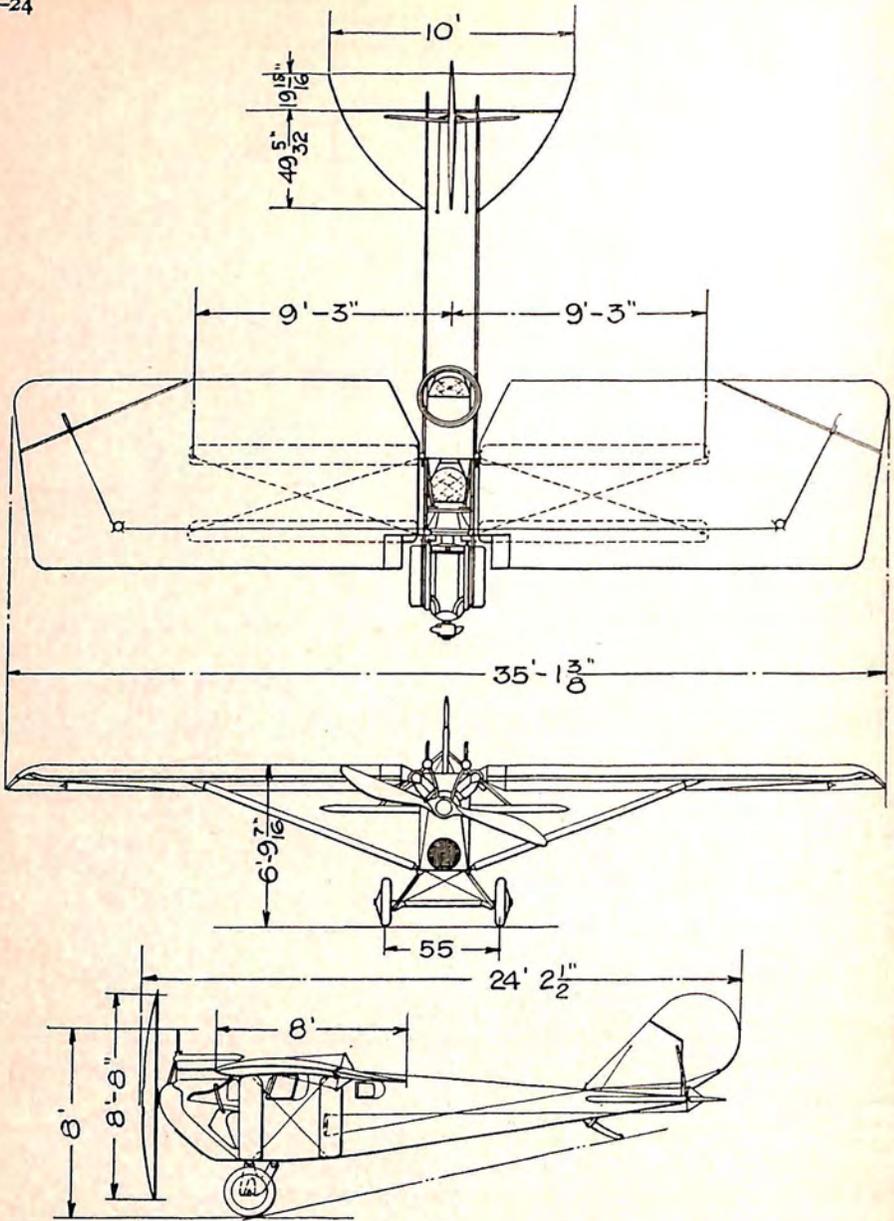


GALLAUDET AIRCRAFT CORPORATION
EAST GREENWICH, R. I.
MODEL "D-4" 1918-LIBERTY-12 400 H.P. MOTOR
126 M.P.H.



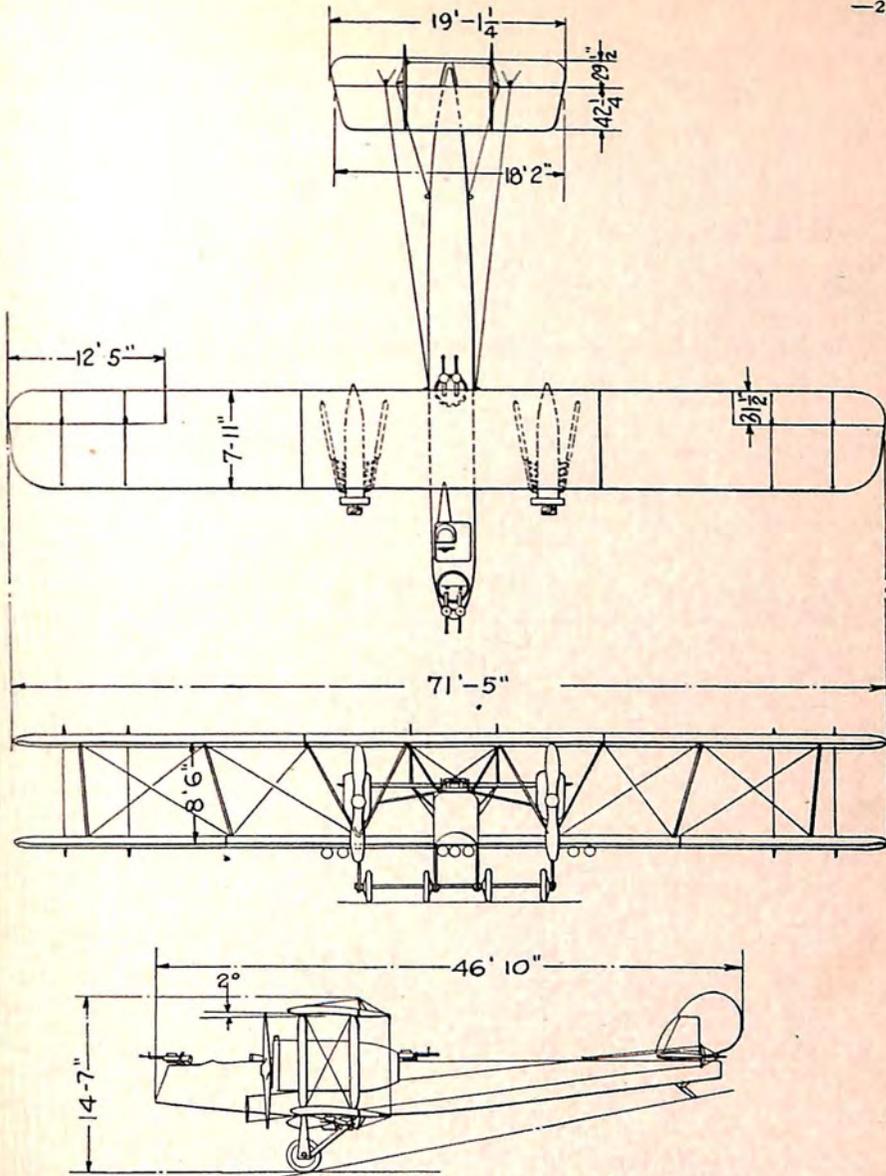
PACKARD MOTOR CAR COMPANY
DETROIT, MICH.

"PACKARD LEPERE"-1918 U.S. AIR SERVICE-"LIBERTY"
12" 400 H.P. MOTOR-136 M.P.H.



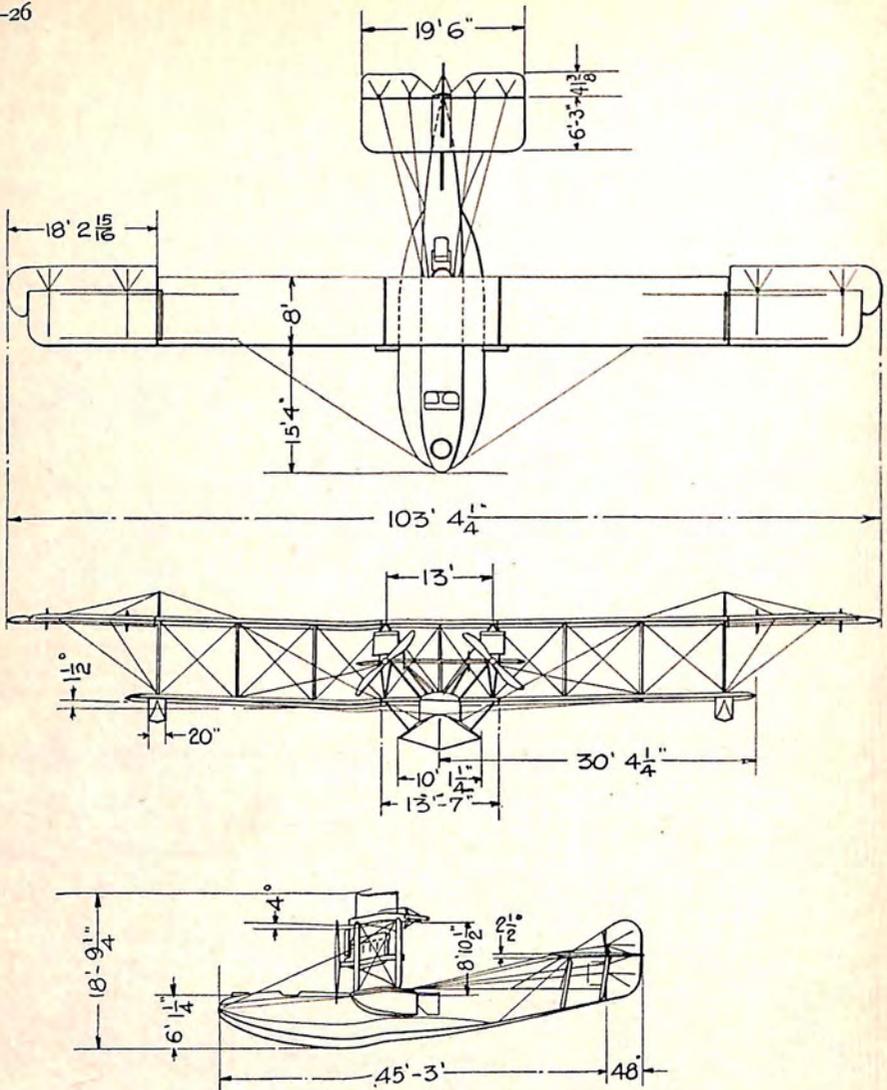
LOENING AERONAUTICAL ENGINEERING CORPORATION
NEW YORK CITY

MODEL M.8-0 OCT, 1918 - WRIGHT 8 CYL. MOTOR - 300 H.P.
151 M.P.H.

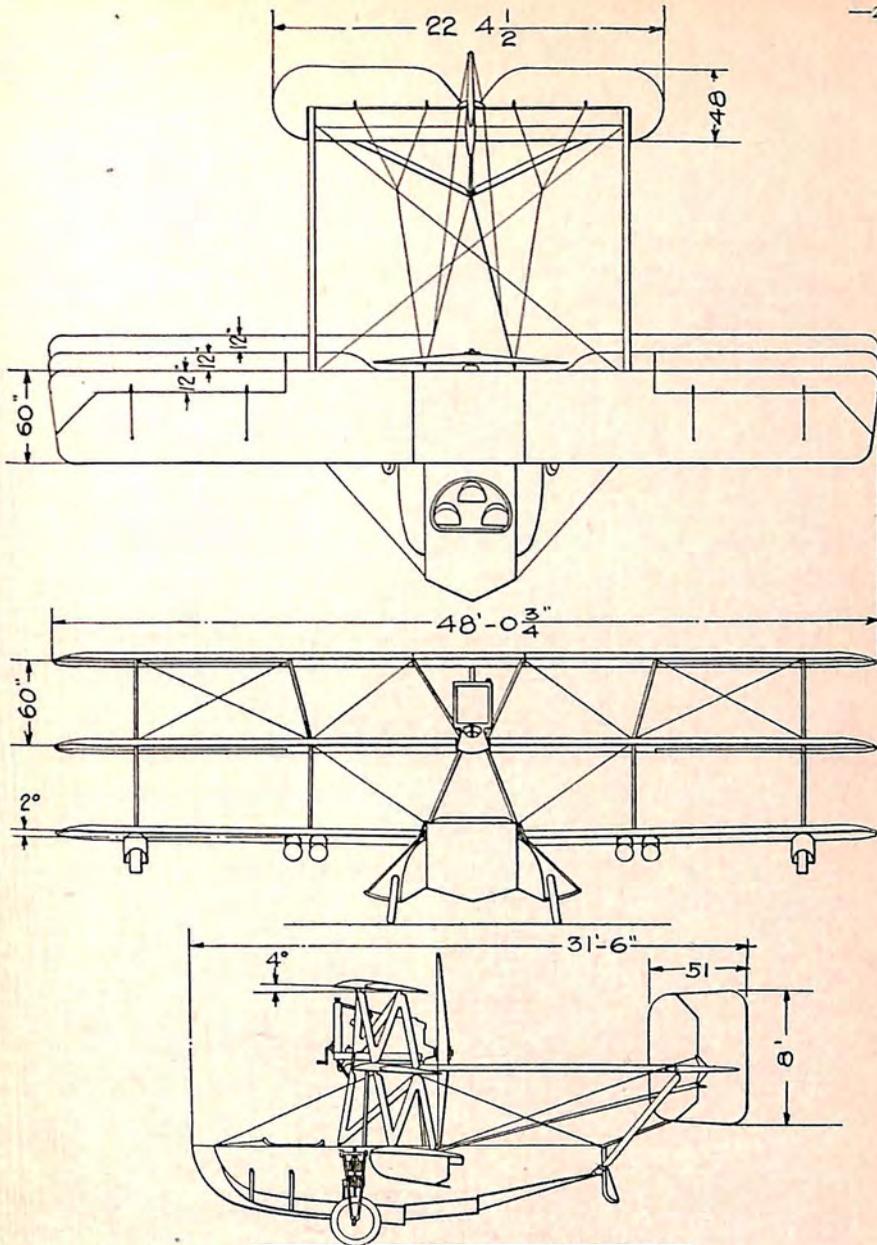


THE GLENN L. MARTIN COMPANY.
CLEVELAND, OHIO.

1918 "MARTIN BOMBER" U.S. AIR SERVICE
2-400 H.P. LIBERTY-12 MOTORS 118 M.P.H.

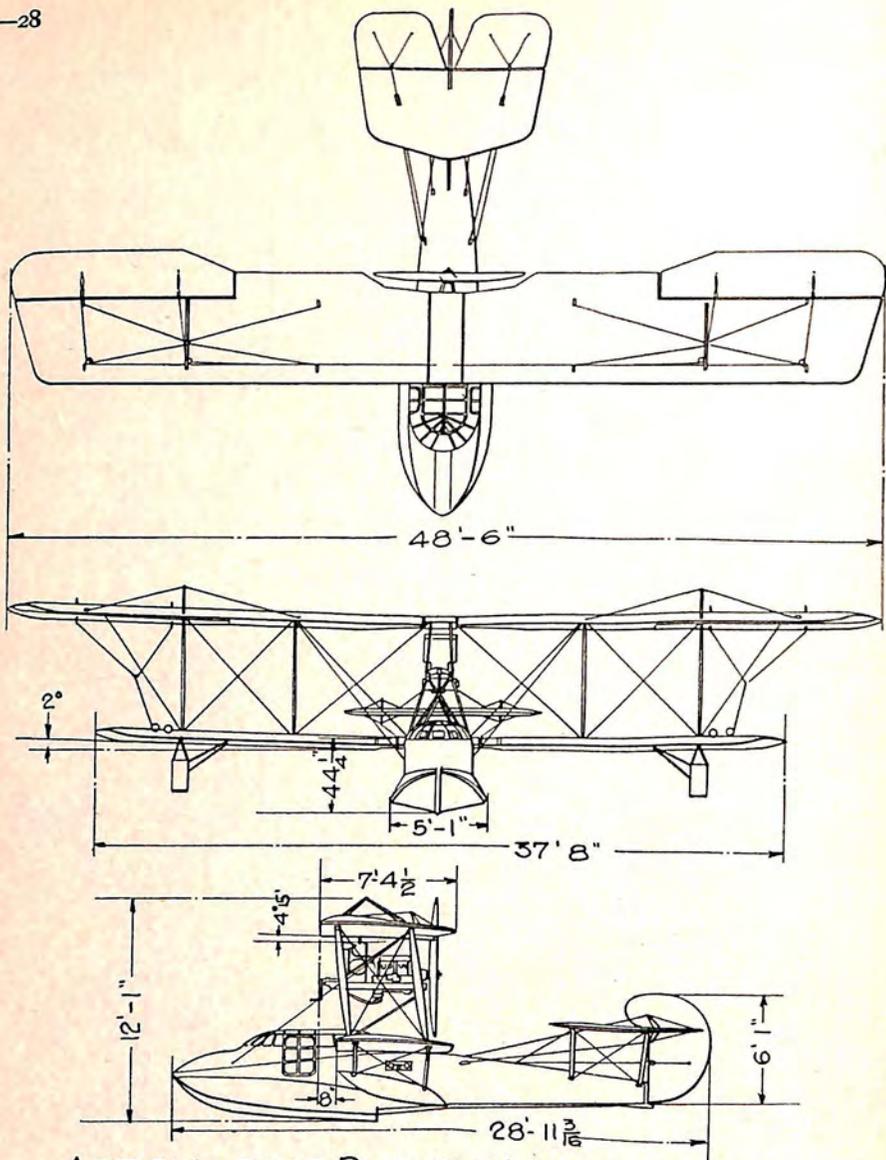


NAVAL AIRCRAFT
BUREAU OF CONSTRUCTION AND REPAIR
MODEL "F.5-L" 1918-2 LIBERTY 12 330(EACH) H.P.
MOTOR 90 M.P.H.

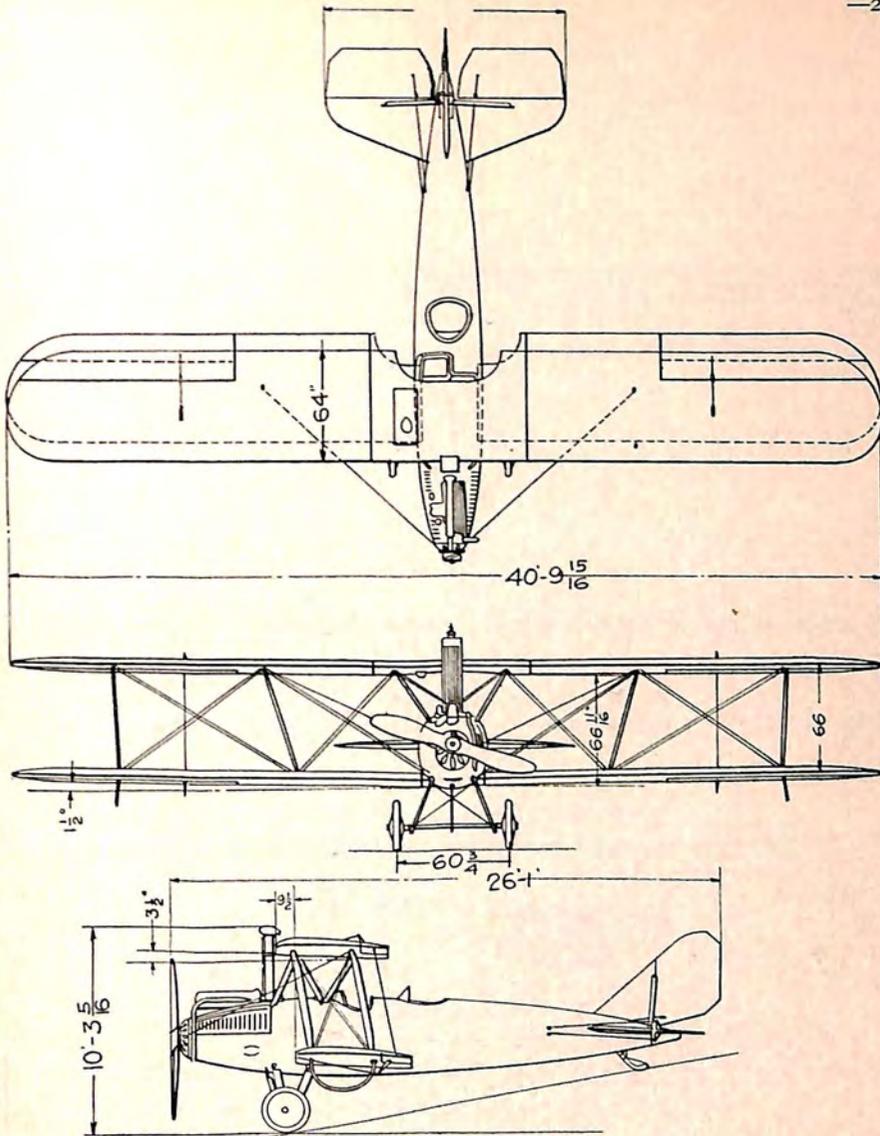


SPERRY AIRCRAFT CORPORATION
FARMINGDALE, L.I. N.Y.

"AMPHIBIAN" OCT. 1918 - LIBERTY 12 CYL. MOTOR - 370 H.P. 85 M.P.H.

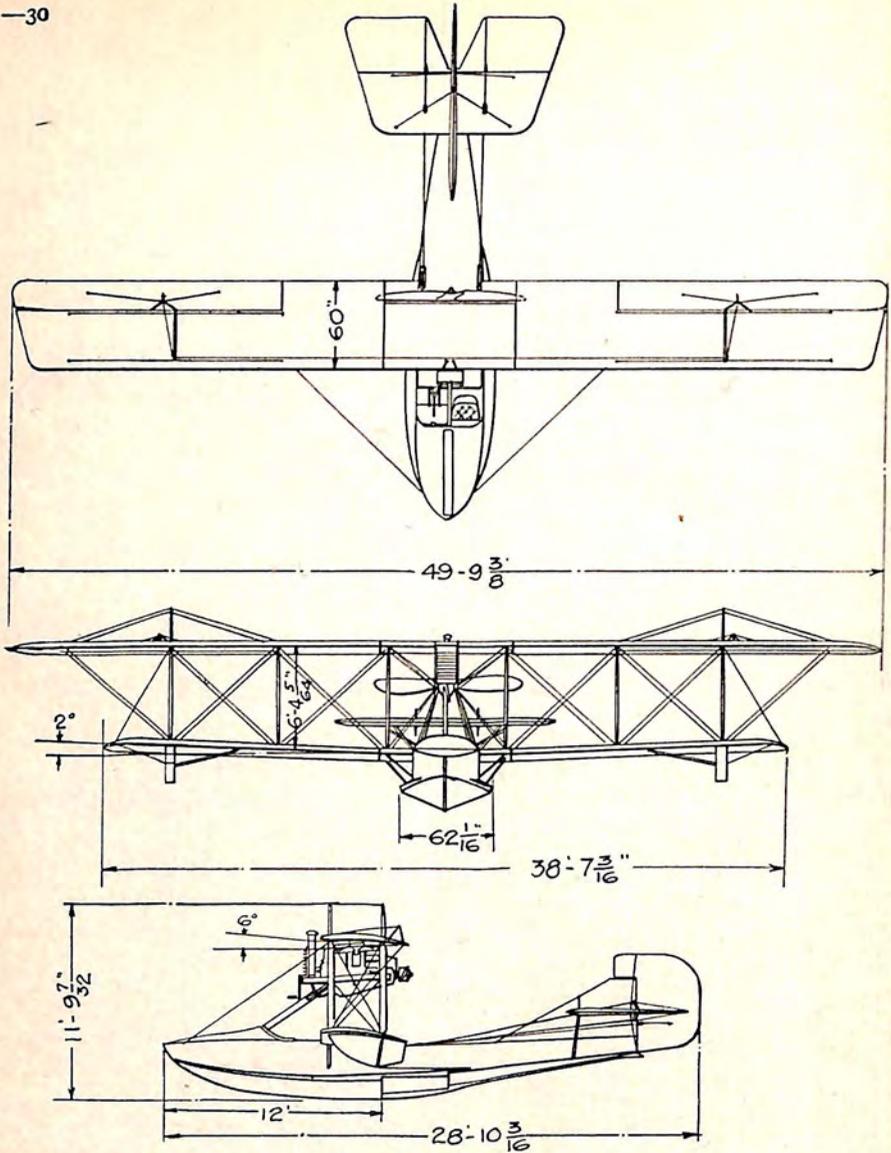


AEROMARINE PLANE & MOTOR COMPANY
KEYPORT N.J.
MODEL "50.B-2" 1919-AEROMARINE "U-8" 180 H.P.
(RATED) 200 H.P. (DELIVERED) 85 M.P.H.

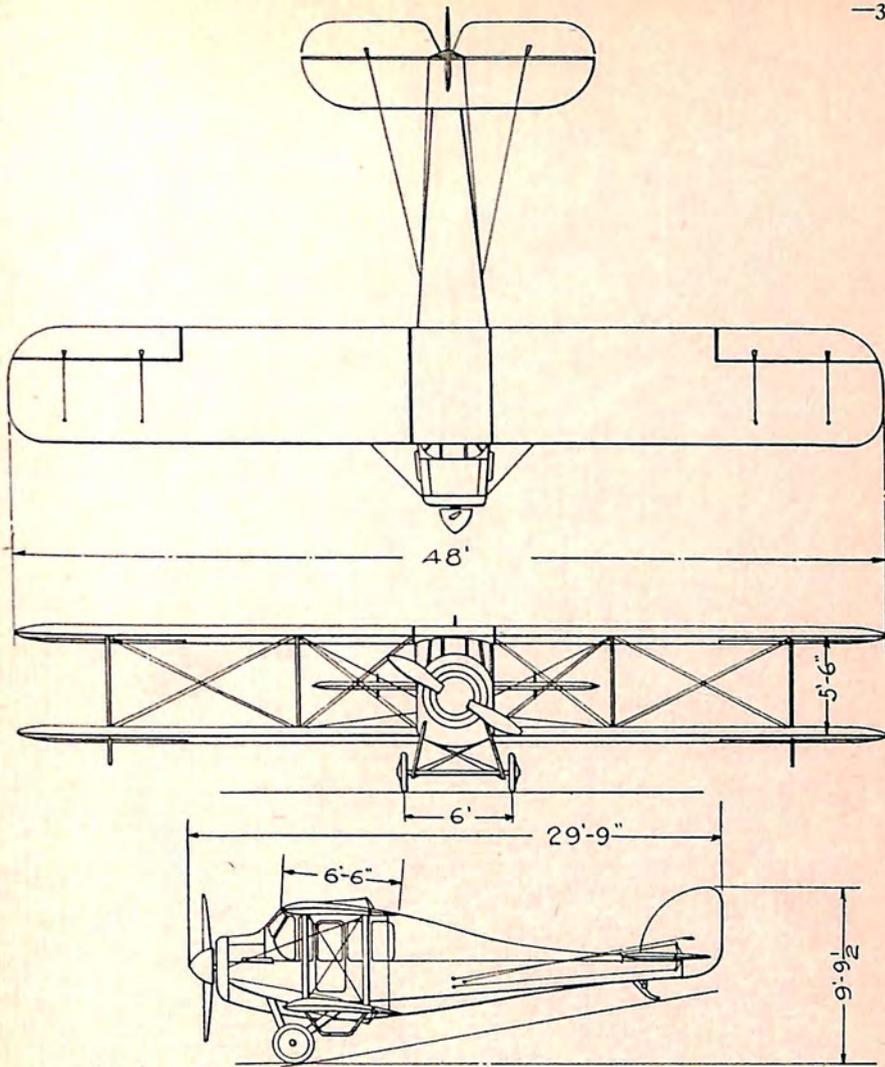


THE CURTISS AEROPLANE AND MOTOR CORPORATION
GARDEN CITY, L.I.N.Y.

THE CURTISS "ORIOLE" 1919 - CURTISS "C6" 6 CYL. 150
H.P. MOTOR - 96 M.P.H.

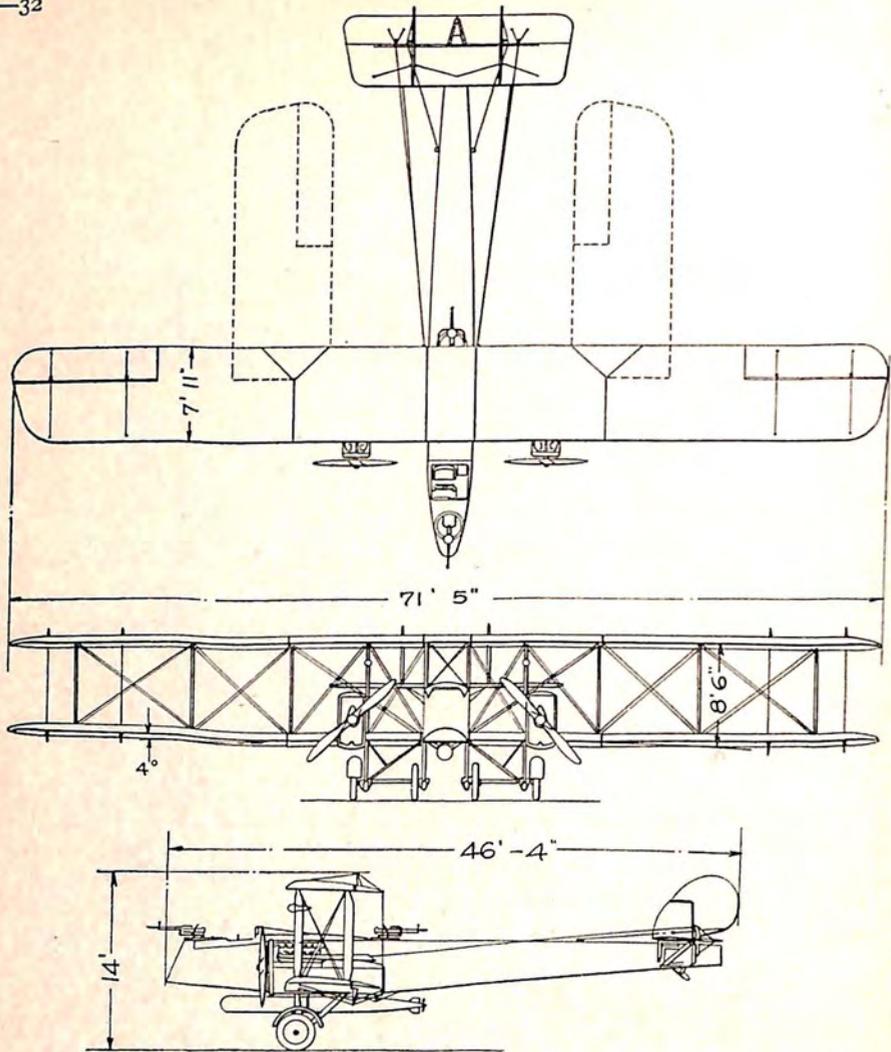


THE CURTISS AEROPLANE AND MOTOR CORPORATION
GARDEN CTY L.I.N.Y.
CURTISS "SEAGULL" 1919-CURTISS "G6" 150 H.P. MOTOR 76 M.P.H.

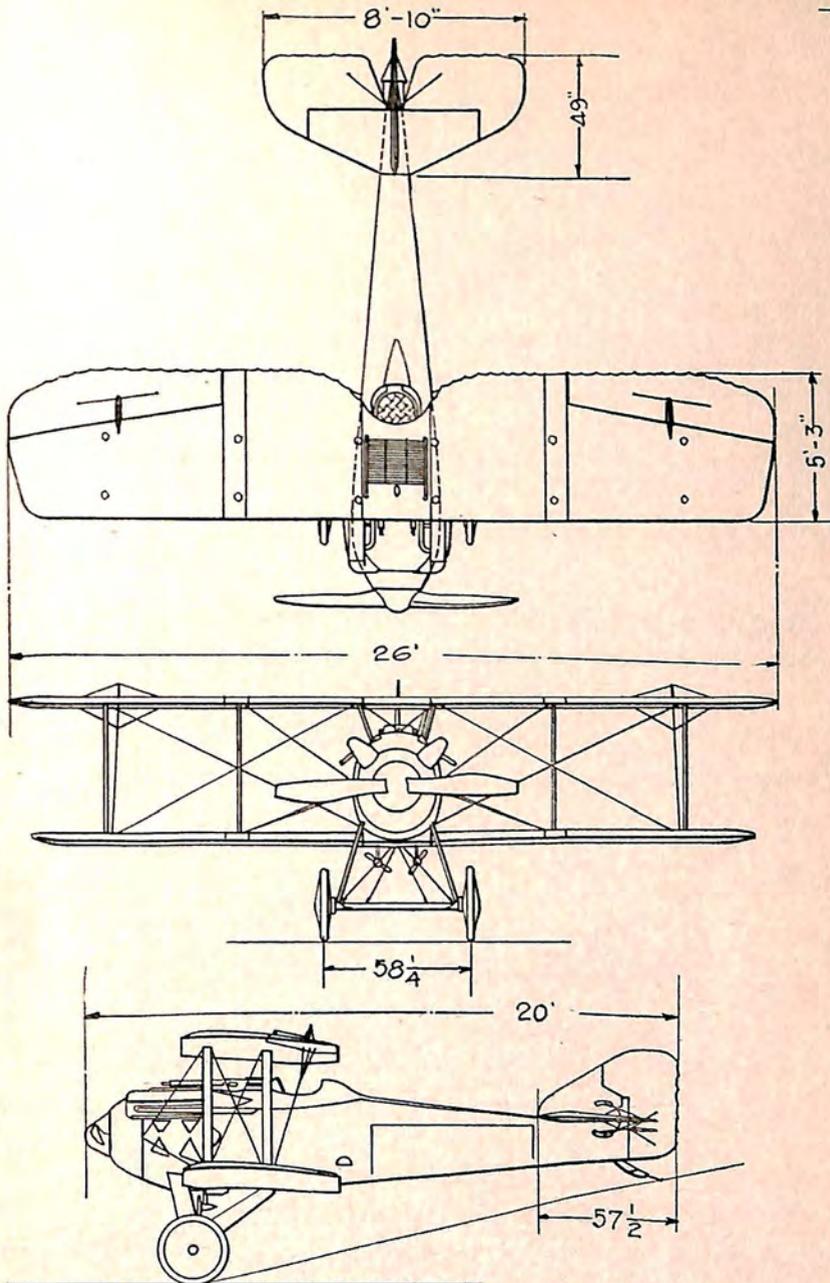


DAYTON WRIGHT COMPANY
DAYTON, OHIO.

MODEL "O.W." 3 PLACE "AERIAL COUPE" - 1919 - WRIGHT
MOD. "E" 8 CYL. 180 H.P. MOTOR 102 M.P.H.

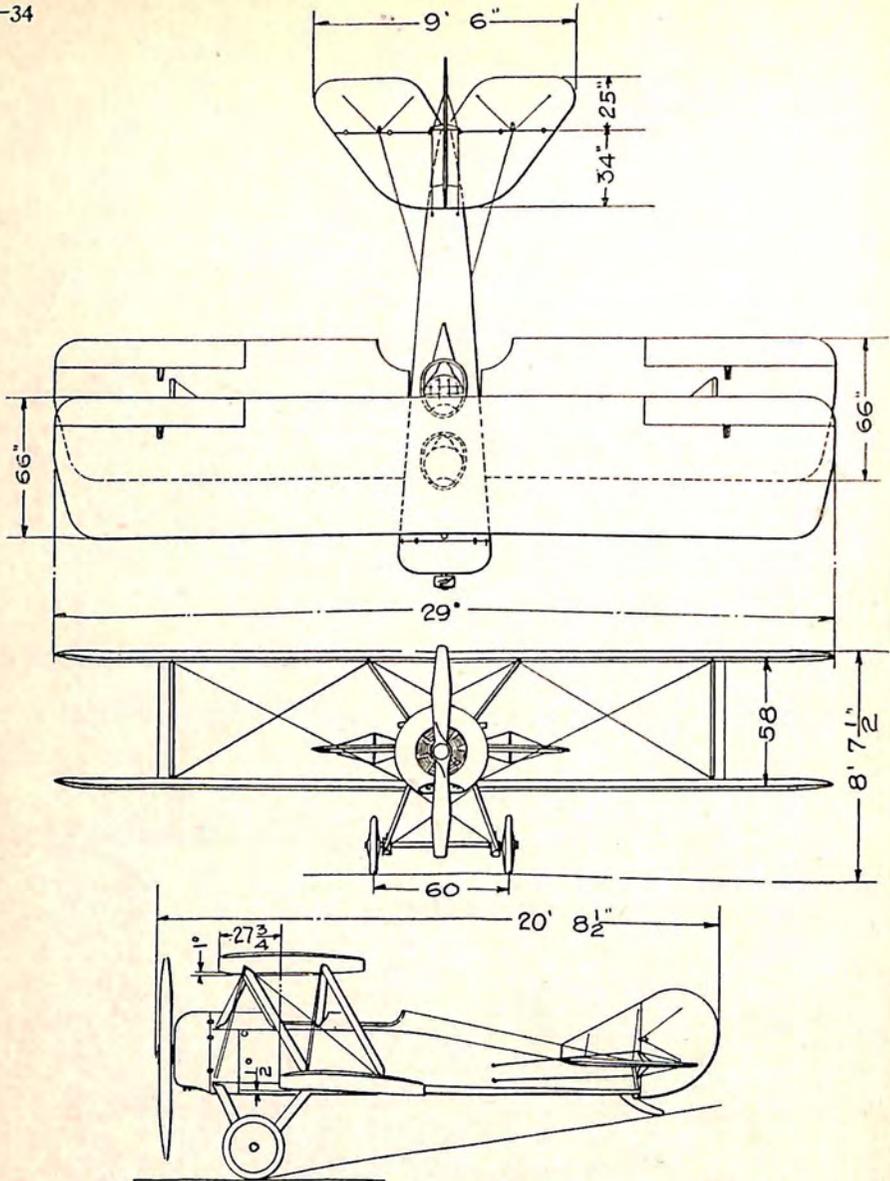


THE GLENN L. MARTIN COMPANY
CLEVELAND, OHIO.
MODEL "M.T." TORPEDO PLANE 1919-2 LIBERTY
400 H.P. (EACH) MOTOR 514 M.P.H

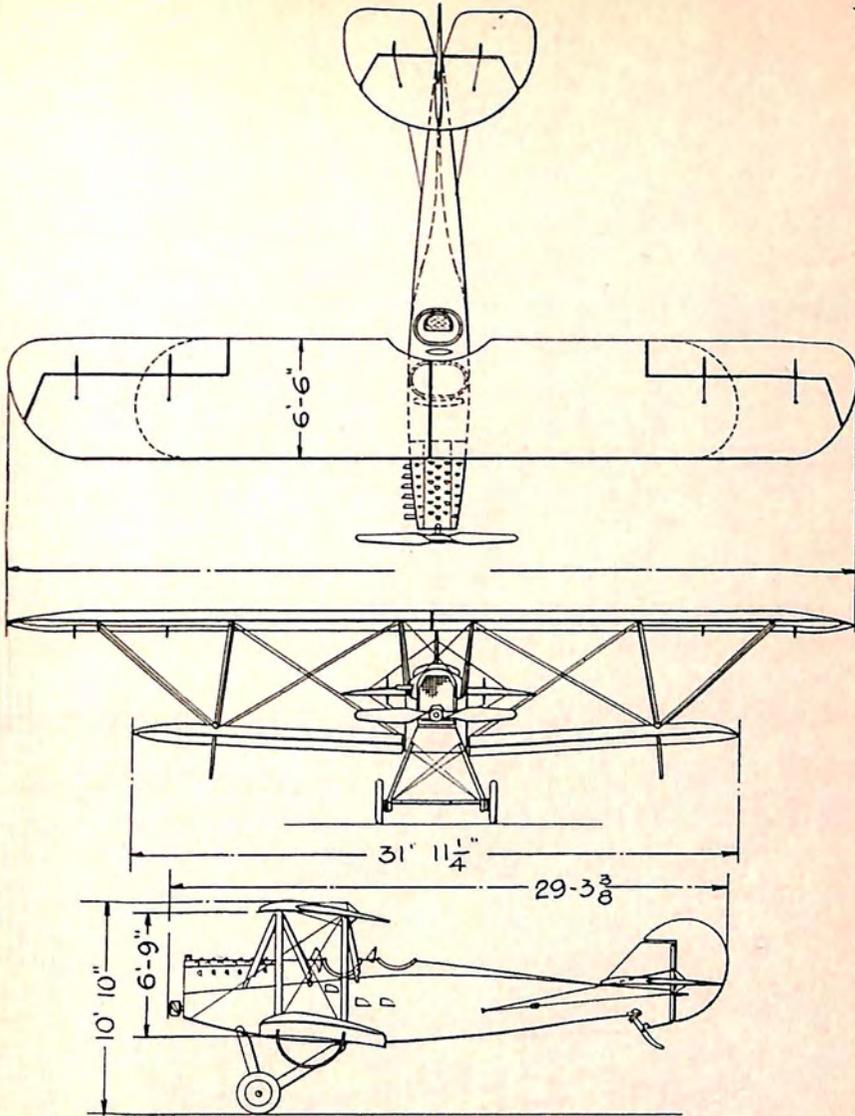


THOMAS-MORSE AIRCRAFT CORPORATION
ITHACA, N.Y.

MODEL "M.B.-3" 1919- WRIGHT, 300 H.P. 8 CYL.
MOTOR-168 M.P.H. IN PULITZER RACE.

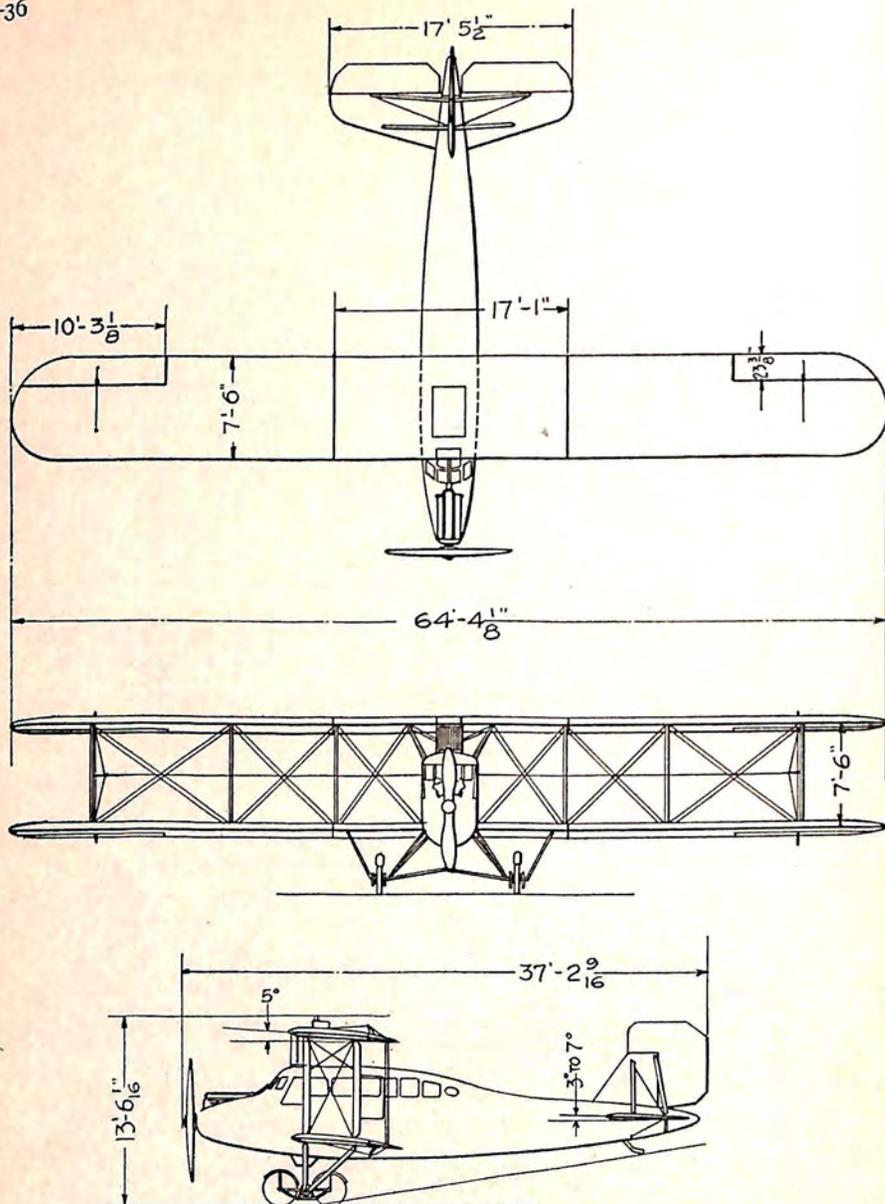


THOMAS-MORSE AIRCRAFT CORPORATION
ITHACA, N.Y.
MODEL "S-6" FEB. 1919 - LE RHONE 80 H.P. ROTARY
MOTOR 105 M.P.H.

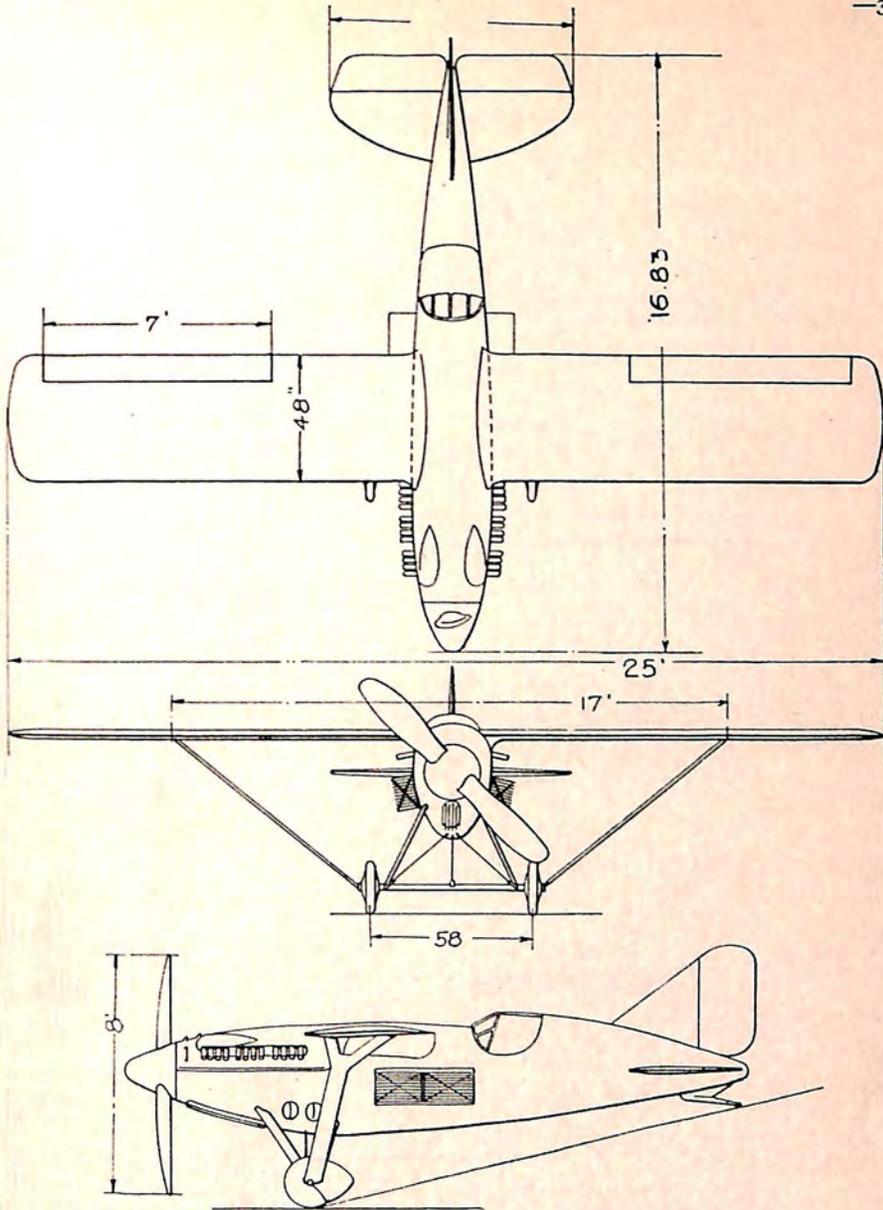


BOEING AIRPLANE COMPANY
SEATTLE, WASH.

"MOUNT RAINIER" BB-1-3 1920-HALL-SCOTT "L-6" MOTOR
200 H.P. 100 M.P.H.

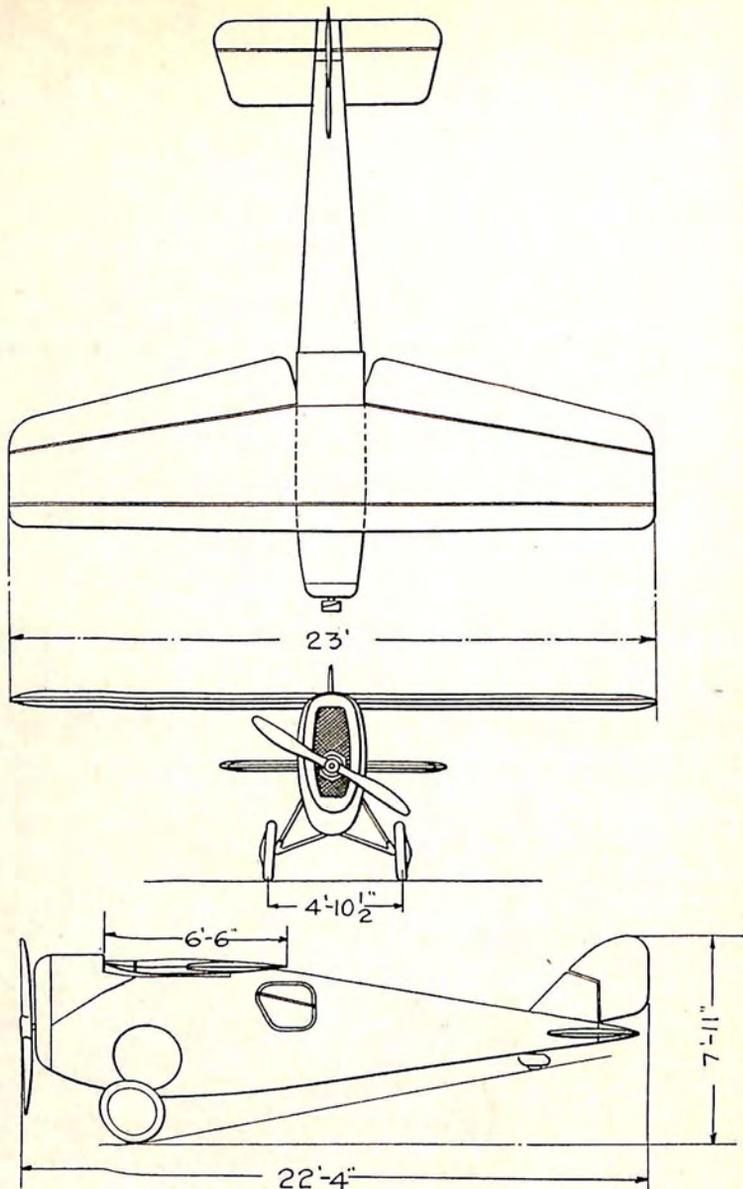


THE CURTISS AEROPLANE AND MOTOR CORPORATION
GARDEN CITY L.I.N.Y.
CURTISS 10 PASSENGER "EAGLE" 1920-CURTISS "C-12"
OR "LIBERTY 12" MOTOR-400 H.P.-100 M.P.H.

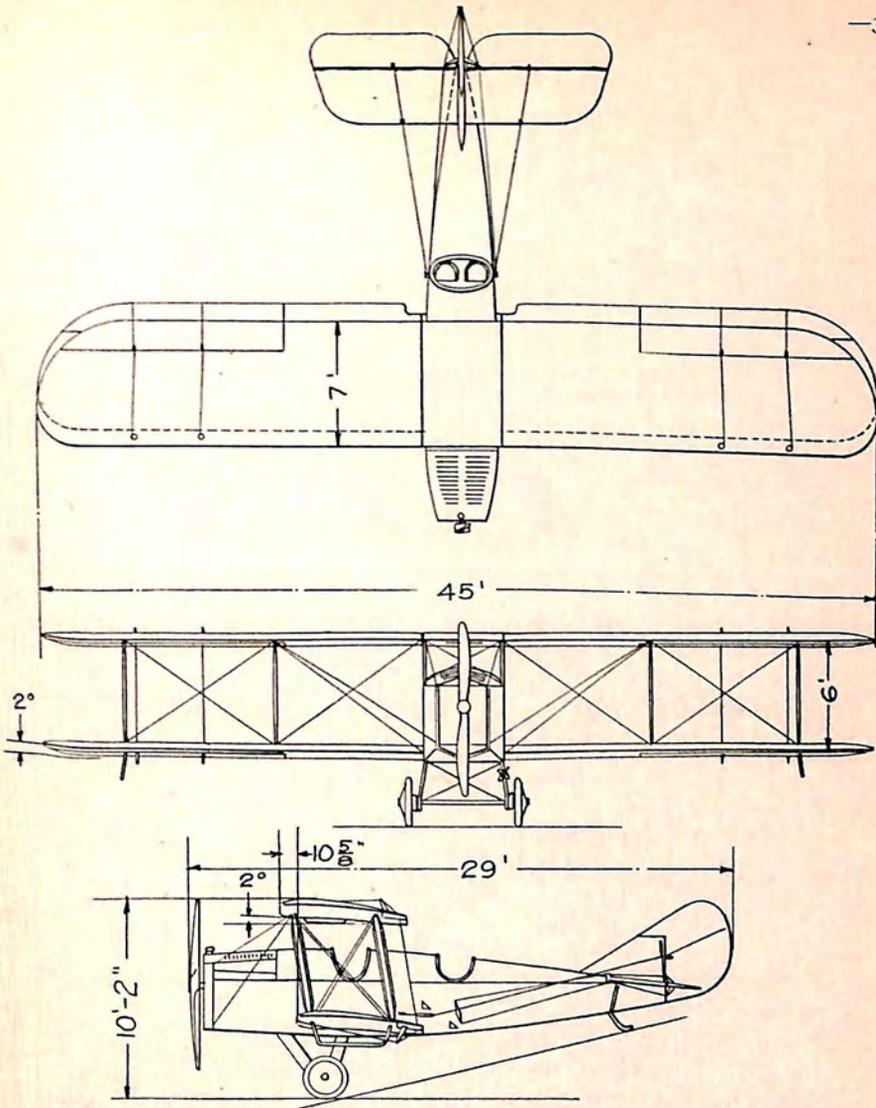


THE CURTISS AEROPLANE AND MOTOR CORPORATION
GARDEN CITY, L.I.N.Y.

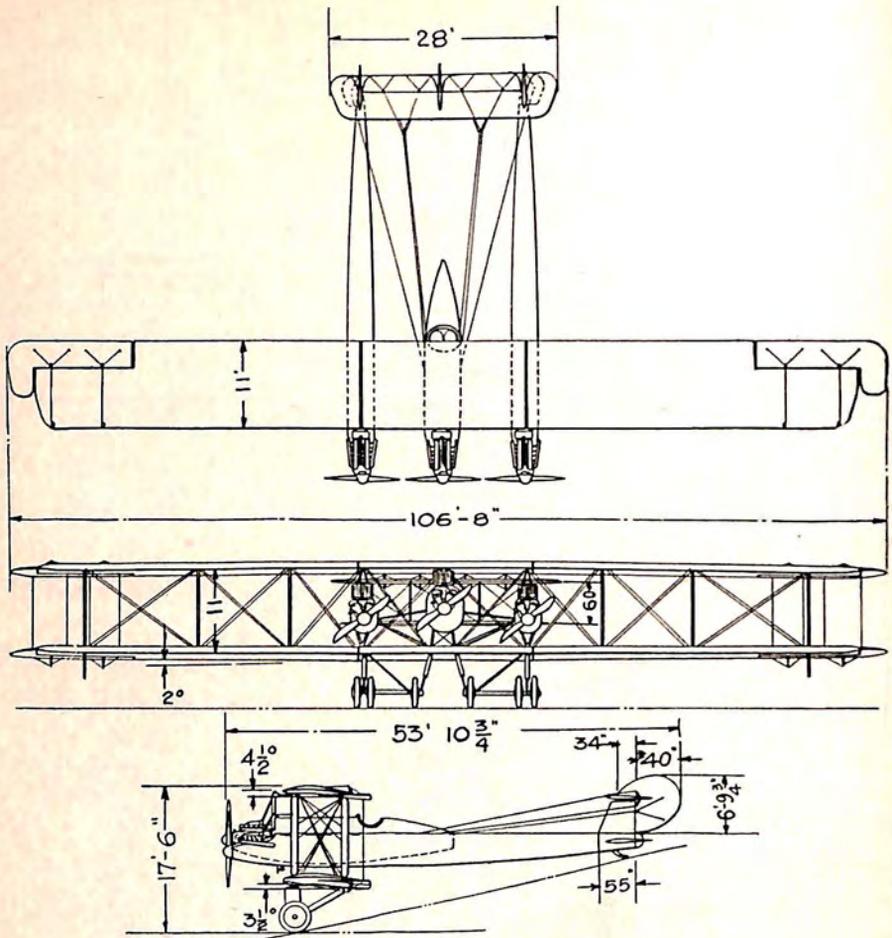
CURTISS "WILDCAT" - 1920 CURTISS C-12 400 H.P. MOTOR
BUILT FOR S.E.J. COX. FOR GORDON BENNETT RACE.



DAYTON WRIGHT COMPANY
DAYTON OHIO
MODEL "RB" MONOPLANE-1920 GORDON BENNETT ENTRY- HALL
SCOTT 6 CYL. 240 H.P. MOTOR APPROX. SPEED 195 M.P.H.

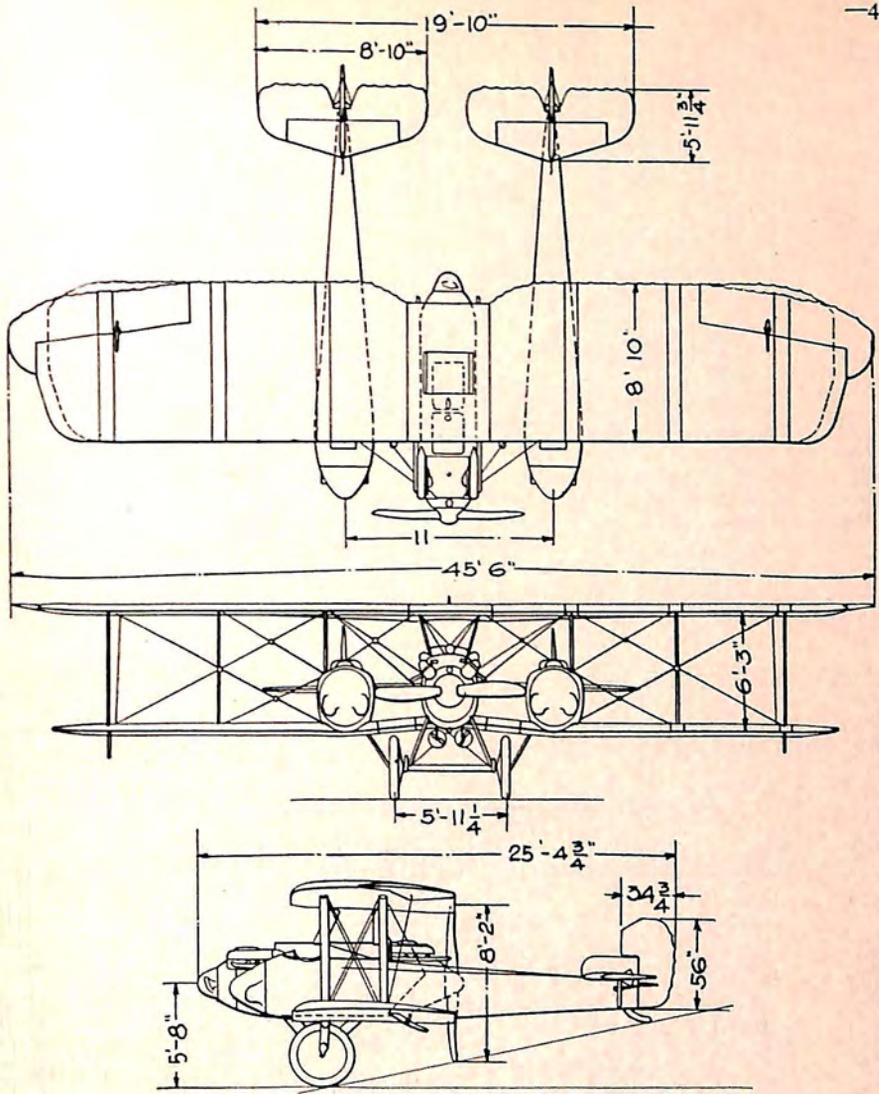


GALLAUDET AIRCRAFT CORPORATION
EAST GREENWICH, R. I.
MODEL C-3 "LIBERTY TOURIST" 1920-1, 400 H.P.
LIBERTY MOTOR



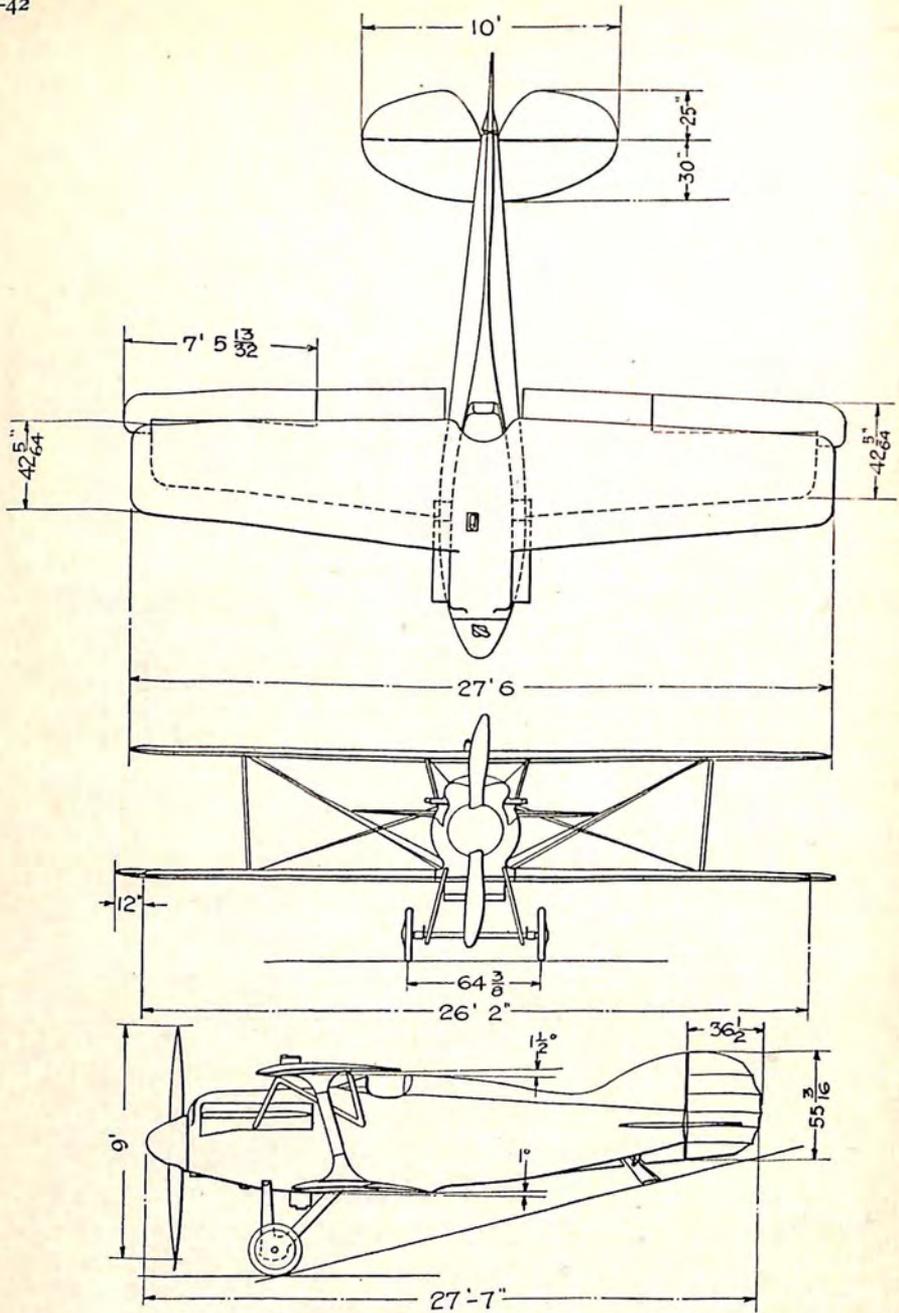
L. W. F. ENGINEERING COMPANY.
NEW YORK - COLLEGE POINT L.I.N.Y.

MODEL "H" GIANT BOMBER 1920. U.S. AIR SERVICE - 3-400
H.P. (EACH) LIBERTY MOTORS 110 M.P.H.

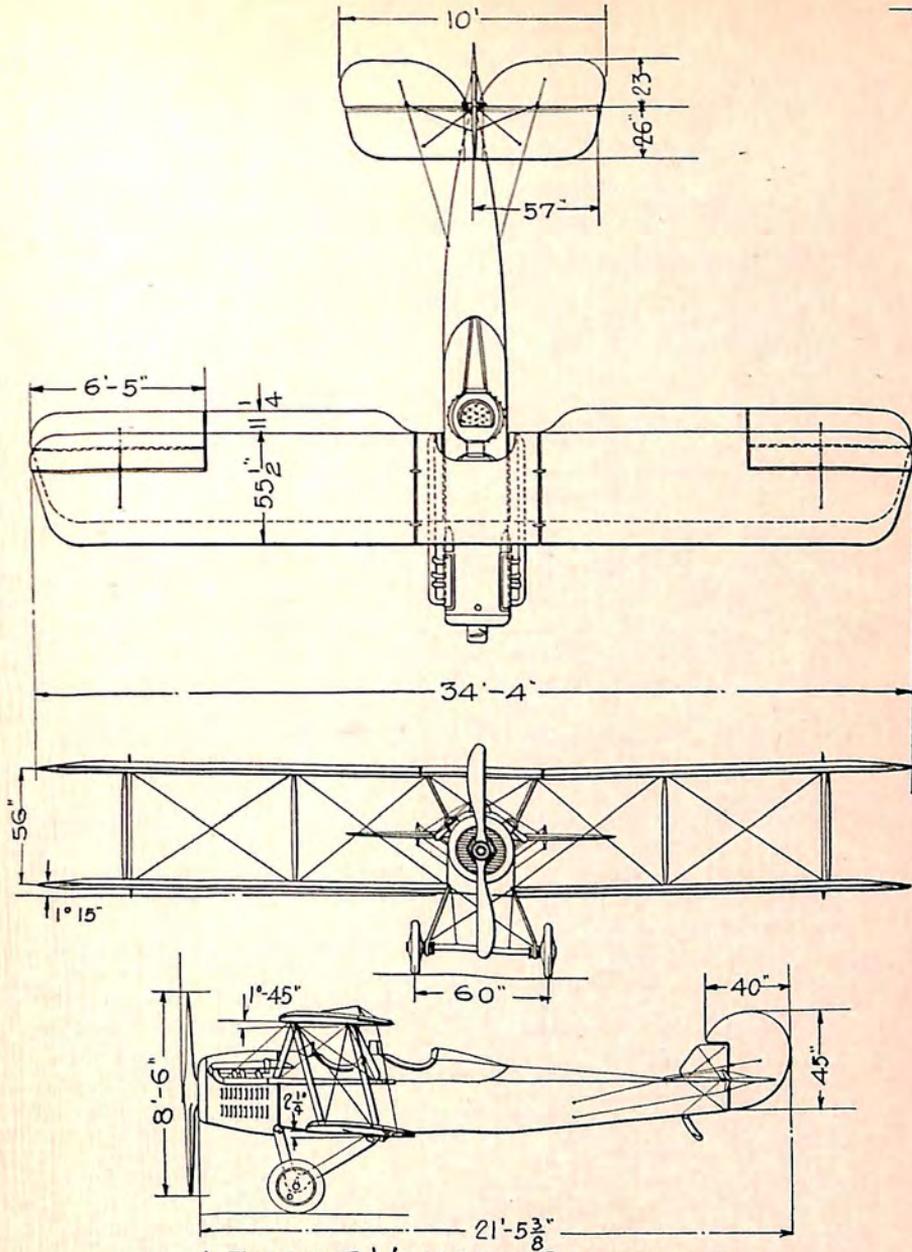


THOMAS-MORSE AIRCRAFT CORPORATION
ITHACA, N. Y.

MODEL "M.B.4" - FEB. 1920-2, 300 H.P. WRIGHT MOTORS



"VERVILLE-PACKARD
U.S. AIR SERVICE 1920 GORDON BENNETT
ENTRY 2025 PACKARD 12 CYL. 600 H.P. MOTOR 178.80
M.P.H. IN PULITZER RACE



LEWIS & VOUGHT CORPORATION.

LONG ISLAND CITY, L.I.N.Y.

MODEL V.E-7-1918-U.S. AIR SERVICE - WRIGHT 180 H.P.
8 CYL. MOTOR 106 M.P.H.

APPENDIX

MANUFACTURERS' AIRCRAFT ASSOCIATION, INC.

501 Fifth Ave., New York, N. Y.

MEMBERSHIP

Aeromarine Plane & Motor Co., Keyport, N. J.
Boeing Airplane Company, Seattle, Wash.
Burgess Company, Marblehead, Mass.
Curtiss Aeroplane & Motor Corp., Garden City, L. I., N. Y.
Curtiss Engineering Corp., Garden City, L. I., N. Y.
Dayton Wright Company, Dayton, O.
Fisher Body Corp., Detroit, Mich.
Gallaudet Aircraft Corp., East Greenwich, R. I.
L. W. F. Engineering Co., College Point, L. I., N. Y.
Glenn L. Martin Co., Cleveland, O.
Packard Motor Car Co., Detroit, Mich.
Sturtevant Aeroplane Co., Framingham, Mass.
Thomas-Morse Aircraft Corp., Ithaca, N. Y.
West Virginia Aircraft Co., Wheeling, W. Va.
Wright Aeronautical Corp., Paterson, N. J.

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

TRUSTEES

Dr. Joseph S. Ames, National Advisory Committee for Aeronautics and member of faculty, Johns Hopkins University.
W. Benton Crisp, Attorney, New York.
Albert H. Flint, President, Manufacturers' Aircraft Association.

DIRECTORS

Albert H. Flint	F. B. Rentschler
C. Roy Keys	J. K. Robinson, Jr.
Glenn L. Martin	Frank H. Russell
F. L. Morse	Inglis M. Uppercu

G. M. Williams

OFFICERS

President	Albert H. Flint
Vice-President	J. K. Robinson, Jr.
Secretary	Frank H. Russell
Treasurer	F. B. Rentschler
General Manager and Ass't Treasurer.....	S. S. Bradley
Director of Information.....	Luther K. Bell

The Manufacturers' Aircraft Association, directly and through its membership, took a leading part during the year in the development of commercial

aeronautics. Its activities were extended, its offices greatly enlarged and connections established abroad.

Feeling that there was a demand as yet ungratified for the further display indoors of military and peace-time aircraft, the Association held one Aero Show in New York and sanctioned and supported a second in Chicago and a third in San Francisco.

The Association's endeavor has been to collect and disseminate accurate information concerning aeronautical needs and progress. To this end its Library has been expanded to include works of general as well as technical reference. A collection of 3000 photographs illustrating the development of the art has been acquired. An index to aeronautical publications throughout the world is distributed weekly. General information is provided municipalities, private companies and individuals regarding air ports and operating problems. Investigation of aerial legislative needs has been carried on and officials of the Association have co-operated in this respect with representatives of the American Bar Association and similar bodies.

NEW YORK AERO SHOW.

The New York Aero Show was held in the Seventy-First Regiment Armory March 6th to 13th. Whereas the exposition of 1919 afforded the public its first opportunity to see fighting aircraft close-up, the 1920 show featured the post-war commercial types. The spirit of the 1920 exhibit was illustrated by the remarkable decorative scheme. The great floor of the Armory was crowded with examples of freight and passenger carriers. Back and above the display was a series of decorative panels.

A dozen huge canvases depicting the historical crossings of the North Atlantic Ocean and the North American continent enabled the visitor to visualize the development of transportation from the time the Vikings penetrated the fogs of Labrador to the summer of 1919, when the dirigible R.-34 made the round trip from England to America, and from the days of the French Voyageurs to the month of October, 1919, when the Army Air Service conducted its Coast-to-Coast Derby.

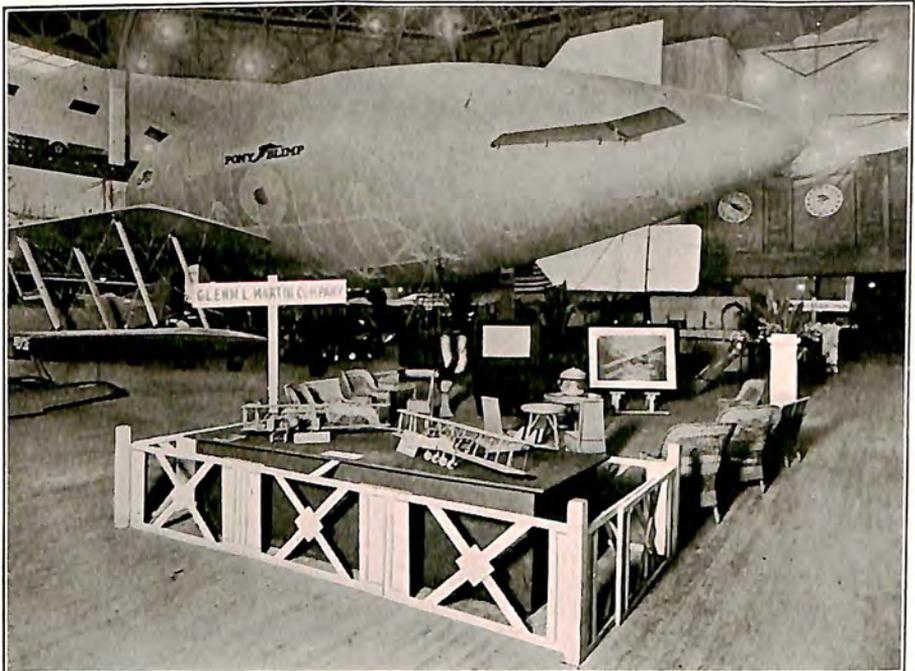
The panels were of such remarkable coloring and real artistic value and were so faithful in depicting historic scenes that, on the conclusion of the San Francisco exposition, whence they were removed from New York, requests were received from museums in various parts of the country for their exhibition as a permanent transportation feature.

The Manufacturers' Aircraft Association was host during the period of the show to representatives of the various Governmental departments, to foreign air attachés and officers and to a special deputation from the Latin-American Republics. Hon. John Barrett, Director-General of the Pan-American Union, sent through the Assistant Director-General, Señor Francisco J. Yanes, this message: "I do not think it any exaggeration to predict that the development of airplane intercourse during the next five years may do almost more than any other influence to promote Pan-American solidarity. build up Pan-American commerce and bring about the best of understanding between the United States and its sister American republics."

Among the distinguished guests of honor on this occasion were: Señor Don Frederico Alfonso Pezet, Peruvian Ambassador to the United States; Señor C. de Quesada, Cuban Vice-consul at New York; Horacio Mira, Chilean Naval Attaché; Comdr. Ambry, Peruvian Naval Attaché; Señor A. Lopez Ulloa, Diplomatic Attaché from Honduras; Dr. Gurzman, Colombian Minister



New York Aero Show, 71st Regiment Armory.



A corner of the Aero Show held in Civic Auditorium, San Francisco.
Below—Chicago Aero Show.

of Finance; General Gomez Mayoral of Colombia, and Señor Don J. E. Lafevre, Minister from Panama.

Days were set aside for military and naval aviation, at which Major General Charles T. Menoher and Brig. General William Mitchell and Captain T. T. Craven and others were guests of honor; for the Air Mail Service and for commercial aeronautics. On the last-mentioned occasion, R. E. M. Cowie, vice-president of the American Railway Express Company, spoke.

THE EXHIBITS

AEROMARINE PLANE & MOTOR COMPANY—Keyport, N. J. Three units.

Aeromarine Model 50-B-2 Flying Boat. Three-place, enclosed cabin, upholstered and trimmed in mahogany.

Aeromarine Model 40-L Flying Boat. Two place.

Aeromarine Model 50 Flying Boat Hull.

CURTISS AEROPLANE & MOTOR CORPORATION—Garden City, L. I., New York.

Curtiss "Eagle"—Second Model, two Curtiss Model K-12 motors, seating ten persons in wicker chairs, all in upholstered cabin. Dual control system.

Curtiss "Oriole"—Model K-6—three place biplane, with Curtiss Model K-6 motor, electric starter.

Curtiss "Seagull"—Flying Boat—three place machine, Curtiss Model K-6 motor, electric starter.

Curtiss JN-4-D—Two passenger training machine, Curtiss Standard J.I. cross-country or instruction machine.

DAYTON WRIGHT COMPANY—Dayton, Ohio.

Dayton Wright Model O. W.—Three place enclosed coupé cabin with baggage accommodation, with Wright or Packard motor.

Dayton Wright K. T. "Cabin Cruiser"—Three passenger enclosed cabin, removable seats, with Liberty-12 or Packard-12 motor.

GALLAUDET AIRCRAFT CORPORATION—East Greenwich, R. I.; New York Office, 25 W. 43rd St.

Gallaudet "Liberty Tourist"—Five seater, dual social control in rear cockpit, with Liberty 400 h.p. motor.

GOODYEAR TIRE AND RUBBER COMPANY—Akron, Ohio.

Goodyear Pony Blimp—Passenger dirigible, with 400 h.p. Ace motor.

L. W. F. ENGINEERING COMPANY—College Point, L. I., N. Y.

L. W. F. Model H "Giant" Bomber—With three 12-cylinder Liberty motors, two fuselages 50 feet long, one nacelle, tractor type.

L. W. F. Model L Butterfly—One seater sport monoplane with Cato air-cooled motor.

THE GLENN L. MARTIN COMPANY—Cleveland, Ohio.

Models of the Transport and Mail Planes, with folding wings.

Motion pictures showing operation of Glenn L. Martin factory and various Martin planes in construction and in flight.

ORDNANCE ENGINEERING COMPANY—Baldwin, L. I., N. Y.

Orengo Type F—Four seater with Wright motor.

STINSON AEROPLANE COMPANY—Dayton, Ohio.

Two passenger Stinson airplane.

THOMAS-MORSE AIRCRAFT CORPORATION—Ithaca, New York.

M. B.-4—Two motored plane, tractor and pusher type, with nacelle between two fuselages, powered by two Wright motors.

WEST VIRGINIA AIRCRAFT COMPANY—Wheeling, W. Va.

Type C—Three seater airplane, with Wright motor.

UNITED STATES NAVAL AVIATION

Model of ZR-2 Hangar, Lakehurst, N. J., Navigating Instruments, etc. Radio exhibit.

UNITED STATES AIR SERVICE.

Model landing field, motion pictures and photographs of U. S. Army Air Service activities, Radio Exhibit operating in conjunction with the Navy.

ENGINES

AEROMARINE PLANE & MOTOR COMPANY—Keyport, N. J.

Aeromarine Type B Aero Engine, 8 cylinders in blocks of 4; 148 h.p. and 1300 r.p.m.

Aeromarine Type L Aero Engine, 6 cylinders, 4 cycles, valve in head, 130 h.p. and 1625 r.p.m.

CURTISS AEROPLANE & MOTOR CORPORATION—Garden City, N. Y.

Curtiss K-12 Aero Engine, 12 cylinder, V type; h.p. 375 at 2250 r.p.m.

Curtiss K-6 Aero Engine. 6 cylinders en bloc; 150 h.p. at 1700 r.p.m.

Curtiss OX-5 Aero Engine, 8 cylinders, V, 90 h.p. at 1400 r.p.m.

HALL-SCOTT MOTOR CAR COMPANY—Berkeley, Calif.

Hall-Scott L-6 Aero Engine, 6 cylinder, 200 h.p. at 1700 r.p.m.

LAWRANCE AERO-ENGINE CORPORATION—New York City.

Lawrance Air-cooled Aero Motor—Type L-2; 3 cylinders; 60 h.p. at 1800 r.p.m.

L. W. F. ENGINEERING COMPANY—College Point, N. Y.

L. W. F. Cato motor—Two cylinder, 72 h.p. at 1825 r.p.m.; air-cooled.

PACKARD MOTOR CAR COMPANY—Detroit, Mich.

Packard Type 1-A—744 Aero Engine—8 cylinder, 160 h.p. at 1525 r.p.m.

WRIGHT AERONAUTICAL CORPORATION—Paterson, N. J.

Wright Model "E" Aero Engine—8 cylinder, V type; 180 h.p.

Wright Model "H"—8 cylinder, V, 300 h.p.

Wright Model "K"—8 cylinder; 300 h.p., V type, geared, with 37 mm.

ACCESSORIES, ETC.

Valentine and Company (Varnishes), Aetna Life Insurance Company, Brewster-Goldsmith Company (Spark Plugs), Fairchild Aerial Camera Corporation, Liberty Starters Corporation, John A. Roebling & Sons Company (Wire), Stewart Hartshorn Company (Wires), American Propeller Manufacturing Company, Pioneer Instrument Company, U. S. Air Service Magazine, Gardner-Moffat Company (Aeronautical Publications), Tale Spins (Aeronautical Publication), Aerial Age Company (Aeronautical Publication), S. Smith & Sons Company, American Balsa Company (Propellers), American Flying Club, Bureau of Standards, Army and Navy Radio Telephone, E. L. Beecher (Motor).

CHICAGO AERO SHOW

The Aeronautical Exposition of Chicago was held in the Coliseum from January 8th to 15th, 1920. Several noteworthy events took place during Exposition week. The Mississippi Valley Aviation Clubs Association was organized at a meeting held at the Aviation Club of Chicago, January 13th, and attended by members of the club and others who were interested in aeronautics.

EXHIBITS

AEROMARINE PLANE AND MOTOR COMPANY.

Aeromarine Model 50-B-2.

CURTISS AEROPLANE AND MOTOR CORPORATION.

*Curtiss "Eagle."**Curtiss "Oriole"—Model K-6.**Curtiss "Seagull."*

DAYTON WRIGHT COMPANY.

*Dayton Wright Model O. W.**Dayton Wright K. T. "Cabin Cruiser."*

WRIGHT AERONAUTICAL CORPORATION.

*Wright Model "E" Aero Engine—8 cylinder V type; 180 h.p.**Wright Model "H" Aero Engine—8 cylinder V type; 300 h.p.*INTER-ALLIED AIRCRAFT CORPORATION. Distributors of Avro airplanes—
Model 40-4K*Model 50-4K equipped with LeRhone rotary air-cooled, 110 h.p. motor.*

AMERICAN AIRCRAFT AND SUPPLY WORKS OF CHICAGO.

Single seater sport plane.

GOODYEAR TIRE & RUBBER COMPANY.

Goodyear Pony Blimp.

UNITED AIRCRAFT CORPORATION.

Canadian Curtiss type.

UNITED STATES NAVAL AVIATION.

Several types of Navy seaplanes and anti-aircraft guns.

U. S. ARMY.

Airplanes and equipment.

U. S. AIR MAIL SERVICE.

*First Curtiss J. N.-4 Mail Plane with a record of a full year's service.**This ship was equipped with Wright motor.*

GALLAUDET AIRCRAFT CORPORATION.

Exhibit of motors and photographs.

PACKARD MOTOR CAR COMPANY.

Packard Type 1-A—744 Aero Engine—8 cylinder 160 h.p. at 1525 r.p.m.

ACCESSORIES, ETC.

Aerial Age Weekly, Aero Club of Illinois, Arthur Johnson Mfg. Company, Aviation Clubs of Chicago, Brewster-Goldsmith Corp., D. G. Cantu (Caproni), Edstrom Machinery Co., Essenkay Products Co., Everyday Engineering Magazine, Floyd Smith Aerial Equipment Co., Gardner-Moffat Co., Inc., Thos. F. Hamilton, Home Insurance Company, Illinois Model Aero Club, John A. Roebing Sons Co., Maurice S. Wetzels, Tale Spins, Whittemore-Hamm Co., Wixon Products, Van Schaack Bros., Chemical Co.

SAN FRANCISCO AERO SHOW

The San Francisco Aeronautical Show was held in the Civic Auditorium April 21st to 28th. During the week races were held and the Pacific Aeronautical Association was formed, consisting of all the aviation clubs in the Pacific Coast states.

SUMMARY OF EXHIBITS

AIRCRAFT:—Aeromarine Plane and Motor Company, Continental Aircraft, Inc., Boeing Airplane Company, Curtiss Aeroplane and Motor Corporation and Earl P. Cooper Airplane and Motor Company, Dayton Wright Company, Robert G. Fowler, Goodyear Tire & Rubber Company, Loughhead Aircraft Manufacturing Company, The Glenn L. Martin Company, Air Service U. S. Army, United States Naval Aviation, Wright Aeronautical Corporation.

ENGINES:—Aeromarine Plane and Motor Company, Continental Aircraft, Inc., Curtiss Aeroplane and Motor Corporation, Earl P. Cooper Airplane and Motor Company, Hall-Scott Motor Car Company.

MISCELLANEOUS:—Tale Spins (aeronautical publication), John A. Roebling Sons Co., Ace (aeronautical publication), Fred Hartsook (aerial photography), Pacific Aeronautics (aeronautical publication), Pacific Model Aero Club, Pacific Aero Club, Jacuzzi Brothers (propellers).

SUMMARY OF INDUSTRIAL ACTIVITIES

AEROMARINE PLANE & MOTOR COMPANY

Sales Offices: Times Bldg., New York City.

Factory: Keyport, N. J.

OFFICERS

President	I. M. Uppercu
Vice-President & Treasurer.....	John W. German
Secretary.	E. deB. Newman
General Sales Manager.....	Chas F. Redden
Engineer in charge	Paul G. Zimmerman
Acting Plant Manager	Ben L. Williams

During the past year the Aeromarine Plane and Motor Company intensified the application of its post-war policy, adopted after the Armistice, which holds in the sentence "To develop marine aircraft for public uses." To answer the demand for a small size flying boat, which would be adaptable to touring purposes in conditions of all comfort, Aeromarine produced in the winter of 1919-20 its Model 50 cabin flying boat. This is a development of the Aeromarine Model 40 which was produced during the war for training. The Model 50 Flying Boat has the same dimensions as the Navy Training Model, its span being 41 feet 6 inches, its overall length 28 feet 11 inches and its maximum height 12 feet 7 inches. Its engine is, however, more powerful, consisting of an Aeromarine Model B-8 water-cooled type, which develops 150 horsepower and gives the flying boat a maximum speed of 75 miles per hour and a climb of 2,200 feet in ten minutes. The capacity of the gasoline tanks is 58 gallons, which affords the Aeromarine Model 50 a radius of operation of 320 miles at full speed. The machine weighs empty 2,375 pounds and carries a useful load of 825 pounds, making a total weight of 3,200 pounds. Instead of being seated in an open cock-pit, the occupants are sheltered against the rush of air and the weather by an enclosed, luxuriously appointed cabin, to which access is had through liberal size side doors. The cabin contains three upholstered seats, the pilot forward and two passengers aft, and affords all the conveniences of a well appointed limousine.

The success which attended the extended operation of the foregoing types prompted Aeromarine to develop a much larger flying boat. With this end in view, the company acquired from the U. S. Navy a number of F-5-L flying boats which formed part of the naval surplus equipment. These were entirely re-fitted. Two comfortable cabins, having a total seating capacity of eleven persons, were fitted forward and aft of the wings, respectively, while the pilot cockpit was placed amidships in a raised position so as to afford maximum visibility.

Although the main effort of Aeromarine was brought to bear on the development of flying boats adapted to public uses, the needs of the U. S.

Navy for specially designed craft were also given careful consideration. As a result a new type of seaplane was produced which is designed to take off from the turrets of a battleship.

The Aeromarine Model A. S. ship's scout is a twin-float, two-seater seaplane. Pilot and observer, the latter also acting as a gunner, sit one behind the other in a narrow, streamlined fuselage just aft of the wings. The pronounced stagger of the wings makes it possible for them not only to see everything above them and thus ward off in time enemy aircraft attacks, but also see ahead and directly downward, which is important for safe landings. Mounted on the rear cockpit is a machine gun which the observer can swing throughout almost an entire hemisphere, thus affording the plane effectual protection. For this purpose the rudder is so designed that no part projects above the fuselage. This makes it possible to fire the machine gun to the rear in the centerline of the craft and eliminates the blind spot which would afford the enemy a safe point for attack. As these types of aircraft are intended for scouting only, they carry no bombs, the purpose of the machine gun being merely to enable the pilot to fight his way through enemy aircraft.

The Aeromarine model A. S. has an overall span of 37 feet 6 inches, an overall length of 30 feet and a maximum height of 11 feet. The total supporting area is 391 square feet. The power plant is a 300 horsepower Wright engine. The high speed of the Aeromarine Model A. S. is about 110 miles per hour, and the landing speed 52 miles per hour, while the climb is 5000 feet in the first ten minutes off the water. The weight of the machine empty is 1743 pounds, the useful load amounts to 987 pounds, making a total flying weight of 2730 pounds.

Perhaps the most outstanding instance of the many and varied activities of Aeromarine during 1920 was the success attending the creation of a new aero engine, called Type U-8D. The U-8D aero engine was specially designed to answer the requirements of commercial and military aviation for a power plant that would combine great sturdiness, dependable operation, low fuel and oil consumption and general accessibility. This engine is of the water-cooled eight cylinder V type, with the cylinder arranged around a common crankcase in two rows of four and having an included angle of 60 degrees. The bore is $4\frac{1}{4}$ inches and the stroke $6\frac{1}{2}$ inches, giving a total piston displacement of 737.67 cubic inches. The rated horsepower is 180 at 1750 r.p.m. and the normal brake horsepower 195 at 1750 r.p.m. The fuel consumption is 0.471 pounds per horsepower hour, and the oil consumption is 0.011 pounds per horsepower hour, both at normal brake horsepower. The Model U-8D engine weighs complete with propeller hub and bolts 511 pounds, and with electric generator and self starter 550 pounds.

The tests of this engine from the very beginning have been an unqualified success. The Navy Department put it through the official 50-hour run. It completed the test without grinding valves, cleaning carbon, or disassembly beyond the removal of the valve cover for inspection of the rockers, nor were any spark plugs changed. The last twenty hours of the test were made in a continuous run, at the conclusion of which the motor was disassembled and all parts were inspected. The general condition of the engine was found to be excellent, the remarkable condition of the valves and valve seats and the extremely slight traces of carbon being specially noteworthy. During this test the engine developed over 200 h.p. and its rated speed of 1750 r.p.m. for half an hour, an excess of 11 per cent. over the rated horsepower, while 2000 r.p.m. 220 h.p. was developed.

BOEING AIRPLANE COMPANY

Plant and General Offices: Seattle, Washington.

OFFICERS

President	W. E. Boeing
Vice-President and General Manager.....	E. N. Gott
Secretary	P. G. Johnson
Chief Engineer	C. L. Egtvedt

The Boeing Airplane Company by means of its engineering and testing department is keeping pace with new development.

Throughout the year the Company has maintained a flying station at Seattle, and, during last winter, at North Island, San Diego, California, during which time a number of noteworthy undertakings have been carried out, made possible by the stamina and reliability of Boeing Aircraft.

Chief among these may be mentioned the achievement of the first ship built of the B. B.-L-6 type which was the first airplane to fly over the summit of Mount Rainier, 14,400 feet above sea level. An account of this flight will be found in Chapter II.

During the past year the Boeing Airplane Company has remodeled over 110 DeHaviland 4's into the more modern DeHaviland 4-B's. Subsequent to the completion of the DeHaviland contract, the Company was awarded a contract for the manufacture of ten type "G.A.X." armored triplanes for the U. S. Army. This type machine is unique, being, as far as ascertainable, the only armored ground attack machine in the world. The design of these ships was furnished by the Engineering Division of the U. S. Air Service at McCook Field, Dayton, Ohio.

CURTISS AEROPLANE & MOTOR CORPORATION

General Offices: Garden City, L. I., N. Y.

FACTORIES:—	Garden City Buffalo, N. Y. Waukegan, Ill.
FLYING FIELDS:—	Curtiss Flying Field, Garden City, L. I., N. Y. Kenilworth Field, Buffalo, N. Y. Curtiss Flying Station, Atlantic City, N. J. Curtiss Airport, Atlantic City, N. J. Curtiss Flying Station, Newport News, Va. Curtiss Flying Field, Waukegan, Ill.
SUPPLY AND REPAIR DEPOTS:—	Dallas, Tex. Houston, Tex. Sacramento, Calif.
SALES DISTRIBUTORS AND DEALERS:—	All parts of United States, South America, and The Far East.

OFFICERS

President	C. M. Keys
Assistant to the President.....	C. Roy Keys
Vice-President	Frank H. Russell
Secretary and Treasurer.....	J. A. B. Smith

During 1920, the Curtiss Aeroplane & Motor Corporation underwent readjustment and reorganization, the most significant aspects of which were the assumption of the presidency by C. M. Keys, the withdrawal of the Willys motor car interests, and the return of Glenn H. Curtiss to active participation in the management of the company as a member of the Board of directors and chief of engineering. All the operations of the Curtiss Engineering Corp. are carried on as part of the activities of the Curtiss Aeroplane & Motor Corp.

Due to the fact that many machines of Curtiss design and manufacture were available shortly after the signing of the Armistice, much of the commercial activity has been carried on with the assistance of Curtiss products. During the year the company continued the development and production of the three-passenger "Oriole" land plane and three-passenger "Seagull" seaplane, and late in the summer the new single-motored "Eagle" was brought out.

This "Eagle," equipped with a 400 horsepower Liberty engine and capable of carrying ten persons or three-quarters of a ton of freight at the rate of 105 miles an hour for ten hours, was the chief new contribution of the Curtiss Company to commercial aeronautics during the year.

The "Eagle," in test flights made at Garden City, set new records for weight carried per horsepower. Piloted by Bert Acosta, the big machine made several successful flights, carrying aloft a useful load of 3533 pounds which, figured in units of horsepower, amounted to nearly 9 pounds per unit, the greatest carrying capacity, so far as reported, of any machine yet produced.

This machine is adapted to either passenger or freight carrying. Entrance is made through a side door reached by means of disappearing steps. The enclosed cabin compartment is finished in leather with eight individual leather upholstered seats, staggard to permit easy movability; dome lights, curtained windows of celluloid and triplex, giving protection from wind and noise, and at the same time free vision; compartment for luggage to rear of passenger cabin.

The general data on the machine:

Total area including		fuselage	78 inches
aileron	937.42 sq. ft.	Fuselage is made of	
Span of upper wing	64 ft. 4 $\frac{1}{8}$ "	Curtiss ply wood	
Span of lower wing	64 ft. 4 $\frac{1}{8}$ "	construction.	
Wing curve	U. S. A. 15	Total gasoline ca-	
Chord	93 inches	capacity	250 gallons
Gap	93 inches	Motor	Liberty 12
Stagger	0	Horsepower	400
Dihedral	0	High speed	100 m.p.h.
Angle of incidence.	5 degrees	Ceiling	16600 feet
Length of fuselage.	36 feet	Climb to 5000 feet.	10 minutes
Maximum width of		Climb to 10,000 feet	25 $\frac{1}{2}$ minutes
fuselage	51 inches	Gross weight	7423 pounds
Maximum height of		Useful load	3533 pounds

The reorganization of the Curtiss Company was also marked by the purchase from the Government of Hazelhurst Field adjacent to the Curtiss Plant at Garden City. The Company's policy is to make this new Curtiss Field available as far as possible to the general public. The Aero Club of America has accepted the offer of club quarters and hangar space at the field.

The history of the origin and development of the Curtiss entry for the Gordon Bennett aviation trophy races held in France in September is interesting. Although the two machines which were sent to France met with ill-luck, one being damaged in landing on its way to the starting point, and the other not being completed in time to participate in the races, speed trials at the Curtiss Field with test wings and on the other side with racing wings, stamped the machine as being one of the fastest ever produced.

In March, 1920, a committee of aeronautical men met at a luncheon at the Engineers Club at Dayton, Ohio, at the invitation of S. E. J. Cox, who had entered a machine under the auspices of the Aero Club of Texas, to go over the designs that had been submitted by builders from all parts of America. On June 19, Mr. Cox signed a contract with the Curtiss Company to build a plane capable of developing 200 miles an hour.

On July 25th, the machine was flown for the first time by Roland Rohlfs, Curtiss test pilot, and even with the large testing wings used on account of the unsatisfactory condition of the testing field, the machine attained a speed of 183 miles per hour.

Arriving at France, it was found that, owing to the rough condition of the Etampes field, the starting point of the race, it would be necessary to make certain changes and by dint of working day and night, the machine was completed the day before the race. Inasmuch as it had been necessary to do the testing work at Villacoublay, Rohlfs set out for Etampes, and in landing, he struck a rough spot on the field, the wheels collapsed, and the machine was badly damaged, Rohlfs escaping with minor injuries.

The general specifications and performance data of the Gordon Bennett monoplane:

Gross weight.....	2200 pounds
High speed.....	214 m.p.h. (Estimated)
Total supporting area.....	90 sq. ft.
Span	27 ft.
Wing curve	c-45
Chord	4 feet
Angle of incidence.....	0 feet
Dihedral	0
Length of fuselage.....	20 feet
Fuselage made of Curtiss ply wood construction.	
Motor	Curtiss C-12,400 h.p.
Gasoline capacity	45 gallons

Approximately one year ago, C. W. Webster, in charge of the distribution of Curtiss airplanes and flying boats in Latin-America, left New York with a consignment of planes. Upon arrival he found that British, French and Italian missions had preceded them, and, with the aid of their respective governments, had firmly entrenched themselves in most of the Latin-American countries.

In spite of the handicaps of late arrivals, lack of organization, and limited resources, Mr. Webster succeeded in the year in establishing organizations in four of the countries. Curtiss work in South America is progressing satisfactorily and plans are now being made to expand into other countries.

ARGENTINA. Lawrence Leon is in charge of the work, with headquarters and airdrome at San Fernando, near Buenos Aires. An aviation school is operated and passenger-carrying and cross-country flying services are maintained. Curtiss machines are being used by the Argentine Army and Navy.

BRAZIL. Orton W. Hoover is in charge of flying, with Roy Schneider in charge of mechanical operations. Headquarters and airdrome are at Sao Paulo. Curtiss flying boats are used by the Brazilian Navy, and the Sao Paulo Military Police (the only state aviation military police force in the world) are using land machines.

COLOMBIA. Knox Martin is in charge, with an airdrome at Bogota.

PERU. Curtiss Aviation activities in Peru are under the direction of the Compania Nacional Aeronautica at Lima. An airdrome is in operation at Villa Vista and Curtiss flying boats are a part of the equipment of the Peruvian Navy.

BOLIVIA. The Bolivian government purchased a Curtiss "Wasp" for its Army.

Curtiss airplanes and flying boats have played an important part in the aeronautical progress in the Far East. Among the noteworthy accomplishments in the Philippines was a 1100-mile flight made by a Curtis "Seagull," touching the principal islands and cities.

DAYTON WRIGHT COMPANY

General Offices: Dayton, Ohio.

Plant and Flying Field, Moraine City, Dayton, Ohio.

OFFICERS

President	H. E. Talbott, Jr.
Vice-President	C. F. Kettering
Secretary and Treasurer.....	C. J. Sherer
General Manager.....	G. M. Williams
Chief Engineer	V. E. Clark
Consulting Engineer.....	Orville Wright
Works Manager.....	J. P. Henry
Aero Engineer.....	H. M. Rinehart
Production Engineer.....	L. C. Luneke

During the year the Dayton Wright Airplane Company was taken over by the General Motors Corporation. The Dayton Wright Company is still operating in the plant at Moraine City, but is occupying only a portion, the other portion being taken up by the General Motors Research Corporation, this being the centralized experimental department for the entire General Motors Corporation.

Although the company has not put on the market any new models during the year, its engineers have been conducting their experimental work in the endeavor to overcome some of the difficulties now being contended with in commercial aeronautics. The results cannot be made public at this time, but are evidenced in part by the R. B. Monoplane which was the Dayton Wright entry in the Gordon Bennett Race. Practical experimental work of another nature was also carried on with the Dayton Wright K. T. "Cabin Cruiser" and O. W. "Aerial Coupé."

On May 22nd, 1920, a new American altitude record for three passengers and pilot was made in the O. W. "Aerial Coupé." A description of this flight will be found in the Chronology. Considering the comparatively small plant carried in the O. W. (180 h.p. Wright) the height of 19,710 ft. reached indicated that this ship ranks high in general efficiency. While the O. W. is generally a three-place machine, its roomy enclosed compartment easily accommodates four people.

A general outline of the R. B. monoplane entry in the Gordon Bennett Race is as follows: The wing construction is of the cantilever type provided with variable camber which permits of a low landing speed in comparison with the maximum flying speed. The landing gear is so designed that it can be drawn entirely up into the fuselage. It does not have an axle extending from one wheel to the other which permits of taking off on comparatively rough ground. The fuselage is streamlined throughout, the pilot's compartment being entirely enclosed. Vision and entrance is gained on the sides immediately aft of the wing through transparent doors.

The general dimensions, areas, weights, etc., are as follows:

Span	21' 2"	Total weight fully loaded	1850.00 pounds
Chord at fuselage	6' 6"	Wing loading per sq. ft.	18.00 pounds
Chord at tips ...	4' 0"	Weight per h.p. ...	7.4 pounds
Overall length ..	22' 8"	<i>Power plant</i> —	
Overall height in line of flight...	8' 0"	Motor — Hall-Scott, 6 cyl. ver. water cooled.	
Incidence	1 degree.	Develops 250 h.p. at 2200 r.p.m.	Weight per h.p. 2.2 lb.
<i>Main Areas</i> —		Fuel consumption per b.h.p. per hr. ....	.58
Main wing (including ailerons)	102.74 sq. ft.	<i>Performance</i> —	
Ailerons, rear ...	23.00 sq. ft.	Landing speed ..	64 m.p.h.
Stabilizer	14.6 sq. ft.	Cruising radius..	275 miles
Elevator	9.6 sq. ft.	Flight duration..	1½ hrs.
Rudder	7.06 sq. ft.	Ceiling	15,000 ft.
Balance of rudder	.85		
Fin	3.00		
<i>Weight</i> —			
Weight empty ..	1400.00 pounds		
Useful load	450.00 pounds		

While this ship was not successful in bringing to this country the Gordon-Bennett Cup, it is felt that the production of the Dayton Wright racer was a means of bringing forth some distinctive and new ideas in airplane construction which will prove invaluable to commercial aeronautics. Mr. Williams, who headed the party which took the racer to France, later spent many weeks with Dayton Wright engineers investigating the aeronautical situation in Europe.

During the year the Dayton Wright Company has had various other work for the United States Government consisting chiefly of the remodeling of a number of DeHaviland 4's into DeHaviland 4-B's.

FISHER BODY CORPORATION

General Offices and Plant: Detroit, Mich.

The Fisher Body Corporation has been inactive in the production of aircraft since the signing of the Armistice.

GALLAUDET AIRCRAFT CORPORATION

General Offices: 25 West 43rd Street, New York City.

Factory and Engineering Dept., East Greenwich, R. I.

OFFICERS

Chairman Board of Directors.....	E. F. Gallaudet
President and General Manager.....	J. K. Robinson, Jr.
Vice-President	J. G. Crawford
Secretary-Treasurer	Wm. B. Leberz
Assistant Treasurer.....	Wm. H. Thorpe

A summary of Gallaudet activities during the year includes work upon a new series of Government Contracts, consisting of two types of seaplanes and the remodeling of a large number of DeHaviland 4's, a further development and improving of the "Chummy Flyabout" and the development and manufacture of the Gallaudet C.-3 or "Liberty Tourist" for Commercial Flying.

A notable event of the year at this plant was the preparation of the planes to be used on the trip from New York to Nome, Alaska, and return by the U. S. Air Service.

In the development of the C.-3 or "Liberty Tourist" a five-seater Liberty motored biplane, the Engineering Department produced a heavier-than-air machine that is the last word in travel comfort, stability and beauty of outline. Besides a number of novel features, including fire protection, luggage receptacles and convertible cockpit, the "Liberty Tourist" has the following general characteristics:

Weight, including passenger load (5) and equipment, 4675 lbs.	
Spread	44' Wing area inc. ailerons.... 548 sq. ft.
Length overall.....	49' 5" Pay load.....1000 lbs.
Chord	8' H. P. loading..... 11.1 lbs.
Gap	6' Wing loading..... 8.5 per sq. ft.
Height	10' 3" Cruising radius..... 500 miles
Dihedral	1½° Estimated ceiling..... 18,000 ft.
Angle of incidence	2° Landing speed..... 40 m.p.h.
Wing contour R. A. F....	15 Maximum speed..... 115 m.p.h.
Power Plant, 12 cylinder 400 h.p. Liberty Motor.	

The contracts now in force with the United States Government include the development and manufacture of two types of Seaplanes designated as the D.-9 and D.-11, the former a fighting two-seater biplane, Liberty motored, with guns fore and aft, complete wireless and dual control. The D.-11 a single-seater monoplane, Wright 300 h.p. motor. Fighting equipment. Both types to be equipped with the Gallaudet patent geared propeller. Other contracts are in hand for the manufacture of various types of seaplanes and land machines for private concerns.

Two of the company officials, E. F. Gallaudet and Wm. B. Leberz, went abroad in the summer of 1920. They spent several months in special aeronautical research.

THE L. W. F. ENGINEERING COMPANY, INC.

General Offices and Factory: College Point, Long Island, N. Y.

OFFICERS

President	Bradley W. Fenn
Vice-President and General Manager.....	A. H. Flint.
Secretary and Treasurer.....	W. N. Bennett

The L. W. F. Engineering Company during 1920 developed its Model H. "Giant" three-motored tractor biplane for the Army Air Service which is using it as a heavy bomber. There were also reconstructed for the Army Air Service and the U. S. Air Mail Service 147 DeHaviland 4 machines including ten twin-motored machines for general utility by the Army and twenty for the Air Mail. Of this production 50 DeHavilands were remodeled for the Air Mail. On these machines are several innovations designed at the L. W. F. factory.

The most important L. W. F. product in 1920 was the "Giant." It is America's largest airplane. It can carry 3000 pounds useful load on long distance flights and on shorter trips 5000 to 6000 pounds. Two great fuselages, 50 feet long, constructed of laminated wood, carry part of the fuel supply and bombs. The crew and controls are located in the nacelle, or tailless body, the central carriage of the plane.

A twelve-cylinder high compression 400 h.p. Liberty motor is set in the nose of the nacelle and one in each nose of the two fuselages, supplying in all 1200 h.p. The wing span is 106 feet from tip to tip. There is accommodation for two pilots, a radio operator and a mechanic. Resting and relief quarters for the crew are installed in the nacelle.

Fully loaded, the plane weighs ten and a half tons. It has a cruising radius of 16 hours at low speed. It lands at 56 miles an hour. The maximum flying speed is 110 miles an hour. With only two of its motors operating it can climb with a full load. Flying at full speed under power from all three motors it can remain in the air 10 hours. Other outstanding features that identify this machine are the monocoque fuselage and nacelle, the intercommunicating gasoline system and the fire extinguisher system. The wing construction is of the Pratt truss type and consists of three upper and three lower panels of 11 ft. chord and equal spans with an 11 ft. gap. Each wing is equipped with balanced interchangeable ailerons. Ribs are built up first and then slipped over the beams which are built up of four pieces, thus forming a hollow box section; the top and bottom are of spruce and the sides of birch. The internal wire bracing is double and of No. 8 solid piano wire and $\frac{3}{16}$ " hard cable. All external wire fittings are applied directly to the beams and project through the covering.

The fuselages and nacelle are supported between the upper and lower planes on tubular struts which are thoroughly streamlined. Each of the engines is streamlined. The main load and crew are carried in the nacelle while each fuselage carries its complete power plant and has a small auxiliary compartment for express mail or cargo. Each power plant is equipped with Delco ignition, electric starters and compression release. The radiators are above the motors, directly in the blast of the propeller and equipped with individual shutter controls.

The tail is of the biplane type. It consists of two double cambered hori-

zontal stabilizer planes superimposed, with elevators attached and a fin on the top of each fuselage followed by a balanced rudder. A third balanced rudder is installed midway between the two.

The landing gear is of the six wheel, two axle type, with the outer two wheels side by side directly under the center of each fuselage and the other two wheels spaced equally between. The landing gear is so placed that when landing the center of gravity falls sufficiently far back of the wheels to prevent any tendency to nose over.

SPECIFICATIONS OF THE "GIANT"

GENERAL DIMENSIONS:—

Width overall.....	106' 8"
Length overall.....	53' 9½"
Height overall.....	17' 6"
Depth of wing chord.....	11'
Gap between wings.....	11'
Stagger	None
Angle of incidence (upper wing).....	4½°
Angle of incidence (lower wing).....	3½°
Backsweep	None
Wing curve.....	USA #6

AREAS:—

Wings, upper (not including ailerons).....	1000 sq. ft.
Wings, lower (not including ailerons).....	1000 sq. ft.
Ailerons (each 54 sq. ft.).....	216 sq. ft.
Horizontal stabilizer (upper and lower).....	174.4 sq. ft.
Area of vertical fin (each 14 sq. ft.).....	28 sq. ft.
Total area of 3 rudders.....	78.9 sq. ft.
Total supporting area (including ailerons).....	2216 sq. ft.

WEIGHTS AND LOADING:—

Net weight (machine empty).....	13,386 pounds
Gross weight (fully loaded).....	21,186 pounds
Useful load.....	7,800 pounds
Loading per sq. ft.....	10.4 pounds
Loading per B. H. P.....	17.6 pounds

POWER PLANT:—

Three Liberty 12s (high compression).....	1200 h.p.
Propeller (L. W. F.).....	9' 6" diam., 6' 8" pitch
Rotation of propeller (from pilot's seat).....	Clockwise

PERFORMANCE:—

Speed 109 m.p.h. at 6000 ft. altitude.	
High speed.....	110 m.p.h.
Low speed.....	56 m.p.h.
Ceiling	15,000 ft.
Climb	6,000 ft. in 10 minutes

THE GLENN L. MARTIN COMPANY
General Offices and Factory: Cleveland, Ohio.

OFFICERS

President	Glenn L. Martin
Vice-President	Lawrence D. Bell

Secretary Thomas H. Jones
 Treasurer Roy W. Hine

Since its inception, which was in Los Angeles, in 1912, the Glenn L. Martin Company has had a steady growth. Today, the Glenn L. Martin Company has unfilled orders, both Army and civilian, amounting to nearly \$1,350,000. It employs more men and women than it did during the war, and plans are under way at the present time for the development of commercial aircraft on a considerable scale.

January, 1920, found the Glenn L. Martin Company in production on a Navy contract for ten huge torpedo planes. The Martin Torpedo Plane is essentially a land type, twin-motored, tractor biplane, designed to carry a 2100-pound torpedo (or the equivalent weight in torpedo and bombs) two machine guns complete, radio equipment, a crew of three men (pilot, navigator and gunner) and sufficient fuel for 480 miles cruising radius. It has a wing spread of 71 feet and 5 inches, with an overall length of 46 feet 4 inches, and a height of 14 feet.

This new type of torpedo plane has several recent developments, such as folding wings, which when folded reduce the overall width of the plane to 35 feet 10 inches—thus minimizing the space required for housing. Another new feature is found in the landing gear which is divided in the middle so as to permit the torpedo cradle, capable of carrying a 2100-pound torpedo, to be suspended underneath the fuselage.

In June, 1920, the United States Army placed an order with the Glenn L. Martin Company for twenty bombers of the M. B.-2 type. The Martin Bomber, type M. B.-2, is a special military machine designed for the Army. It is intended to be used for night bombardment and is designed accordingly to carry from 1791 to 3400 pounds of bombs, five Lewis machine guns, flares, night navigation equipment, wireless and interphone outfit, and a very complete set of instruments and accessories. It is equipped with general electric type superchargers, which enable the motors to develop full power to an altitude of 18,000 feet and thereby permit a ceiling of approximately 30,000 feet to be reached.

The gross weight of the M. B.-2 bomber is 12,075 pounds, and the useful load, comprising a crew of three men, gasoline and oil for four hours' flight, complete armament equipment and bomb supply, is 4750 pounds.

The entire bomb load is carried within the fuselage on bomb racks which allow almost two tons of bombs to be carried. This enables the plane, in war service, to make short raids with an exceptionally heavy cargo of explosives.

The two 400 horsepower Liberty Motors can drive the plane 107 miles an hour at sea level and it can climb more than 4,000 feet in ten minutes. The landing speed, with full load, is 60 miles per hour.

From tip to tip, the wing span is 74 feet 2 inches, although this can be reduced to 37 feet 10 inches by folding. The overall length is 43 feet $7\frac{1}{16}$ inches, and the height 15 feet $6\frac{3}{4}$ inches. The wing chord is 95 inches or approximately 8 feet. The total wing area is 1121 square feet.

In addition to the present Army contract calling for twenty Martin Bombers type M. B.-2, the Glenn L. Martin Company has received up to the present time Government orders amounting to forty-six planes, twenty-six of which have already been put into active service and have made enviable records of performance.

Of the four corps de armée planes built for the Army in 1918, one is in

the Smithsonian Institute at Washington, D. C., while the other three are still in service at various Government aviation fields throughout the U. S. These four planes were undoubtedly the most completely equipped airplanes in existence at that time. In addition to their regular equipment, they carried navigation lights, signal lights and search lights for night landings, land flares, electrically heated flying suits, internal telephonic system for communication between members of the crew, a complete wireless set, and two gun mounts for Lewis machine guns.

Six Martin Mail Planes were built in 1919 for the Post Office Department for use in the Aerial Mail Service between New York and Chicago. The general design of these planes is very similar to the types built for the Army. They carry a supply of fuel for six hours' operation as well as a crew of two men and 1500 pounds of mail, which is divided among five compartments. These planes have established a remarkable record of efficiency in the Mail Service.

Of the ten planes built recently by the Glenn L. Martin Company for the U. S. Navy, the first two were of the M. B. T. type, which is very similar in general design to the original Martin Bombers, with the exception of the divided landing gear. The succeeding eight planes were of the M. T. type, which is a totally new design, the outstanding features being the high left wing section and folding wings. The two 12-cylinder Liberty engines more-over were mounted on the lower wings just outside of the first wing strut away from the fuselage.

The first Martin Bomber Torpedo Plane or M. B. T. type was given its trial flight January 31, 1920, at the Martin airdrome. The naval officials stationed at the Martin Plant considered the trial flight a most unusual success. This same plane was flown from Cleveland to the Naval Air Station at Anacostia, D. C., and has been in constant operation ever since in the experimentation of torpedo dropping.

The second machine of the M. B. T. type was shipped to the Naval Aircraft Factory at Philadelphia, where it was fitted with flotation gears for operation with the Atlantic fleet. The eight remaining M. T. type or Martin Torpedo Planes were divided between the airplane torpedo detachments of the Atlantic and Pacific fleets, four being sent to the Pacific and three to the Atlantic. The remaining one M. T. plane was lent to the Army for experimentation purposes in dropping 1000-pound bombs. It was later ferried to Anacostia for delivery to the Atlantic fleet.

At the present time, the Glenn L. Martin Engineering Department is preparing plans and designs for two distinctly new types of planes; one a four to six passenger small twin engine touring machine, and the other a huge bi-motored commercial plane capable of carrying from 15 to 24 passengers or a cargo of over 3,500 pounds.

PACKARD MOTOR CAR COMPANY

General Offices and Plant: Detroit, Mich.

OFFICERS

President and General Manager.....	Alvan Macauley
Vice-Pres. in charge of Engineering.....	Col. Jesse G. Vincent
Vice-Pres. in charge of Distribution.....	H. H. Hills
Vice-Pres. in charge of Production.....	E. F. Roberts
Secretary	Frank R. Robinson
Treasurer	F. L. Jandron

The aeronautical activities of Packard during 1920 have been entirely in charge of the engineering division, and have been devoted to development work for the government. During the year three new airplanes have been successfully completed, which completes the Packard line, so that the company now has engines developing from 125 to around 600 b.p.h. In addition the engineering division has now nearly completed designing a 6-cylinder engine for the U. S. Navy for use in dirigibles.

For use by other than the government, Packard has sold a number of engines with specifications identical with the Liberty. These have been used both for aviation engines and speed boats.

For the government service the most important job has been the development of the 2025 engine. This is a twelve cylinder, V type, engine, producing up to 600 b.h.p. at 2,000 r.p.m. The weight is 1118 pounds, giving 1.94 pounds per horsepower at 1920 r.p.m. It will operate with great economy as low as 1275 r.p.m., giving about 400 b.h.p. It is the largest airplane engine yet designed for quantity production and the most powerful of any except a special racing development.

Among the notable features of the design is the fact that a single duplex carburetor is used, obviating the necessity of synchronizing the four carburetors common on other machines of high power. Another is that all vents are outside the cowling, eliminating fire danger. A third is the extreme ruggedness of the design, which will permit of some 250 flying hours at 1275 to 1350 r.p.m. without overhauling the engine. These engines have been built and delivered to the Engineering Division, U. S. Air Service, McCook Field, Dayton, Ohio.

Packard has also delivered to McCook Field engines of the 1116 type, developed during the year. This engine weighs 820 pounds, and develops from 200 b.h.p. at 1200 r.p.m. to 330 at 2000 r.p.m. It is a twelve cylinder engine of the same general type.

The fourth and smallest engine in the Packard line, which was also perfected during the year, is the 744, an eight cylinder motor. Its weight is 595 pounds, and its power curve runs from 145 b.h.p. at 1200 r.p.m. to 215 at 2000. These also have been delivered to the Airplane Engineering Division at McCook Field.

The engineering department has developed, also, for all the engines, a new type of installation giving greater accessibility, also an electric starter to be attached to the rear end of the engine.

The most notable record made with Packard engines during the year was that for altitude by Major Shroeder, U. S. A., an account of which will be found in the chronology.

STURTEVANT AEROPLANE COMPANY

General Offices and Plant: Jamaica Plain, Boston, Mass.

OFFICERS

President	Noble Foss
Vice-President	Benj. S. Foss
Treasurer	W. Emerson Barrett
Secretary	Horatio Alden

Important research work in the development of the Sturtevant airplane engines has been undertaken and work on the Sturtevant supercharger has

been going forward actively. As a result of protracted tests and experiments, no final design of this supercharger is now ready.

The Sturtevant plant at the time of the Armistice had an organization of more than 1,000 persons, which has since been disbanded.

It is the established policy of the company to hold itself in readiness for production at any time conditions may warrant.

THOMAS-MORSE AIRCRAFT CORPORATION

Main Office and Plant: Ithaca, N. Y.

OFFICERS

President	F. L. Morse
Vice-President	William T. Thomas
Treasurer	Jerome A. Fried
Secretary	Raymond Ware
Chief Engineer	B. Douglas Thomas

During the year 1920 continued development was carried out on Thomas-Morse types M. B.-3 single seater fighter, M. B.-4 twin engined mail carrier and S.-6 two seater training type.

Type M. B.-4 is believed to have been the first successful twin engined machine produced in this country with pusher and tractor propellers located in a central nacelle. In tests conducted at Ithaca March 1, 1920, witnessed by representatives of the Post Office Department an average speed of 134½ m.p.h. was recorded, and a complete turn and climb to 1,000 feet made with one motor working. A speed of slightly over 100 m.p.h. was made with one motor in operation. Sand loads of 1,200 lbs. in addition to full supply of gasoline, oil, etc., and speeds up to 140 m.p.h. were recorded in level flights.

Continued testing of type M. B.-3 fighter was carried out by the Engineering Division of the Air Service, McCook Field, Dayton, Ohio, and in a number of flights by Lieut. Patrick Logan all manner of aerobatics were indulged in, including zooms from the horizontal to 2,000 feet, spins, rolls, loops, etc., for the purpose of ascertaining the degree of maneuverability of which the machine was capable. The results of these tests proved most gratifying, as the machine controlled perfectly.

For the purpose of ascertaining the suitability of type S.-6 for cross country work, a trip was arranged for Pilot Paul Wilson from Ithaca to Washington, Dayton and return on April 30, 1920, an account of which will be found in the Chronology. The trip was successful in every particular, and demonstrated without question the advantages to be gained by a low landing speed (in this case from 35-38 m.p.h.), as numerous landings were made on fields of inadequate size, poor surroundings and extremely rough surface, especially on the flight from Washington to Dayton. In spite of this, in many cases, getaways were effected without moving the machine from the point where it came to rest after landing. A gasoline consumption of 19 miles a gallon was maintained on the flight from Ithaca to Washington and an average speed of 72.5 m.p.h. with the motor throttled to approximately 75% of its power.

No forced landings were made except one on account of heavy rain; and the final landing on the return to Ithaca was made in almost pitch darkness, at 10:10 P. M., the only aid available being rendered by gasoline flares, which were lit along the sides of the straightaways.

A number of DeHaviland 4's were remodeled during the year by moving the gasoline tanks forward, as well as numerous other changes making for the betterment of the plane.

During the past three months work has been proceeding on small quantity production of type M. B.-3 fighters, a number of which have been ordered by the Engineering Division of the Air Service.

WEST VIRGINIA AIRCRAFT CO.
Offices: Wheeling, West Virginia.
Factory: Warwood, West Virginia.

TRAINING SCHOOLS:—Daytona, Florida.
Princeton, New Jersey.
Beech Bolton, West Virginia.

OFFICERS

President J. C. McKinley
Manager C. H. Phillips

The West Virginia Aircraft Company has operated Curtiss J. N. 4-D machines in passenger carrying and instruction at its three fields. Its manufacturing activities have been limited. It has modified a Curtiss J. N. into a three-plane machine, with a 150 h.p. Wright engine. This development has proven very satisfactory.

WRIGHT AERONAUTICAL CORPORATION
General Offices and Factory: Paterson, New Jersey

OFFICERS

President George H. Houston
Vice-Pres. and General Manager..... F. B. Rentschler
Secretary and Treasurer..... James F. Prince

The Wright Aeronautical Corporation in 1920 has consistently improved the design and construction of the Wright engines to maintain its leading position in aviation engine building in the United States. At the same time much thought and energy have been expended on the development of types of engines differing from the Hispano-Suiza type.

A new model of the 180 h.p. Wright engines, known as the E.-2, has been put into production. This model contains several important modifications to increase still further the dependability and ultimate life of this widely used engine. These modifications have also resulted in an increase in power, but with no increase in weight. Plane designers will appreciate the rearrangement of several parts which has been done to facilitate mounting in the plane. This work has been logically developed and carefully executed. Each change has been made only after very thorough study and experiments made to the end that all modifications would improve, letting nothing detract from the performance of this engine.

Orders are now being filled for the new model of the 300 h.p. Wright

Engine, known as the H.-2. This model incorporates some of the changes mentioned in the description of the new E.-2. Dependable and reliable as are these two powerful models, yet by no means are they the full endeavor to improve the aeronautical power plant. Model E.-2 and H.-2 have been built, tested and flown. They accomplished more than was anticipated. On our drawing tables, in the shops and in the test are two really experimental models, whose performance cannot be foreseen. Not a task has been left undone on these two experimental models, so that when completed, we will know conclusively whether or not a Radial Wright Engine is a possibility for aviators to look forward to.

This experimental work on entirely new types of engines, together with the completion of E.-2 and H.-2 models, is so clearly an American product of American designers, engineers and mechanics that it has been decided to drop the foreign type name of Hispano in the Wright Engine Products. Now than the sixth American model, the H.-2, has been completed, retaining only one or two of the original foreign features of design, it appears time also to drop the foreign name and to tell the world these Yankee built and designed engines are from now on to be known under the American name of Wright engines.

To determine the actual dependability of a Wright Engine a novel test was started by the Army Air Service at McCook Field on a model E.-2 Wright engine. The purpose was to determine the length of time the engine could be operated in the air without repairs or overhaul. In order that no particular amount of service or attention should be given to this engine during this dependability test no one was informed that a test or special record was being made. The flights were as called for all in the day's work. At this writing 153 hours have been flown by this engine without one single engine part being replaced or adjusted. Not even a valve has been reground. The mileage flown for this 153 hours is about 14,000 miles. Word has just been received that this dependability test has been finished showing this stock engine to have run 183 hours, covering 16,500 miles without any engine repair. The test was stopped because the plane was to be otherwise used. On examination of the engine all parts were found in splendid condition, and ready for a continuation of the run.

In governmental use the dependability, power and lightness of Wright engines have caused them to be installed in the following planes, the model of the Wright Engine used being indicated by the model letter as "E," "H," "A," or "I."

NAVY DEPARTMENT

Vought V. E.-7.....	"E" 2 place Biplane, advanced training.
Loening M. 8-O.....	"H" 2 place Monoplane, Turret Duty.
Loening M. 8-O-S.....	"H" 1 place Monoplane, pursuit Marine Corps.
Loening M. S.....	"H" 2 place Monoplane Seaplane.
Curtiss N. 9-H.....	"A & I" 2 place Biplane Seaplane, Training.
Curtiss C. T.....	2 "H" Torpedo Carrying Seaplane.
Navy T. F.....	2 "H" Tandem Fighting Flying Boat.
Aeromarine A. S.....	"H" 2 place Biplane Seaplane.
Alexandria F.....	"A" 2 place Biplane Flying Boat.

WAR DEPARTMENT

Curtiss J. N.-4-H.....	"I" 2 place Training Biplane.
Curtiss J. N.-6.....	"A & I" 2 place Training Biplane.

Vought V. E.-7.....	"I & E" 2 place Advance Training Biplane.
Vought V. E.-8.....	"H" 1 place Advance Training Biplane.
DeHaviland 4-B.....	"H" 2 place Fighter Biplane.
Ordnance Type D.....	"H" 1 place Scout Biplane.
Ordnance Type D.-3.....	"H" Single Seater Pursuit.
Ordnance Type D.-2.....	"H" Single Seater Pursuit.
Ordnance Type H.-2.....	2 "H" (proposed) 3 place Observation Biplane.
Thomas-Morse M. B.-3.....	"H" 1 place Pursuit Biplane.
Thomas-Morse M. B.-4.....	2 "H" Tandem.
Loening M.-8.....	"H" 2 place Pursuit Monoplane.
Army Experimental Uxsbia ..	"H" 2 place Observation Biplane.
Army Experimental S. E.-5-A.	"I & E" 1 place Pursuit Biplane.
Verville V. C. P.-1.....	"H" 1 place Pursuit Plane.
Standard J.-1.....	"I" Training.

POST OFFICE DEPARTMENT

Curtiss J. N.-4-H.....	"A & I" Biplane.
DeHaviland 4.....	2 "E" Mail Plane.

Civilian aviators can obtain Wright engines, when desired, in many of the commercial planes, as most of the leading manufacturers have built planes powered with Wright engines. The Service Department of the Wright Aeronautical Corporation is ready to assist on instructions for installation or upkeep of Wright engines in planes. The Engineering Department will very willingly advise plane manufacturers on questions pertinent to power plants required for conditions to be met. All branches of the organization are functioning to maintain the Wright Engines in their present position as the dependable aircraft power plant.

WRIGHT MOTORS

MODEL.	"E.-2"	"H.-2"
No. of Cylinders.....	8	8
Bore	120 m/m 4.724"	140 m/m 5.511
Stroke	130 m/m 5.118"	150 m/m 5.905
Weight complete.....	480 lbs.	620 lbs.
Compressed ratio.....	55 to 1	5.36 to 1
Horsepower guaranteed	190	330
R. P. M.....	1800	1900
Oil consumption per h.p. hour.....	.026 lbs.	.022 lbs.
Gas consumption per h.p. hour.....	.48 lbs.	.50 lbs.

U. S. AIR SERVICE
LIST OF OFFICERS ON DUTY IN WASHINGTON

ADMINISTRATIVE GROUP

NAME.	RANK.	DUTIES.
Menoher, Charles T...	Maj. Gen...	Chief, Air Service.
*Mitchell, William.....	Brig. Gen...	Asst. Chief of Air Service.
*Frank, W. H.....	Major	Acting Executive.
Pearson, W. F.....	Major	Administrative Executive on temporary duty at Ft. Omaha.
*Simons, J. W., Jr.....	Major	Acting Administrative Executive and Asst. to Administrative Executive.
Trabold, A. R.....	Captain	Chief, Miscellaneous Div., Administrative Group.

PERSONNEL DIVISION

Lincoln, Rush B.....	Major	Chief, Personnel Division.
Milledge, John.....	Captain	Chief, Enlisted Section, Personnel Division.
Sorenson, Edgar P....	1st Lieut. ..	Asst. to Chief, Enlisted Section.
York, A. C.....	Captain	Chief, Officers' Section, Personnel Division.
Sigourney, H. C.....	Captain	In charge of Discharges, office of Chief, Officers' Section, Personnel Division.
Hopkins, H. V.....	1st Lieut. ..	In charge of Reserve Commissions and Liaison Officer between General Staff and Office, Chief of Air Service, Reserve Commissions.
Reading, W. M.....	Captain	Chief, Civilian Sec., Personnel Division.

OFFICE, CHIEF SUPPLY GROUP

Gillmore, Wm. E.....	Lt. Col.	Chief, Supply Group.
*Robins, Augustine W..	Major	Asst. to Chief, Supply Group.
Ralph, Edward J.....	Captain	Asst. to Chief, Requirements Division and Supply Group Personnel Office.

PROPERTY DIVISION

*Brett, George H.....	Major	Acting Chief, Property Division.
Christine, Frederick F..	Captain	Transportation Officer; Records and Statistics.
Knight, Climpson M...	1st Lieut. ..	Operating Costs, Buildings & Grounds; Asst. to Lieut. Williams.
Page, Edwin R.....	1st Lieut. ..	New Projects, Property Specialists.
Puryear, Alfred I.....	1st Lieut. ..	Handling the abandonment of Fields; Asst. to Capt. Christine.

*Pilot.

NAME.	RANK.	DUTIES.
Williams, Walter D....	1st Lieut.	..Operating Costs, Buildings and Grounds.
Albro, Ames S.....	2nd Lieut.	..Administrative and Executive; Field Service Personnel.
Beveridge, John.....	2nd Lieut.	..Assistant to Lieut. Page (engines).
*Johnson, Cortlandt S...	2nd Lieut.	..Assistant to Capt. Christine.
Shangraw, Clayton C..	2nd Lieut.	..Assistant to Lieut. Page (radio).

PROCUREMENT DIVISION

Hall, Chalmers G.....	Colonel	....Chief, Procurement Division.
Reardan, John D.....	Major	....Asst. to Chief, Procurement Division; Chief, Purchase Section; Acting Chief, Production and Inspection Sections.
Broughton, John J.....	Captain	....Asst. to Chief, Production Section.
Callaghan, Wm. J.....	Captain	....Chief, Follow-Up Branch, Purchase Section.
Eding, Gerrard J.....	Captain	....Asst. to Chief, Inspection Section.
Nesbitt, Arthur E.....	Captain	....Chief, Purchase Branch, Purchase Sec.
Gray, George A.....	Captain	....Asst. to Chief, Purchase Branch, Purchase Section.

REQUIREMENTS DIVISION

*Jones, Byron Q.....	Major	....Asst. to Chief, Supply Group, and Chief, Requirements Division.
Payne, Halbert E.....	Captain	....Chief of Records and Statistics; in charge of compilation of Equipment Manual and General Air Service. Requirements.
*Jones, Aaron E.....	1st Lieut.	..Asst. to Chief, Requirements Division.

ENGINEERING DIVISION

*Harms, Henry W.....	Major	....Asst. to Chief, Engineering Division; Liaison Officer with McCook Field.
York, John Y.....	1st Lieut.	..Air Service Representative with Ordnance Committee, Ordnance Dept.
Howard, Dudley B.....	1st Lieut.	..Assigned to Patents Section, Eng. Div.
*Harmon, Ernest E.....	2nd Lieut.	..Acting Chief, Patents Section.

FINANCE CONTACT DIVISION

Volandt, Wm. F.....	Captain	....Chief, Finance Contact Division; Recorder, Air Service Section, War Department Claims Board; Contracting Officer in settlement of claims.
Emerson, Wilbur T....	1st Lieut.	..Chief, Finance Contact Section, Finance Contact Division.

MATERIAL DISPOSAL & SALVAGE DIVISION

Hall, Chalmers G.....	Colonel	....Chief, Mat. Disp. and Salvage Division.
*Graham, Harry.....	1st Col.	....Asst. Chief, Mat. Disp. and Salvage Div.
Grady, Clyde.....	1st Lieut.	..Chief, Control Section.
*Pilot.		

ADVISORY BOARD

- Fuller, A. L.....Lt. Col.
 *Kilner, Walter G.....Major
 *Fickel, Jacob E.....Major
 *Walsh, RaycroftMajor
 *Dargue, H. A.....Major
 Reardan, John D.....Major
 *Cousins, Ralph P.....Captain
 *Simons, J. W., Jr.....MajorChief, Administrative Group.
 Gillmore, W. E.....Lt. Col. ...Chief, Supply Group.
 *Feichet, James E.....Lt. Col. ...Chief, T. & O. Group.
 *Hickam, H. M.....MajorChief, Information Group.

INFORMATION GROUP

- *Hickam, H. M.....MajorChief, Information Group.
 Jones, E. L.....CaptainChief, Dissemination Division.
 *Seaton, D. S.....CaptainChief, Special Division.
 Clayton, A. J.....1st Lieut.
 *Healy, J. A.....1st Lieut.
 *Andrews, W. V.....1st Lieut.
 *Spalding, J. H.....1st Lieut. ..Chief, History Division.
 *Mills, C. H.....1st Lieut. ..Library Division.
 Carey, E. F.....2nd Lieut. ..Property Officer.

TRAINING AND OPERATIONS GROUP

- *Lt. Col. James E. Feichet, Chief, Training and Operations Group.
 *Major W. C. Sherman, Assistant Chief, Training and Operations Group.

TRAINING DIVISION

- *Capt Maxwell Kirby, Chief, Air Service Training.
 *Capt. L. N. Keesling, Assistant Chief, Air Service Training.
 *1st Lt. R. J. Brown, Chief, Reserve Section.
 1st Lt. J. E. Lynch, Chief, Schools Section, O. I. C., Educational and Vocational Training.
 *1st Lt. C. C. Moseley, O. I. C., Pilot Schools.
 *1st Lt. J. C. Kennedy, Chief, Tactical Units Section.
 *1st Lt. H. S. Kenyon, Asst. Chief, Tactical Units Section.

OPERATIONS DIVISION

- *Capt. H. E. Hartney, Chief of Operations Division (Temporary).
 *Capt. Howard T. Douglas, Assistant to Chief.
 *1st Lt. James B. Carroll, Chief, 2nd Section.
 *1st Lt. St. Clair Street, Chief, 3rd Section.
 *2nd Lt. Clarence E. Crumrine, Chief, 4th Section.

CIVIL AFFAIRS DIVISION

- *Capt. H. E. Hartney, Chief, Civil Affairs Division.
 1st Lt. W. D. Wheeler, Assistant Chief.
 *2nd Lt. G. W. Goddard, Chief, Photographic Section.
 *Pilot.

BALLOON AND AIRSHIPS DIVISION

- *Major P. E. Van Nostrand, Acting Chief, Balloon and Airships Division.
- *Major Frank N. Kennedy, O. I. C., Engineering Section.
- 1st Lt. Robert S. Olmstead, O. I. C., Training Section.
- 1st Lt. Philip Schneeberger, Assistant to O. I. C., Engineering Section.
- 1st Lt. Clifford E. Smythe, O. I. C., Gas Section.
- 2nd Lt. William C. Connolly, Assistant O. I. C., Material Section.

COMMUNICATIONS DIVISION

- *Lt. Col. C. C. Culver, Chief, Communications Division.

MEDICAL DIVISION

- A. E. Truby, Colonel, Chief.
- Benjamin Warriner, Major.
- Edgar T. Hitch, Major.
- William J. Freebourne, Captain.

ENGINEERING SECTION

McCOOK FIELD, DAYTON, O.

- | | |
|----------------------------------|------------------------------------|
| *Major Thurman H. Bane. | *1st Lieut. Harry A. Sutton. |
| *Major Virginius E. Clark. | *1st Lieut. John P. Van Zandt. |
| *Major Howard C. Davidson. | *1st Lieut. Raymond E. Vaughn. |
| *Major Alfred H. Hobley. | *1st Lieut. Lorenzo L. Snow. |
| *Major Edward L. Hoffman. | *2nd Lieut. Reuben D. Biggs. |
| *Major Lawrence W. McIntosh. | *2nd Lieut. Donald L. Bruner. |
| *Major Harold S. Martin | *2nd Lieut. Wallace R. Fletcher. |
| *Major Carlyle H. Wash. | *2nd Lieut. Albert C. Foulk. |
| *Captain Charles C. Benedict. | *2nd Lieut. Kenneth G. Fraser. |
| *Captain Arthur W. Brock, Jr. | *2nd Lieut. Geo. W. Haskins. |
| *Captain Reuben H. Fleet. | *2nd Lieut. Albert F. Hegenberger. |
| *Captain Harrison W. Flickinger. | *2nd Lieut. Arthur L. Johnson. |
| *Captain George E. A. Hallett. | *2nd Lieut. Bayard Johnson. |
| Captain John V. Costello. | *2nd Lieut. Oakley G. Kelly. |
| *Captain Rudolph W. Schroeder. | *2nd Lieut. Chas. N. Monteith. |
| 1st Lieut. Edwin E. Aldrin. | *2nd Lieut. Chas. L. Morse. |
| *1st Lieut. Ernest W. Dichman. | *2nd Lieut. Fred'k W. Niedermeyer. |
| 1st Lieut. Harold R. Harms. | *2nd Lieut. George W. Polk. |
| *1st Lieut. John A. Macready. | *2nd Lieut. Carl W. Pyle. |
| *1st Lieut. George B. Patterson. | *2nd Lieut. Mark H. Redman. |
| *1st Lieut. Kellogg Sloan. | *2nd Lieut. Leigh Wade. |

STUDENTS IN ENGINEERING SCHOOL, MC COOK FIELD

- *Major Frank D. Lackland.
- *Captain Norman J. Boots.
- *Captain Clinton W. Howard.
- *Captain George C. Kenney.
- *1st Lieut. Carl A. Connell.
- *1st Lieut. Donald P. Muse.
- 1st Lieut. Frank B. Lyndall.
- *Pilot.

ARMY AREA AIR SERVICE OFFICERS

FIRST ARMY AREA

First Corps Area—Includes the North Atlantic Coast Artillery District and the States of Maine, New Hampshire, Vermont, Massachusetts, Connecticut and Rhode Island; headquarters, 99 Chauncey Street, Boston, Mass.

Air Service Officer, Maj. Leonard H. Drennan.

Second Corps Area—Includes the States of New York, New Jersey, and Delaware; headquarters, Governors Island, New York. The island of Porto Rico, with the islands and keys adjacent thereto, is, for administrative purposes, attached to the Second Corps Area.

Air Service Officer, Maj. Henry L. Watson.

Third Corps Area—Includes the States of Pennsylvania, Maryland, Virginia, and the District of Columbia; headquarters, Ft. McHenry, Md. (temporarily at Baltimore, Md.).

Air Service Officer, Maj. Albert L. Sneed.

SECOND ARMY AREA

Fourth Corps Area—Includes the States of North Carolina, South Carolina, Georgia, Florida, Alabama, Tennessee, Mississippi, Arkansas, and Louisiana; headquarters, Ft. McPherson, Ga. (temporarily at Charleston, S. C.).

Air Service Officer, Maj. Henry B. Clagett.

Fifth Corps Area—Includes the States of Ohio, West Virginia, Indiana, and Kentucky; headquarters, Ft. Benjamin Harrison, Indiana.

Air Service Officer, Maj. Ira Longanecker.

Sixth Corps Area—Includes the States of Illinois, Michigan, and Wisconsin; headquarters, Ft. Sheridan, Ill. (temporarily at Chicago, Ill.).

Air Service Officer, Maj. William C. McChord.

THIRD ARMY AREA

Seventh Corps Area—Includes the States of Missouri, Kansas, Iowa, Nebraska, Minnesota, North Dakota, and South Dakota; headquarters, Ft. Crook, Neb.

Air Service Officer, Capt. Ira A. Rader.

Eighth Corps Area—Includes the States of Texas, Oklahoma, Colorado, New Mexico, and Arizona; headquarters, Ft. Sam Houston, San Antonio, Tex.

Air Service Officer, Maj. Henry C. Pratt.

Ninth Corps Area—Includes the North Pacific Coast Artillery District, the South Pacific Coast Artillery District; the States of Washington, Oregon, Idaho, Montana, Wyoming, Utah, Nevada and California; headquarters, Presidio of San Francisco, Cal. (temporarily at San Francisco, Cal.). The territory of Alaska is attached to the Ninth Corps Area for administrative purposes.

Air Service Officer, Capt. Henry H. Arnold.

The Hawaiian Department—Includes the Hawaiian Islands and their dependencies; headquarters, Honolulu, Hawaii.

Air Service Officer, Maj. John F. Curry.

The Philippine Department—Includes all of the Philippine Archipelago and troops in China; headquarters, Manila, P. I.

The Panama Canal Department—Includes the entire Canal Zone; headquarters, Quarry Heights, Balboa Heights, Canal Zone.

Air Service Officer, Capt. Millard F. Harman, Jr.

NUMBER OF OFFICERS AND MEN

(As of Nov. 12, 1920)

OFFICERS

Regular Army Officers on Duty with Air Service.....	9	
Regular Army Officers Detailed with Air Service.....	95	
Regular Army Officers Commissioned in Air Service.....	854	
Temporary Officers in the Air Service.....	110	
Temporary Officers in Hospitals.....	18	
Temporary Officers Allotted to other Organizations.....	4	
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Total officers.....	1,090	1,090

Exclusive of officers in hospital or allotted to other organizations (22), there were the following divisions: Military aviators, 5; airplane pilots, 688; balloon observers, 70; airplane observers, etc., 74; non-flyers, 231. According to rank there were the following: Major general, 1; brigadier general, 1; colonel, 2; lieutenant colonel, 13; major, 106; captain, 152; first lieutenant, 307; second lieutenant, 509.

MEN

Assigned in U. S. and Insular Possessions.....	7,452	
Unassigned in U. S. and Insular Possessions.....	525	
Flying Cadets.....	276	
Overseas.....	90	
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Total enlisted men.....	8,343	8,343
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Grand total strength, A. S.....	9,433	

LOCATION OF AIR SERVICE UNITS

WINGS

1st (Headquarters), Kelly Field, Tex., 2nd (Headquarters), Langley Field, Hampton, Va.

GROUPS

- 1st Day Bombardment Group: Headquarters, Kelly Field, Tex. Troops: 11th, 20th, 96th and 166th Day Bombardment Squadrons and 258th Heavy Bombardment Squadron.
- 1st Pursuit Group: Headquarters, Kelly Field, Tex. Troops: 27th, 94th, 95th and 147th Pursuit Squadrons.
- 1st Observation Group: Headquarters, Manila, P. I. Troops: 2nd and 3rd Observation Squadrons.
- 1st Surveillance Group: Headquarters, camp at Fort Bliss, Tex. Troops: 8th, 90th and 104th Surveillance Squadrons.
- 1st Army Observation Group: Headquarters, Langley Field, Hampton, Va. Troops: 1st and 12th Army Observation Squadrons.
- 2nd Observation Group: Headquarters, Honolulu, Hawaii. Troops: 4th and 6th Observation Squadrons.
- 3rd Observation Group: Headquarters, France Field, Canal Zone. Troops: 5th (not yet joined) and 7th Observation Squadron.

AERO SQUADRONS

- 1st Army Observation, Mitchel Field, Garden City, N. Y.
 2nd Observation, Fort Mills, P. I.
 3rd Observation, Camp Stotseburg, P. I.
 4th Observation, Luke Field, Fords Island, Hawaii, Flight A, Schofield Barracks, Hawaii.
 5th Observation, Mitchel Field, Mineola, N. Y.
 6th Observation, Luke Field, Fords Island, Hawaii.
 7th Observation, France Field, C. Z.
 8th Surveillance, McAllen, Tex., Flight B, D. S., Cp. Bragg, N. C.
 9th Corps Observation, Mather Field, Calif., Flight A, D. S., Fresno, Calif. Flight B, D. S., Red Bluff, Calif.
 10th Corps Observation, Bolling Field, Anacostia, D. C.
 11th Day Bombardment, Kelly Field, San Antonio, Tex.
 12th Army Observation, Nogales, Ariz., Flight A, Douglas, Ariz.
 20th Day Bombardment, Kelly Field, San Antonio, Tex.
 27th Pursuit, Kelly Field, San Antonio, Tex.
 50th Observation, Langley Field, Hampton, Va., Flight A, Fort Screvens, Ga. Flight B, Langley Field, Hampton, Va.
 88th Observation, Langley Field, Hampton, Va.
 90th Surveillance, Sanderson, Tex., Flight A, Del Rio, Tex.
 91st Corps Observation, Rockwell Field, Calif., Flight A, Puryear Field, El Canto, Calif.
 94th Pursuit, Kelly Field, San Antonio, Tex.
 95th Pursuit, Kelly Field, San Antonio, Tex.
 96th Day Bombardment, Kelly Field, San Antonio, Tex.
 99th Corps Observation, Bolling Field, Anacostia, D. C.
 104th Surveillance, Camp at Fort Bliss, Tex., Flight B, Post Field, Fort Sill, Okla.
 135th Observation, Post Field, Fort Sill, Okla., Flight A, D. S., Fort Leavenworth, Kans.
 147th Pursuit, Kelly Field, San Antonio, Tex.
 166th Day Bombardment, Kelly Field, San Antonio, Tex.
 258th Heavy Bombardment, Aberdeen Proving Ground, Md.
 614th Construction, Camp Travis, Tex.

AIR PARK COMPANIES

- 2nd, Kelly Field, San Antonio, Tex.
 5th, Kelly Field, San Antonio, Tex.

AIRSHIP COMPANIES

- No. 8, Camp Owen Biene, Fort Bliss, Tex.
 No. 10, Langley Field, Hampton, Va.
 No. 16, Brooks Field, San Antonio, Tex.
 No. 19, Langley Field, Hampton, Va.

BALLOON COMPANIES

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| No. 1, Ross Field, Arcadia, Calif. | No. 5, Brooks Field, San Antonio, Tex. |
| No. 2, Ross Field, Arcadia, Calif. | No. 6, Brooks Field, San Antonio, Tex. |
| No. 3, Fort Ruber, H. T. | |
| No. 4, Fort Leavenworth, Kans. | |

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| No. 7, Brooks Field, San Antonio, Tex. | No. 21, Fort Kamehameha, H. T. |
| No. 9, Fort Omaha, Nebr. | No. 22, D. S., Princetown, Mass. |
| No. 11, Brooks Field, San Antonio, Tex. | No. 23, Post Field, Fort Sill, Okla. |
| No. 12, Fort Omaha, Nebr. | No. 24, Fort Winfield Scott, Calif. |
| No. 13, Ross Field, Arcadia, Calif. | No. 25, Ross Field, Arcadia, Calif. |
| No. 14, Fort Winfield Scott, Calif. | No. 26, D. S., Princetown, Mass. |
| No. 15, Ross Field, Arcadia, Calif. | No. 27, Manila, P. I. |
| No. 17, Manila, P. I. | No. 28, Lee Hall, Va. |
| No. 18, Aberdeen Proving Ground, Md. | No. 29, Lee Hall, Va. |
| No. 20, Lee Hall, Va. | No. 30, Lee Hall, Va. |
| | No. 31, Goodman Field, West Point, Ky. |
| | No. 32, Camp Benning, Ga. |

PHOTO SECTIONS

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|---------------------------------------|---|
| No. 1, Camp at Fort Bliss, Tex. | No. 11, Honolulu, Hawaii. |
| No. 2, Kelly Field, San Antonio, Tex. | No. 12, France Field, Canal Zone. |
| No. 4, D. S., Camp Knox, Ky. | No. 14, Mitchel Field, L. I. |
| No. 6, Manila, P. I. | No. 15, Crissy Field, San Francisco, Calif. |
| No. 7, Langley Field, Hampton, Va | |

ARMY SERVICE CORPS

- Provisional Guard Company No. 3, Germany, A. P. O. 927.
 Provisional Guard Company No. 9, Germany, A. P. O. 927.
 Provisional Guard Company No. 12, Germany, A. P. O. 927.
 Provisional Guard Company No. 13, Germany, A. P. O. 927.

AIR ASSISTANTS ASSIGNED BY U. S. AIR SERVICE FOR DUTY ABROAD

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|---|--|
| *Major Melvin H. Hall,
American Embassy,
London, England. | *Lt. Col. James E. Chaney,
American Embassy,
Rome, Italy. |
| *Major J. H. Brereton,
American Embassy,
Paris, France. | *Major Benjamin D. Foulois,
No. 7 Wilhelmplatz,
Berlin, Germany. |
| | Lt. Col. Edward Davis,
American Embassy,
The Hague, Netherlands. |

*Pilot.

AIRCRAFT

CLASSIFIED LIST OF AIR SERVICE FIELDS, STATIONS, DEPOTS, ETC.

CLASS I—ACTIVE STATIONS

FLYING FIELDS

NAME.	P. O. ADDRESS.	SPECIAL FUNCTION.
Carlstrom Field.....	Arcadia, Fla.	Pilot School.
Kelly Field.....	San Antonio, Tex.	Border Operations and Training.

NAME.	P. O. ADDRESS.	SPECIAL FUNCTION.
Langley Field	Hampton, Va.	Flying Field.
March Field	Riverside, Calif.	Pilot School.
Mather Field	Sacramento, Calif.	Operations,
Mitchel Field	Garden City, L. I., N. Y.	Operations,
Post Field	Ft. Sill, Okla.	Obs. School.

EXPERIMENTAL FIELD

McCook Field Dayton, Ohio Aeronautical Engineering

BALLOON SCHOOLS

Army Balloon School.....Ft. Omaha, Nebr. Balloon Training.
 Army Balloon School.....Lee Hall, Va. Balloon Training.
 Brooks FieldSan Antonio, Tex.Dirigible Training.
 Ross FieldArcadia, Calif.Balloon Training.

AVIATION GENERAL SUPPLY DEPOTS

Avia. Gen. Supply Depot Americus, Ga. Gen. Supply Depot.
 and Souther Field.
 Avia. Gen. Supply Depot Fairfield, Ohio Gen. Supply Depot.
 and Wilbur Wright Field
 Avia. Gen. Supply Depot...Houston, Tex. Gen. Supply Depot.
 Avia. Gen. Supply Depot...Little Rock, Ark. Gen. Supply Depot.
 Avia. Gen. Supply Depot...Middletown, Pa. Gen. Supply Depot.
 Avia. Gen. Supply Depot...Richmond, Va. Gen. Supply Depot.
 Avia. Gen. Supply Depot...San Antonio, Tex. Gen. Supply Depot.
 Avia. Gen. Supply Depot...Washington, D. C. Gen. Supply Depot.
 Avia. Gen. Supply Depot...Morrison, Va. Gen. Supply Depot.

AVIATION SUPPLY & REPAIR DEPOT

Avia. Supply and Repair Rockwell Field, Coro- Sup. & Repr. Depot.
 Depot. nado, Cal.

WAREHOUSE, MATERIALS DISPOSAL & SALVAGE DIVISION

Storage Warehouse.....Detroit, Mich.Storage Warehouse.

TEMPORARY STORAGE DEPOTS

*Barron Field.....Everman, Tex.Temporary Storage.
 Chanute Field.....Rantoul, Ill.Temporary Storage.
 Dorr FieldArcadia, Fla.Temporary Storage.
 Ellington FieldHouston, Tex.Temporary Storage.
 *Gerstner FieldLake Charles, La.Temporary Storage.
 *Chapman FieldMiami, Fla.Temporary Storage.
 Love FieldDallas, Tex.Temporary Storage.
 Park FieldMillington, Tenn.Temporary Storage.
 *Rich FieldWaco, Tex.Temporary Storage.
 Scott FieldBelleville, Ill.Temporary Storage.
 *Taliaferro FieldHicks, Tex.Temporary Storage.
 SelfridgeMt. Clemens, Mich. ... Temporary Storage.

*Under process of abandonment. Still under jurisdiction of C. A. S.

REPAIR DEPOTS

NAME.	P. O. ADDRESS.	SPECIAL FUNCTION.
Avia. Repair Depot.....	Dallas, Tex.	Repair Depot.
Avia. Repair Depot.....	Montgomery, Ala.	Repair Depot.
*Avia. Repair Depot.....	Speedway, Indianapo- lis, Ind.	Repair Depot.

ARTILLERY FIRING CENTERS

Godman Field	Camp Knox, Stithton, F. A.	Firing Center.
	Ky.	
Pope Field	Camp Bragg, Fayette- ville, N. C.	F. A. Firing Center.

AIR SERVICE MECHANICS SCHOOL

Kelly Field	San Antonio, Tex.	Mechanics School.
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PHOTOGRAPHIC SCHOOL

Langley Field	Hampton, Va.	Photographic School.
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AERIAL COAST DEFENSE

France Field	Panama Canal Zone....	Aerial Coast Defense.
Luke Field	Pearl Harbor, H. I....	Aerial Coast Defense.
Philippine Dept.	Manila, P. I.	Aerial Coast Defense.
Langley Field	Hampton, Va.	Aerial Coast Defense.
New Dorp.	Staten Island, N. Y. ...	Aerial Coast Defense.

ORDNANCE PROVING GROUND

Aberdeen Proving Ground..	Aberdeen, Md.	Ord. Proving Ground.
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CORPS AREA AND DEPARTMENT AIR SERVICE OFFICERS

First Corps Area.....	99 Chauncey St., Bos- ton, Mass.	C. A. A. S. Office.
Second Corps Area.....	Ft. Schuyler, N. Y. ...	C. A. A. S. Office.
Third Corps Area.....	Baltimore, Md. (Temp.)..	C. A. A. S. Office.
Fourth Corps Area.....	206 Riggs Bldg., Charles- ton, S. C. (Temp.)	C. A. A. S. Office.
Fifth Corps Area.....	Ft. Benjamin Harrison, Indiana.	C. A. A. S. Office.
Sixth Corps Area.....	230 E. Ohio St., Chicago, Ill. (Temp.)	C. A. A. S. Office.
Seventh Corps Area.....	Ft. Crook, Nebr.	C. A. A. S. Office.
Eighth Corps Area.....	Ft. Sam Houston, Tex..	C. A. A. S. Office.
Ninth Corps Area.....	Sante Fe Bldg., San Francisco, Cal. (Temp.)	C. A. A. S. Office.
Hawaiian Dept.	Honolulu, H. I.	D. A. S. Office.
Panama Canal Dept.	Canal Zone	D. A. S. Office.
Philippine Dept.	Manila, P. I.	D. A. S. Office.

DISTRICT OFFICES

Buffalo, N. Y.	2050 Elmwood Ave. ...	District Office.
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Name	P. O. Address	Special Function
Boston, Mass.99 Chauncey St.	District Office.
Chicago, Ill. ....	.230 E. Ohio St.	District Office.
Portland, Oregon	Yeon Bldg.	District Office.
New York, N. Y.	Starr & Borden Aves., L. I. City, N. Y.	District Office.
San Francisco, Calif.	Sante Fe Bldg.	District Office.

PLANTS

U. S. Fabric Inspec. Depot..Saylesville, R. I.Fabric Inspec.
 U. S. Aeron, Engine Plant..Long Island City, N. Y., Aeronautical Eng.
 Starr & Borden Aves.
 Goodyear Tire & Rub. Co..Akron, OhioBalloons.

U. S. BORDER PATROL AIRDROMES

McAllen AirdromeMcAllen, Tex.Border Patrol.
 Laredo AirdromeLaredo, Tex.Border Patrol.
 Marfa AirdromeMarfa, Tex.Border Patrol.
 Del Rio Airdrome.....Del Rio, Tex.Border Patrol.
 El Paso AirdromeEl Paso, Tex.Border Patrol.
 Douglas AirdromeDouglas, Tex.Border Patrol.
 Sanderson AirdromeSanderson, Tex.Border Patrol.
 Calexico AirdromeCalexico, Calif.Border Patrol.

CLASS II—INACTIVE STATIONS

FLYING FIELDS

Bolling FieldAnacostia, D. C. FLYING FIELD.
 Rockwell FieldCoronado, Calif. FLYING FIELD.

AIRCRAFT YEAR BOOK

NAVAL AVIATION

OFFICERS ASSIGNED TO NAVAL AVIATION ON DUTY IN
NAVY DEPARTMENT

OFFICE OF NAVAL OPERATIONS

Capt. T. T. Craven, U. S. N.
 Commander W. J. Giles, U. S. N.
 *Commander Kenneth Whiting, U. S. N.
 Commander R. M. Griswold, U. S. N.
 *Lt. Comm. P. N. L. Bellinger, U. S. N.
 *Lt. Comm. R. E. Byrd, U. S. N.
 *Lt. Comm. Zachary Lansdowne, U. S. N.
 *Lt. Comm. J. P. Norfleet, U. S. N.
 Lt. Comm. C. Y. Johnson, U. S. N.
 *Lt. Comm. N. B. Chase, U. S. N.
 *Lt. Comm. Wadleigh Capehart, U. S. N.
 Lt. (J. G.) James J. McAtee, U. S. N. R. F.
 Lt. Ernest J. Fuller, U. S. N. R. F.
 Lt. (J. G.) Chase E. Mathews, U. S. N. R. F.

BUREAU OF NAVIGATION

Lt. Comm. R. M. Griffin, U. S. N.
 *Lt. W. L. Richardson, U. S. N. R. F.
 Lt. (J. G.) C. N. Keyser, U. S. N. R. F.

BUREAU OF ENGINEERING

Lt. Comm. S. M. Kraus, U. S. N.
 *Lt. Comm. B. G. Leighton, U. S. N.
 Lt. Chas. F. Goob, U. S. N. R. F.
 *Lt. H. W. Roughley, U. S. N. R. F.
 Lt. Howard W. Kitchen, U. S. N.
 *Lt. (J. G.) E. B. Koger, U. S. N. R. F.
 *Lt. (J. G.) M. E. Williams, U. S. N. R. F.
 Lt. (J. G.) M. Z. Bishop, U. S. N. R. F.
 Lt. (J. G.) Joseph C. Jennings, U. S. N. R. F.
 *Ens. Wm. Miller, U. S. N.

BUREAU OF CONSTRUCTION AND REPAIR

Commander J. C. Hunsaker, U. S. N.
 Lt. Comm. Garland Fulton, U. S. N.
 Lt. Carl B. Harper, U. S. N. R. F.
 *Lt. Edw. W. Rounds, U. S. N. R. F.
 *Lt. (J. G.) Chas. E. Baugh, U. S. N. R. F.
 Lt. (J. G.) W. G. Brown, U. S. N. R. F.
 Lt. (J. G.) Chas. H. Chatfield, U. S. N. R. F.
 Lt. (J. G.) W. S. Diehl, U. S. N. R. F.

*Pilot.

Lt. (J. G.) Raymond D. MacCart, U. S. N. R. F.
 Lt. (J. G.) Chas J. McCarthy, U. S. N. R. F.
 Lt. (J. G.) Chris. A. Rodegerdts, U. S. N. R. F.
 *Lt. (J. G.) Walter C. Wilson, U. S. N. R. F.

BUREAU OF ORDNANCE

Lt. Comm. J. W. Rankin, U. S. N.

BUREAU OF SUPPLIES AND ACCOUNTS

Lt. Comm. Emory D. Stanley, U. S. N.

YARDS AND DOCKS

Lt. K. B. Bragg, U. S. N.

LIST OF OFFICERS AT NAVAL AIRCRAFT FACTORY,
LEAGUE ISLAND, PHILA.

Comm. G. C. Westervelt, U. S. N.
 *Comm. H. C. Richardson, U. S. N.
 *Comm. R. D. Weyerbacher, U. S. N.
 Lt. S. S. Pierce, U. S. N. R. F.
 Lt. W. McFellers, U. S. N. R. F.
 *Lt. R. W. Fleming, U. S. N.
 Lt. R. S. Barnaby, U. S. N. R. F.
 Lt. (J. G.) W. B. Dunlap, U. S. N. R. F.
 Lt. (J. G.) R. Emerson, U. S. N. R. F.
 Lt. (J. G.) V. N. McKenna, U. S. N. R. F.
 Ens. W. A. Sprout, U. S. N. (T).

COMMANDER AIR FORCE, ATLANTIC FLEET

Capt. A. W. Johnson, U. S. N.

COMMANDER AIR FORCE, PACIFIC FLEET

*Capt. H. C. Mustin, U. S. N.

*Pilot.

GRADUATES OF NAVAL ACADEMY WHO ARE ALSO NAVAL
AVIATORS AS OF NOV. 1st, 1920.

CAPTAINS.

H. C. Mustin.
 G. W. Steele.
 COMMANDERS.
 W. G. Childs.
 Kenneth Whiting.
 R. W. Cabannis.
 A. C. Read.
 L. H. Maxfield.
 H. C. Richardson.
 R. D. Weyerbacher.
 J. H. Towers.

LIEUTENANT

COMMANDERS.

A. H. Douglas.
 Geo. D. Murray.
 Harold B. Grow.
 Wm. Masek.
 C. P. Mason.
 M. A. Mitecher.
 V. C. Griffin.
 L. L. Babbitt.
 H. T. Bartlett.
 G. D. Chevalier.

B. G. Leighton.	H. W. Hoyt.
H. B. Cecil.	R. G. Pennoyer.
E. W. Coil.	R. W. Fleming.
D. W. C. Ramsey.	John F. Maloney.
R. E. P. Elmer.	John D. Price.
V. D. Herbster.	Calvin T. Durgin.
Newton H. White, Jr.	A. J. Selman.
R. D. Kirkpatrick.	R. M. Farrar.
J. C. Montfort.	J. J. Ballentine.
R. R. Paunack.	F. B. Connell.
E. W. Spencer.	E. L. Erickson.
Paul Cassard.	J. S. Farnsworth.
P. N. L. Bellinger.	J. G. Farrell.
R. E. Byrd.	F. C. Fechteler.
Wadleigh Capehart.	V. F. Grant.
N. B. Chase.	W. S. Factor.
Zachary Lansdowne.	J. B. Kneip.
J. P. Norfleet.	A. C. McFall.
LIEUTENANTS.	K. McGinnis.
Homan J. Miller.	A. W. Radford.
Harry V. Baugh.	Hugo Schmidt.
F. W. Wead.	J. H. Strong.
R. E. Davison.	C. W. Wieber.
C. J. McReavy.	G. B. Woolley.
W. D. Thomas.	H. E. Halland.
Homer Clark.	C. H. Havill.
F. B. Stump.	

LIST OF NAVAL AIR STATIONS AND FIELDS WHERE EXPERIMENTAL WORK OR TRAINING IS CARRIED ON.

Rockaway, L. I.	Coco Solo, C. Z.
Anacostia, D. C.	Pearl Harbor, T. H.
Hampton Roads, Va.	Lakehurst, N. J.
Pensacola, Fla.	Cape May, N. J.
San Diego, Calif.	Dahlgren, Va.
Carlstrom Field, Arcadia, Fla. (Courtesy U. S. Air Service).	
Great Lakes, Machinists School.	
Naval Training Station, Great Lakes.	
March Field, Riverside, Cal. (Courtesy U. S. Air Service).	
Mineola, Mitchel Field, L. I. (Courtesy U. S. Air Service).	

NUMBER OF OFFICERS AND MEN

The total personnel, officers and enlisted men, assigned to Naval Aviation, as of December 15, 1920, was 7,883. Of this number 624 were officers, classified as follows: 376 qualified aviators, heavier-than-air and lighter-than-air; 39 student aviators; 114 ground officers; 95 staff officers. Of the 376 qualified aviators, 244 are in the Naval Reserve, 60 hold temporary commissions and 72 are regular officers in the U. S. Navy. Forty more graduates of the Naval Academy began aviation instruction December 1, 1920. Including reserves and temporary commissioned officers, 52 aviators were attached to the Atlantic Fleet and 50 to the Pacific Fleet, as of November 1, 1920. Of the enlisted personnel, 4627 had aviation ratings and 2632 general ratings, as of November 1, 1920.

NAVAL OFFICERS PERFORMING AVIATION DUTIES ABROAD.

*Lieut. R. G. Pennoyer, London.

*Lieut. F. P. Culbert, Berlin.

*Pilot.

DATA ON UNITED STATES DIRIGIBLE Z.R.-2 (FORMERLY THE R-38)
AND PLANS FOR FLIGHT TO UNITED STATES IN 1921

Successful operation of lighter-than-air craft over both land and water during the war, and proof of its usefulness in national defense, impelled Naval Aviation to recommend an airship building program. To save time and gain experience, the R-38, one of two dirigibles under construction at the Royal Airship Works, Bedford, England, was purchased from the British Government. It was renamed the Z.R.-2, another, an American airship under construction in the United States, having been named the Z.R.-1.

The compilers of this volume are indebted to Naval Aviation for release of certain data concerning the Z.R.-2 and an account of typical airship operations, which probably has anticipated the methods of operating the giant dirigible which the Navy Department hoped to fly to the United States soon after its completion in February, 1921.

A detachment of 72 U. S. Naval Aviation officers and men were in training for this purpose at the Royal Air Station, Howden, England, for many months in 1920. The party, headed by Commander L. H. Maxfield, had navigated the R.-32, a British dirigible similar to the R.-34, and also received technical instruction at the Royal Airship Works at Cardington, Bedford; and at the Sunbeam Motor Works, Wolverhampton, where the power plants for the Z.R.-2 were assembled.

In 1919, the airship R.-34 made an epochal round-trip flight across the Atlantic. Huge as that craft appeared, it is almost one-third smaller than the Z.R.-2 and has only half the cruising range. This would seem to indicate the possibility of the Z.R.-2 not only flying the Atlantic in 1921, but actually continuing on, possibly without pause, until it reaches the Pacific Ocean.

The Z.R.-2 is approximately 700 feet long and more than 85 feet in diameter. It has a gas capacity of 2,720,000 cubic feet, as against 2,000,000 cubic feet for the R.-34. The disposable lift of the Z.R.-2 is about 45 tons, while that of the R.-34 is only about 25 tons. The economic cruising speed of the Z.R.-2 is around 60 miles an hour. There are six engine cars.

Airship terminals at Lakehurst, N. J., and Cape May, N. J., were being completed late in 1920. It is expected to establish a

terminal on the Pacific Coast. The hangar at Lakehurst is the largest in the world and was designed to house the Z.R.-2 and permit the assembling of the Z.R.-1.

In daily routine aboard the big airships, the first thing done is to take "lift and trim." This means calculating the total lift of the airship by adding up the amount of ballast — i.e., water, gasoline, oil, etc., on board, and noting its location on a chart. In this way a record of the airship's daily lift and variation from day to day is noted. Thus, if to-day's lift is appreciably less than it was yesterday, and no gas has been valved, there is obviously a loss somewhere, and a search for leaks in the gas bags is made. By noting the location of ballast on board, the "trim"—i.e., the tendency for lightness or heaviness in one end of the ship or the other—can be seen and compensated for if necessary, it being desirable to keep weights distributed as evenly as possible along the length of the ship to avoid stresses on the hull structure.

After "lift and trim" is taken, the airship is thoroughly cleaned. Engineers then do any necessary work on the engines and cars, riggers inspect controls, gas bags, valves, the outer cover, fin surface, etc., and do the necessary upkeep work, and, where there is a wooden hull, carpenters inspect and repair the framework.

Once a week the purity of each gas bag in the ship is tested, this serving as a check on the general condition of gas tightness of each bag and the ship as a whole. As the purity of the gas directly affects the lift of the ship no pains are spared to keep the gas bags always in the best possible condition.

In preparing ship for flight it is first necessary to know how large a crew is going to be carried and the length and nature of the flight, as knowing this it is then possible to figure out just how much gas is needed to give the necessary additional lift, how much ballast and fuel must be carried. The officer in charge of the operation having figured out just what is necessary, informs the Chief Engineer and gas plant how much gas will be needed. Members of the crew take their respective stations. Gas is taken into the ship through a central gassing hose about twelve inches in diameter with leads off to each gas bag, and comes in directly from the holders through large gas mains sunk in the hangar floor. Four riggers are detailed to put water ballast aboard as it is needed when the lift increases from incoming gas.

When the ship is gassed, fuelled and ballasted, a very careful "lift and trim" is taken and charts made out showing the amounts and location of all fuel and ballast. These charts are posted in the control car and are referred to by the operating officers during

flight. Engineers finally check and run all engines and the ship is ready for flight. When the ship is ready to go out, the flying crew gets on board, sufficient ballast being discharged to compensate for the weight of the crew taken on board. As soon as the ship is clear of the hangar the ship's nose is turned into the wind, in which position it is guided to the desired point for taking off.

The ship in flight is operated as far as possible along the lines of seagoing operation and orders are given and watches stood and relieved similarly. In the present ships where the radio cabin is in the control car there is also a radio operator always on watch. In the power cars there is one engineer always on watch. Orders from the control car to power units are transmitted by engine telegraph similar to ship engine telegraphs but especially designed for airships.

Meals are served at regular times. There are two cooks attached to two of the power units and hot coffee or chocolate and a certain amount of hot food can be served. One of the crew is assigned as cook, and he prepares and serves the meals. In landing, which is done at a set time as received by radio from the Station or Base, the crew are piped to landing stations where they remain with as little movement as possible while the ship is put in trim and its buoyancy checked and regulated. The station is radioed for the ground wind, its direction, the temperature, and barometric pressure which, when received, enable the Captain to make the necessary landing calculations.

The following is the personnel of the Z.R.-2:

OFFICERS

- | | |
|--|--|
| *L. H. MAXFIELD, Comdr., USN.—
Commanding Officer | *M. H. ESTERLEY, Lieut., USNRF. |
| V. N. BIEG, Lieut. Comdr., USN. | W. R. TAYLOR, Lieut. (MC), USN. |
| *E. W. COIL, Lieut. Comdr., USN. | J. H. KYGER, Lieut. (SC), USN. |
| *H. W. HOYT, Lieut., USN. | *J. H. HYKES, Ensign, USN. |
| *R. W. PENNOYER, Lieut., USN. | *W. J. MEDUSKY, Ensign, USN. |
| *C. G. LITTLE, Lieut., USNRF. | *S. S. HALLIBURTON, Ch. Mach., USN. |
| *T. B. NULL, Lieut., USNRF. | H. T. DYER, Comdr., USN. (special
representative Bureaus of Engi-
neering and Construction and Re-
pair). |
| *J. B. LAWRENCE, Lieut., USNRF. | |
| *A. R. HOUGHTON, Lieut., USNRF. | |
| *Pilot. | |

ENLISTED MEN

ALLER, C. I.	CBM	CASS, C. W.	CMM (A)
BROOM, C. H.	CMM (A)	COLLINS, G. F.	CR (R)
BURNETT, J. C.	CY	COONS, R. M.	CMM (A)
CARLSON, A. E.	CQM (D)	CROWL, L. E.	CMM (A)
CHRISTENSEN, H.	CQM (D)	CULLINAN, J. W.	CMM (A)
COLLIER, J. H.	CCM (A)	CUTLER, F. H.	Y-3
COLEMEN, L. K.	CMM (A)	DEEM, C. M.	MM-1 (A)

DICKERSON, T. D.	CMM (A)	McCARTHY, J. F.	QMI (D)
Downs, E. S.	CPM	McCAULEY, C. J.	MMI (A)
FRANK, C. W.	QM-1 (D)	MOORMANN, F. F.	CMM (A)
GALATIAN, A. B.	CMM (A)	O'CLAIRE, H. H.	CBM
HANCOCK, J. T.	CMM (A)	PECKHAM, F. L.	CQM (D)
HARRIGAN, J. J.	CQM (D)	PETTIT, A.	CBM
HECKBERT, C. A.	BM-1	RUSSELL, W. A.	CMM (A)
HEGEL, M. C.	Y-3	SHIELDS, S.	CCM (A)
JONES, R.	MM-1	STEELE, W. J.	CMM (A)
JULIUS, W.	CMM (A)	STEVENS, L. T.	CMM (A)
KNIGHT, S. H.	QM-1	THOAMS, T. L.	CQM (D)
LAY, M.	CBM	WALKER, N. C.	QM-3 (D)
LAMKEY, W. A.	CMM (A)	WATERMAN, J. E.	E-1 (R)
LEONARD, J. J.	CQM (D)	WELCH, G.	CMM (A)
LEWIS, E. C.	CQM (D)	RILEY, E. M.	CY
LOFTIN, A. L.	MMI (A)		

SUMMARY OF WORK AT NAVAL AIRCRAFT FACTORY

The annual report of the Chief of the Bureau of Construction and Repair, for the fiscal year 1920, states with regard to the Naval Aircraft Factory:

"Experimental and research work along various lines has continued at a somewhat limited pace during the year, due to curtailment of appropriations and consequent reduction in personnel."

During the year, four more flying boats of the N.C. type, which crossed the Atlantic, were built, and two more are under construction. The Bureau also undertook the development of a design for a seaplane larger than any in existence, a 60,000 pound flying boat. The design embodies several new features, including metal wing structures and a unique power plant of nine Liberty engines in three groups, each group being geared to a single propeller.

During the year work progressed on the construction of a 1,940,000 cubic foot rigid airship similar to the German L.-49 class.

A series of F.-5 boats drawn from store has been altered in an effort to determine possible improvements as follows: one boat fitted with folding wings, one with tandem Liberty engines, one with streamline wire, one with new type of bottom, one with fireproof wings, and one with a well for a mapping camera.

AERONAUTICAL ACTIVITIES, BUREAU OF ENGINEERING

In an endeavor to provide a suitable power plant for aircraft of apparently ever-increasing size, the bureau has taken up the question of multi-engined power plants driving a single propeller with a view to using either a single unit of this type in large aircraft, or a number of such units. During the year, such units were under development and construction, the types developed including those suitable for installation in both seaplanes and airplanes and types for installation in rigid or non-rigid airships.

Aviation may very shortly expect to have available air-cooled engines of domestic manufacture equal in performance to the better types of water-cooled engines now in use.

There have been interesting developments in composition, metal and variable pitch propellers.

The development in radio has been mainly along the following lines: lightning of apparatus, improvement in receiving facilities, elimination of confusing noises, improvement of inter-communication.

MARINE CORPS

MARINE CORPS OFFICERS ON ACTIVE DUTY AS QUALIFIED NAVAL AVIATORS

MAJORS.

Alfred A. Cunningham.
Thomas C. Turner.
Francis T. Evans.
Roy S. Geiger.

CAPTAINS.

Robert J. Archibald.
David L. S. Brewster.
Benjamin Goodman.
Walter E. McCaughtry.
George W. Martin.
Harvey B. Mims.
John A. Minnis.
Arthur H. Page, Jr.
Russell A. Presley.

FIRST LIEUTENANTS.

Basil G. Bradley.
Kenneth B. Collins.
Frank H. Fleer.
Harold C. Major.
Francis P. Mulcahy.
Stanley H. Ridderholk.
Ford O. Rogers.

Thomas R. Shearer.

SECOND LIEUTENANTS.

Amos P. Booty.
Hayne D. Boyden.
Walter V. Brown.
Arthur L. Caperton.
Franklin G. Cowie.
Guy B. Hall.
Donald E. Keyhoe.
Goodyear W. Kirkman.
Duncan W. Lewis.
Edw. G. MacFayden.
George L. Murray.
Herman J. Norton.
Horace D. Palmer.
Jacob F. Plachta.
Eugene Rovegno.
Lawson H. Sanderson.
Christian F. Shilt.
Russell L. Stephens.
Leo Sullivan.
Harold H. Titus.
Sherman H. Zea.

AVIATION STATIONS OF MARINE CORPS

Marine Flying Field,
Marine Barracks,
Quantico, Va.
Marine Flying Field,
Marine Barracks,
Parris Island, S. C.
Squadron "D,"

Marine Aviation Force,
Santo Domingo City, D. R.
Squadron "E,"
Marine Aviation Force,
Port au Prince,
Republic of Haiti.

A flying field similar to the one at Quantico is being established at San Diego, California.

Enlisted personnel for Aviation are trained at Aviation Mechanics School, Great Lakes, Ill.

On account of the flying field at Quantico not being completed some officers have been sent in the past to the U. S. Air Service Field at Arcadia, Fla., for advanced training.

OFFICERS AND ENLISTED MEN IN MARINE CORPS

As of November 1, 1920, there were 1,034 officers and men in Marine Corps Aviation, of which 58 were officers, 4 warrant officers and 972 enlisted men. There are 285 Marine officers qualified as naval aviators.

AERONAUTICAL BOARD

The object of this Board is to prevent duplication, and to secure coordination in Aviation matters of the Army and the Navy, to draw plans for new projects, for the construction of aircraft, for experimental stations, for coastal air stations, for stations to be used jointly by the Army and the Navy, or for extensive additions thereto.

The membership of the Aeronautical Board is as follows:

ARMY.	NAVY.
Major General Chas. T. Menoher, U. S. A., Chairman.	Captain Thomas T. Craven, U. S. N.
Lt. Col. J. E. Fechet, A. S.	Commander J. C. Hunsaker, U. S. N.
Lt. Col. A. W. Fuller, A. S.	Commander W. S. Pye, U. S. N.

WORKING COMMITTEE

Lieut. George C. Tinsley, A. S. Comm. Vaughn K. Coman, U. S. N.

TECHNICAL COMMITTEE

OPERATIONS, HEAVIER-THAN-AIR

Captain H. E. Hartney, A. S. Comm. Kenneth Whiting, U. S. N.

OPERATIONS, LIGHTER-THAN-AIR

Major P. E. Van Nostrand, A. S. Lieut. Comm. Z. Lansdowne, U. S. N.

DESIGN AND CONSTRUCTION, HEAVIER-THAN-AIR

Maj. Henry W. Harms, A. S. Comm. H. C. Richardson, U. S. N.

DESIGN AND CONSTRUCTION, LIGHTER-THAN-AIR

Major G. E. A. Hallett, A. S. Lieut. Com. G. Fulton, U. S. N.

AERONAUTICAL POWER PLANTS

Major H. S. Martin, A. S. Lieut. Comm. S. M. Kraus, U. S. N.

SECRETARY

Lieutenant A. J. Clayton, A. S.

The name of the Board, which had formerly been the Joint Army and Navy Board on Aeronautics, was changed by the Secretary of War and the Secretary of the Navy on December 29, 1919, to "The Aeronautical Board." Shortly after this the Joint Technical Board on Aircraft Except Zeppelins was dissolved and its functions taken over by the Aeronautical Board. Ten officers, five from the Army and five from the Navy, were then assigned to the Aeronautical Board as a Technical Committee in connection with the drawing up of projects for the development of aeronautics and air stations. The addition of the Technical Committee brought the number of officers assigned to the Board to a total of nineteen.

During the past year the Aeronautical Board has considered and made

recommendations upon many questions concerning the aeronautical work of the Army and Navy dealing with policy, production, purchase and sale of material, selection and construction of aeronautical sites and bases, training, operations, and the general functions of aircraft, with a view to securing coordination and preventing duplication of activities wherever possible.

Among the important recommendations recently made by the Board is the general policy relating to the use of Government landing fields and facilities by civil and commercial aircraft, which provides for the use of landing fields for emergency purposes, but does not permit of the use of such a field as a base for the operation of commercial aircraft.

THE HELIUM BOARD

The Helium Board (Army and Navy) in connection with the Bureau of Mines¹ has continued its development of and experiments with helium gas, for use in future lighter-than-air operations by the Army and Navy Air Services. Colonel C. DeF. Chandler, A. S., U. S. A., and Commander A. K. Atkins, U. S. N., constituted the membership of the Helium Board in 1920.

¹ See also Bureau of Mines report in Appendix.

THE AIR MAIL

PERSONNEL

Otto Praeger, Second Assistant Postmaster General.

Major L. B. Lent, Supt. of Engineering.	Charles I. Stanton, Supt. of Flying Operations.	Carl F. Egge, Supt. of Mail Transportation.
	D. B. Colyer, pilots, etc.	
	J. C. Edgerton, radio.	
	Charles Fay, inspection.	
	G. L. Conner, Chief Clerk.	
	E. W. Majors, Chicago Repair Depot.	
	C. A. Parker, Bustleton Repair Depot.	
	E. J. Scanlon, Newark Supply Depot.	

DIVISION SUPERINTENDENTS

P. W. Smith, Supt. New York-Cleveland-Wash. Division.....	Hazelhurst Field, Hempstead, L. I., N. Y.
J. E. Whitbeck, Supt. Cleveland-Chicago Division.....	Air Mail Field, Cleveland, Ohio.
E. W. Majors, Supt. Chicago-Omaha Division.....	Air Mail Field, Maywood, Ill.
C. F. Egge, Supt. Twin Cities-St. Louis Division.....	Air Mail Field, Minneapolis, Minn.
A. R. Dunphy, Supt. Cheyenne-Salt Lake Division.....	Air Mail Field, Cheyenne, Wyo.
J. A. Jordan, Supt. Pacific Division.....	Air Mail Field, Reno, Nev.

AIR MAIL PERFORMANCE

MONTH.	MILES FLOWN.	PERFORMANCE PER CENT.	LETTERS CARRIED.	COST.
1918				
May (15 days).....	5,324	78.87	190,000	\$ 3,682.11
June	10,685	94.97	523,240	9,922.71
July	11,855	97.57	678,680	10,001.46
August	11,984	99.96	663,520	9,555.67
September	10,900	100.00	608,000	9,638.74
October	11,617	98.68	671,520	9,841.76
November	11,118	98.07	674,160	10,673.68
December	8,415	77.23	711,120	13,300.46
	81,898	93.17	4,720,240	\$76,616.59

THE AIR MAIL

MONTH.	MILES FLOWN.	PERFORMANCE PER CENT.	LETTERS CARRIED.	COST.
1919				
January	9,653	82.00	724,200	\$13,741.58
February	9,307	88.18	619,560	13,645.16
March	10,699	92.59	701,240	13,880.29
April	11,105	95.06	667,080	13,516.44
May	22,578	96.92	1,065,060	17,715.66
June	30,835	99.65	1,425,880	30,891.62
July	56,577	96.04	1,948,160	41,134.36
August	58,022	98.43	2,274,800	40,614.59
September	56,308	98.60	2,227,520	34,861.53
October	50,437	86.27	2,203,800	35,609.03
November	41,757	86.91	2,163,360	31,127.58
December	35,782	73.61	1,649,840	33,909.86
	393,060	91.18	17,670,500	\$320,647.70
1920				
January	33,952	69.83	1,725,000	52,551.66
February (Hardest winter)...	32,647	71.02	1,489,680	46,004.12
March	37,861	77.25	1,694,440	44,725.71
April	41,890	86.16	1,682,640	55,343.40
May	54,132	90.72	2,044,480	57,004.83
June	49,867	69.74	2,360,200	80,209.43
July	74,002	96.39	2,576,040	85,993.59
August	116,023	.....	.....	70,074.30
September .....	.....	.....	.....	.....
October .....	.....	.....	.....	.....
November .....	.....	.....	.....	.....
December .....	.....	.....	.....	.....
	440,374	93.52	13,752,480	\$491,907.04
1918.....	81,898	93.17	4,720,240	\$76,616.59
1919.....	393,060	91.18	17,670,500	320,647.70
1920.....	440,374	93.52	13,752,480	491,907.04
	915,332	92.62	36,143,220	\$889,171.33

PLANES IN SERVICE

TYPE	ENGINE	HORSE POWER.	MAIL CAPACITY.	NUMBER	
				IN SERVICE.	NUMBER ON ORDER.
Curtiss J. N.-4-H....	Wright Engine...	150	200 lbs.	7	None
Standard J. R.-1-B....	Wright Engine...	150	200 lbs.	7	None
Curtiss R.-4-L.....	Liberty-12	400	400 lbs.	17	None
D. H.-4 Remodeled..	Liberty-12	400	400 lbs.	40	12
Twin D. H.....	2 Liberty-6.....	400	600 lbs.	20	None
Curtiss H. A.....	Liberty-12	400	800 lbs.	2	None
Glenn L. Martin....	2 Liberty-12.....	800	1500 lbs.	3	None
Junker (J. L.-6)....	B. M. W.	200	1000 lbs.	4	None
L. W. F. (type V)..	Isotta Fraschini...	250	500 lbs.	1	Pending

LIST OF AIR MAIL FIELDS

PLACE.	FIELD.	HANGARS.
Washington, D. C.	College Park, Md. Field leased—exclusive use.	Owned by P. O. Dept.
Philadelphia, Pa.	Bustleton, Pa. Field leased—exclusive use.	Owned by P. O. Dept.
New York, N. Y.	Curtiss Field, Hempstead, N. Y. Use of field leased from Curtiss Aeroplane and Motor Corp.	3 Hangars, 60'×100', leased from Curtiss Corporation.
Newark, N. J.	Heller Field, Newark, N. J. Nominal rental for field—exclusive use.	Hangar owned by P. O. Dept.
Bellefonte, Pa.	Nominal rental for field—exclusive use.	Hangar 60'×100' owned by P. O. Dept.
Clarion, Pa.	(Emergency) Municipal field—nominal rental.	Municipal Hangar, 60'×60'—nominal rental.
Cleveland, O.	Nominal rental for use of Glenn L. Martin Field.	Hangar 100'×100' owned by P. O. Dept.
Bryan, O.	Field leased, nominal rental, exclusive use.	Hangar 80'×100' leased, nominal rental, exclusive use.
Chicago, Ill.	Maywood, Ill. Field leased..	3 Hangars 90'×100' owned by P. O. Dept.
Rantoul, Ill.	Chanute Field (Army Air Service). No rental.	No rental for hangar (Army Air Service.)
St. Louis, Mo.	No rental for field—municipal.	Owned by P. O. Dept.
La Crosse, Wisc.	Municipal field—no rental.	Municipal hangar—no rental.
Minneapolis, Minn. ...	Field owned by Twin City Aero Corporation. Not exclusive use.	Owned by Twin City Aero Corp, exclusive use of hangar. Nominal rental.
Iowa City, Iowa	Public Field—no rental...	1 Hangar, 60'×100'.
Omaha, Nebr.	Public Field—no rental...	Exclusive use of Hangar, 100'×100'.
North Platte, Nebr. ...	Public Field—no rental...	Exclusive use of Hangar, 80'×90'.
Cheyenne, Wyo.	Public Field—no rental...	Exclusive use of Hangar, 80'×90'.
Rock Springs, Wyo....	Public Field—no rental...	Exclusive use of Hangar, 80'×90'.
Salt Lake City, Utah....	Public Field—no rental...	Exclusive use of Hangar, 80'×100'.
Elko, Nev.	Public Field—no rental...	Exclusive use of Hangar, 60'×100'.
Reno, Nev.	Public Field—no rental...	Exclusive use of Hangar, 60'×100'.
San Francisco, Cal.	Public Field—no rental...	Exclusive use of Hangar, 80'×100'.
Washington (College Park) and Newark Fields used by the New York-Washington Route.		

Philadelphia (Bustleton) is the Eastern Repair Depot.
Rantoul (Chanute Field) and St. Louis Fields used by the Chicago-St. Louis
Route.

LaCrosse and Minneapolis-St. Paul Fields used by Chicago-Twin City Route.
Chicago (Maywood) is also the Western Repair Depot.

TRANSCONTINENTAL AIR MAIL CONTROLS

<i>Curtiss Field, Long Island, New York —</i>	<i>Field Distance.</i>
Bellefonte, Pa.	230 miles
Clarion, Pa.	100 miles
Cleveland, Ohio	100 miles
Bryan, Ohio	165 miles
Chicago, Ill.	155 miles
Iowa City, Iowa	191 miles
Omaha, Nebr.	233 miles
North Platte, Nebr.	248 miles
Cheyenne, Wyo.	205 miles
Rock Springs, Wyo.	237 miles
Salt Lake City, Utah	163 miles
Elko, Nevada	235 miles
Reno, Nevada	200 miles
Sacramento, Calif.	97 miles
San Francisco, Calif.	92 miles
Totals.....	<hr/> 2651 miles

MISCELLANEOUS GOVERNMENTAL
FOREST FIRE PATROL RECORD

MATHER FIELD, CALIF.: (From May 17th, 1920.)

Number of patrols.....	120
Area covered	1,693,735 sq. miles.
Flying time	411 hours.
Fires discovered	137
Number of planes in commission July 31st.....	5

RED BLUFF, CALIF.: (From May 20th, 1920.)

Number of patrols.....	135
Area covered	1,456,360 sq. miles.
Flying time	372 hours.
Fires discovered	105
Number of planes in commission July 31st.....	6

FRESNO, CALIF.: (From May 16th, 1920.)

Number of patrols.....	124
Area covered	1,235,000 sq. miles.
Flying time	439 hours.
Fires discovered	65
Number of planes in commission July 31st.....	4

MARCH FIELD, CALIF.: (From May 20th, 1920.)

Number of patrols.....	138
Area covered	801,171 sq. miles.
Flying time	500 hours.
Fires discovered	40
Number of planes in commission July 31st.....	4

MEDFORD, OREGON: (From July 1st, 1920.)

Number of patrols.....	29
Area covered	345,180 sq. miles.
Flying time	110 hours.
Fires discovered	25
Number of planes in commission July 31st.....	4

EUGENE, OREGON: (From July 1st, 1920.)

Number of patrols.....	39
Area covered	715,645 sq. miles.
Flying time	163 hours.
Fires discovered	92
Number of planes in commission July 31st.....	6

U. S. COAST GUARD

(Treasury Department)

COMMANDANT, COMMODORE W. E. REYNOLDS, U. S. C. G.

- (a) Aide for Aviation, Coast Guard Headquarters, Washington.
Lieut. Comm. Stanley V. Parker, U. S. C. G.
- (b) Commanding Officer, Coast Guard Aviation Station, Morehead City, N. C.
Lieut. Commander (E) C. E. Sugden, U. S. C. G.
Officers on duty at Aviation Station, Morehead City.
Lieut. Comm. Robert Donohue, U. S. C. G.
Lieut. Comm. E. F. Stone, U. S. C. G.
Lieut. Comm. E. F. Palmer, U. S. C. G.
Gunner C. T. Thrun, U. S. C. G.
Gunner J. H. Earle, U. S. C. G.
Machinist W. S. Anderson, U. S. C. G.
Officers Qualified for Aviation Duty.
Flight.
Lieut. Comm. Stanley V. Parker, U. S. C. G.
Lieut. Comm. P. B. Eaton, U. S. C. G.
Lieut. Comm. E. A. Coffin, U. S. C. G.
Lieut. Comm. C. E. Sugden, U. S. C. G.
Lieut. Comm. Robert Donohue, U. S. C. G.
Lieut. Comm. E. F. Stone, U. S. C. G.
Lieut. Comm. W. P. Wishaar, U. S. C. G.
Lieut. Comm. C. C. Von Paulsen, U. S. C. G.
Gunner C. T. Thrun, U. S. C. G.
Machinist W. S. Anderson, U. S. C. G.
Engineering.
Lieut. Comm. (E) N. B. Hall, U. S. C. G.
Lieut. (E) E. F. Palmer, U. S. C. G.
Gunner J. H. Earle, U. S. C. G.
- (c) The complement of the Aviation Station is fixed at present at 31 enlisted men.

THE PUBLIC HEALTH SERVICE

(Treasury Department)

The Public Health Service, Treasury Department, controls the entry into American ports of civil aircraft. In the case of an aircraft leaving a foreign country, the pilot of such a craft must secure an American consular bill of health from the American consul at the port of departure, and at the port of arrival must pass quarantine inspection as for maritime carriers. For this purpose the United States quarantine regulations on October 22, 1920, have been amended as follows by the Secretary of the Treasury:—

Paragraph 2 is amended to read as follows:

"2. Masters of vessels or aircraft clearing from or leaving any foreign port or any port in the possessions or other dependencies of the United States for a port in the United States or its possessions or other dependencies must obtain a bill of health, in duplicate, signed by the proper officer or officers of the United States as provided for by law, except as provided for in paragraph 3."

Paragraph 47 is amended to read as follows:—

"47. The form of certificate which shall be issued to a vessel or aircraft

when released from quarantine shall be prescribed by the Surgeon General of the Public Health Service, and shall embody the statement that the vessel or aircraft has in all respects complied with the quarantine regulations prescribed by the Secretary of the Treasury, and that in the opinion of the quarantine officer it will not convey quarantinable disease, and that said vessel or aircraft is granted free or provisional pratique to enter her port of destination, the name of which is to be embodied in the blank."

SUB-COMMITTEE ON COMMERCIAL AVIATION
OF
ECONOMIC LIAISON COMMITTEE,
REPRESENTING
DEPARTMENTS OF THE GOVERNMENT
AND
CIVILIAN ACTIVITIES.

This committee, although without official standing, has endeavored to further aeronautics by discussing co-ordination of the various activities, gathering information and discussing current problems concerning the art.

THE MEMBERSHIP

- Dr. R. S. MacElwee, Dept. of Commerce, Washington, D. C. (Chairman.)
 W. R. Manning, State Department, Washington, D. C.
 S. S. Bradley, Manufacturers Aircraft Association, 501 Fifth Ave., N. Y. C.
 Capt. M. S. McCollough, U. S. A., Air Service, War Department, Washington, D. C.
 Comm. V. K. Coman, U. S. N., Navy Department, Washington, D. C.
 Capt. Stanley V. Parker, Coast Guard Headquarters, Washington, D. C.
 John M. Lyon, Bureau of Immigration, Department of Labor, Washington, D. C.
 J. C. Edgerton, Air Mail Service, Post Office Department, Washington, D. C.
 Capt. L. W. Miller, U. S. A., Air Service, War Department, Washington, D. C.
 Dr. L. J. Briggs, Bureau of Standards, Washington, D. C.
 Maj. H. M. Hickam, U. S. A., Air Service, War Department, Washington, D. C.
 Ernest C. Corkhill, Division of Customs, Treasury Department, Washington, D. C.
 George W. Lewis, National Advisory Committee for Aeronautics, Washington, D. C.

BUREAU OF FOREIGN AND DOMESTIC COMMERCE
(Department of Commerce)

The Bureau of Foreign and Domestic Commerce of the Department of Commerce has for some time been gathering information on commercial aviation, a considerable part of such material consisting of reports sent in by American consular officers in compliance with circular instructions and questionnaires prepared by the Bureau and issued through the Department of State. A request for information on commercial aviation has also been addressed to the commercial attachés of the Department of Commerce in a number of foreign countries, particularly for such information on the sub-

ject as may not be accessible to or not likely to be transmitted by consular officers.

BUREAU OF STANDARDS

(Department of Commerce)

The Bureau of Standards has for some time closely co-operated with the air services of both the Army and Navy. Its altitude laboratory, constructed at the time the United States entered the war, was for a long time the only plant of this kind in existence. It is so designed that the engine to be tested may be enclosed in an airtight concrete chamber from which the air and exhaust gases are removed by means of a vacuum pump. At the same time the temperature of the air entering the carburetor and within the chamber itself is reduced by a refrigerating plant so that the atmospheric conditions met with at any desired altitude up to about 35,000 feet may be duplicated. Complete equipment is provided for measuring the horsepower output of the engine as well as the temperatures and pressures at various points.

A very complete investigation of ignition appliances used in connection with aeronautic engines was started during the war and has been continued since that time. It has included the testing of all the commonly-used types of spark plugs, magnetos, and battery systems of ignition. A special spark plug porcelain was developed which possesses properties rendering it superior to the ordinary forms of refractory material.

The performance of aircraft radiators, particularly as regards their head resistance, is of great importance in aeronautic work. This was thoroughly investigated and specimens of almost all the standard types of radiator core were tested, not only for head resistance, but for efficiency as heat dissipating devices.

A wind tunnel with an interior dimension of 54 inches was constructed early in the war and many tests of model aerofoils, drop bombs, and of the head resistance of radiators have been conducted. More recently a somewhat similar tunnel in which a much higher wind speed may be secured has been completed and the work has been continued.

A special section of one of the scientific divisions is devoted to the investigation and testing of aeronautic instruments. Its work has included assistance to manufacturers in the design of special instruments required for airplanes and dirigibles, in the testing and output of aeronautic instrument factories, and in the collection of information pertaining to domestic and foreign aviation instruments. A great many reports were issued to the military services during the war and since that time.

The Bureau's work in connection with aeronautic engines, ignition systems, and radiators will be found to be completely covered in the series of publications of the National Advisory Committee for Aeronautics. Reports on the aeronautic instrument work have been issued in temporary form directly from the Bureau.

The optical division of the Bureau aided in the development of special ultra-violet sensitive plates for use in airplane photography and these have given extremely satisfactory results.

The testing of all sorts of materials used in airplane construction was carried on during the war and is still undertaken quite frequently at the request of the government departments. Almost all of the activities of the Bureau of Standards affect aviation in one form or another, but the above subjects are those believed to be of greatest importance.

FOREST PRODUCTS LABORATORY

MADISON, WIS.

(Conducted by U. S. Forest Service, Dept. of Agriculture.)

The laboratory employs some 200 persons, including a large technical staff. Scientific investigation is carried on along many lines of great interest to the aircraft industry—strength tests, kiln drying, wood preservation, chemical products, etc. The laboratory makes the result of its labors available to the public as quickly as possible. It is in constant touch with various industries.

BUREAU OF MINES

(Department of the Interior)

The aeronautical work of the Bureau of Mines, Department of the Interior, consists mainly in the development of helium production for use in lighter-than-air craft, which work is being carried on in conjunction with the Helium Board of the Army and Navy.¹

The development of a process whereby helium, a non-inflammable gas, for use in lighter-than-air craft, can be produced in quantities and at a comparatively low cost, constitutes one of the greatest single contributions of the United States to the science of aeronautics. Experimental work on helium production was started by the Bureau of Mines in 1917, when an allotment of \$100,000, half each from the Army and Navy, recommended by the Aircraft Production Board, became available for this purpose. At that time not more than 100 cubic feet of helium had been isolated in the whole world and the cost of one cubic foot was approximately \$1,700, which was absolutely prohibitive for use in balloons and airships.

However, as helium is non-inflammable and its lifting power is but slightly below that of hydrogen, about 92 per cent, the quantity production of helium at a low cost was considered extremely desirable for war service, for it would have eliminated the fire risk of observation balloons and airships.

Therefore, upon our entry into the war three experimental plants for the production of helium from natural gas obtained from the Petrolia pool, at Petrolia, Tex., were erected. The operation of these plants was attended by great success, for at the time of the Armistice altogether 225,000 cubic feet of helium had been produced, 147,000 cubic feet of which was ready for shipment to the battle fronts. This gas was produced at a cost of about 39 cents per cubic foot—a most remarkable reduction in price.

As the result of this success of the experimental helium plants, for which the Bureau of Mines, and in particular its chief metallurgist, Dr. Frederick G. Cottrell, together with the Linde Air Products Company, were mainly responsible the Navy Department decided to erect at Fort Worth, Tex., a large helium production plant employing the Linde process. This plant commenced operation on November 5, 1920, and expects to produce helium at a cost of about 5 cents per cubic foot.

Two of the original experimental helium plants have been dismantled, but in the third plant experimental work is being vigorously pursued by the Bureau of Mines, employing a process entirely different from that used by the Navy, which, it is expected, will further reduce the production cost of helium.

A helium research laboratory is now being erected at Washington, D. C.,

¹ See also Helium Board Report in Appendix.

on funds supplied jointly by the Army and Navy. This plant will be in charge of the Bureau of Mines and its particular function will be the study of the properties of gases and liquids under low temperature conditions with particular reference to helium and its separation from natural gas.

THE NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

2722 Navy Building, Washington, D. C.

ORGANIZATION

CHARLES D. WALCOTT, Sc.D., Chairman

S. W. STRATTON, Sc.D., Secretary

JOSEPH S. AMES, Ph.D., Chairman, Executive Committee

Major THURMAN H. BANE, U.S.A.

CHARLES F. MARVIN, M.E.

Captain T. T. CRAVEN, U.S.N.

Maj. Gen. CHAS. T. MENOHER, U.S.A.

WILLIAM F. DURAND, Ph.D.

MICHAEL I. PUPIN, Ph.D.

JOHN F. HAYFORD, C.E.

Rear Admiral D. W. TAYLOR, U.S.N.

ORVILLE WRIGHT, B.S.

Executive Officer, G. W. LEWIS

Assistant Secretary, J. F. VICTORY

During the past year the National Advisory Committee for Aeronautics has not only exercised its major functions in the field of scientific research in aeronautics but has also given much thought and attention to the broad general subject of commercial aeronautics, the means of developing it, and the governmental measures that would promote and encourage such development.

During the summer of 1920, the Committee detailed the leader of its aeronautical engineering staff, while in Europe, to make observations. The information thus obtained was made available to the American public through a series of special reports. One of the indications clearly evident from the reports issued by the Committee, is that Great Britain is doing her best to assure mastery of the air and with this object in view is devoting considerable energy and funds to the development of commercial aeronautics. France has subsidized a number of aeronautical enterprises. Germany, hampered as it is by the peace treaty restrictions, is giving greater attention to the development and operation of airships rather than airplanes. The Committee's reports indicate that the prevailing opinion in European countries generally is that the people and governments must develop and support commercial aeronautics as a vital element of their military policies.

The National Advisory Committee for Aeronautics emphasizes the need for the regulation and encouragement of commercial aeronautics in America not only from considerations of wise military preparedness, but also because, aside from military considerations, the development of commercial aviation will in time yield adequate returns in itself in the form of promoting and strengthening means of transportation, advancing the progress of civilization, and increasing the national wealth.

The Committee has proposed to Congress the establishment of a Bureau of Aeronautics in the Department of Commerce for the regulation and encouragement of civil air navigation and has recommended the principle of federal aid to the States in the establishment of landing fields throughout the country.

Two important contributions to the science of aeronautical engineering

have been worked out during the past year by the committee's field station, known as the Langley Memorial Aeronautical Laboratory. By the use of a specially devised accelerometer the stresses developed in an airplane in flight under different conditions have been very carefully computed. These data will be of great aid in the designing of an airplane to perform under certain specified conditions. The problems of stability in an airplane and of the forces acting on the various control surfaces have been studied, with the result that knowledge has been gained that permits the more accurate design of an airplane with assurance of stability and ease of control.

Under its direction, the altitude chamber was erected at the Bureau of Standards which has permitted experiments to be conducted on aircraft engines under operating conditions found at high altitudes. Through the direction and financial support given by the committee to the Bureau of Standards, the airplane radiator problem has been solved.

The most important research conducted in the United States in connection with the development of air propellers has been continuously conducted under the direction of the committee by Dr. W. F. Durand, of Leland Stanford University, member of the committee.

CONVENTION FOR THE REGULATION OF AIR NAVIGATION
(October 13, 1919.)

Amended Text as Signed by the United States of America with Reservations:

CHAPTER I

GENERAL PRINCIPLES

ARTICLE 1

The high contracting Parties recognize 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 aerodromes 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 States.

No incorporated company can be registered as the owner of an aircraft unless it possesses 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 licenses issued or rendered valid by the State whose nationality the aircraft possesses.

ARTICLE 13

Certificates of airworthiness and of competency and licenses 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 recognized as valid by the other States.

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

ARTICLE 14

No wireless apparatus shall be carried without a special license 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 license 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 spaces 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 the 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 aerodromes fixed by the latter. Notification of these aerodromes 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 favor of its national aircraft in connection with the carriage of persons and goods for hire between two points on its territory.

Such reservations and restrictions shall be immediately published, and shall be communicated to the International Commission for Air Navigation, which shall notify them to the other contracting States.

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 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 aerodrome 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.

In every such aerodrome there shall be a single tariff of charges for landing and length of stay applicable alike to national and foreign aircraft.

ARTICLE 25

Each contracting State undertakes to adopt measures to ensure that every aircraft flying above the limits of its territory, and every aircraft whatever 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 authorization. In case of such authorization 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 authorized 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

There shall be instituted, under the name of the International Commission for Air Navigation, a permanent Commission placed under the direction of the League of Nations, and composed of:

Two representatives of each of the following States: The United States of America, France, Italy, and Japan;

One representative of Great Britain and one of each of the British Dominions and of India;

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 votes of all the other contracting States.

All the States other than the five first named shall each have one vote.

The International Commission for Air Navigation shall determine the rules of its own procedure and the place of its permanent seat, but it shall be free to meet in such places as it may deem convenient. Its first meeting shall take place at Paris. This meeting shall be convened by the French Government, as soon as a majority of the signatory States shall have notified to it their ratification of the present Convention.

The duties of this Commission shall be:

- (a) To receive proposals from or to make proposals to any of the contracting States for the modification or amendment of the provisions of the present Convention and to notify changes adopted;
- (b) To carry out the duties imposed upon it by the present Article and by Articles 9, 13, 14, 15, 17, 27, 28, 36, and 37 of the present Convention;
- (c) To amend the provisions of the Annexes A—G;
- (d) To collect and communicate to the contracting States information of every kind concerning international air navigation;
- (e) To collect and communicate to the contracting States all information relating to wireless telegraphy, meteorology, and medical science which may be of interest to air navigation;
- (f) To ensure the publication of maps for air navigation in accordance with the provisions of Annex F;
- (g) To give its opinion on questions which the States may submit for examination.

Any modification of the provisions of any one of the Annexes may be made by the International Commission for Air Navigation when such modification shall have been approved by three-fourths of the total possible votes which could be cast if all the States were represented, and shall become effective from the time when it shall have been notified by the International Commission for Air Navigation to all the contracting States.

Any proposed modification of the Articles of the present Convention shall be examined by the International Commission for Air Navigation, whether it originates with one of the contracting States or with the Commission itself. No such modification shall be proposed for adoption by the contracting

States unless it shall have been approved by at least two-thirds of the total possible votes.

All such modifications of the Articles of the Convention (but not of the provisions of the Annexes) must be formally adopted by the contracting states before they become effective.

The expenses of organization and operation of the International Commission for Air Navigation shall be borne by the contracting States in proportion to the number of votes at their disposal.

The expenses occasioned by the sending of technical delegations will be borne by their respective States.

CHAPTER IX

FINAL PROVISIONS

ARTICLE 35

The High Contracting Parties undertake as far as they are respectively concerned to co-operate as far as possible in international measures concerning:

(a) The collection and dissemination of statistical, current, and special meteorological information, in accordance with the provisions of Annex G.;

(b) The publication of standard aeronautical maps, and the establishment of a uniform system of ground marks for flying, in accordance with the provisions of Annex F.;

(c) The use of wireless telegraphy in air navigation, the establishment of the necessary wireless stations, and the observance of international wireless regulations.

ARTICLE 36

General provisions relative to customs in connection with international air navigation are the subject of a special agreement contained in Annex H. to the present Convention.

Nothing in the present Convention shall be construed as preventing the contracting States from concluding, in conformity with its principles, special protocols as between State and State in respect of customs, police, posts, and other matters of common interest in connection with air navigation. Any such protocols shall be at once notified to the International Commission for Air Navigation, which shall communicate this information to the other contracting States.

ARTICLE 37

In the case of a disagreement between two or more States relating to the interpretation of the present Convention, the question in dispute shall be determined by the Permanent Court of International Justice to be established by the League of Nations and until its establishment by arbitration.

If the parties do not agree on the choice of the arbitrators, they shall proceed as follows:

Each of the parties shall name an arbitrator, and the arbitrators shall meet to name an umpire. If the arbitrators cannot agree, the parties shall

each name a third State, and the third State so named shall proceed to designate the umpire, by agreement or by each proposing a name and then determining the choice by lot.

Disagreement relating to the technical regulations annexed to the present Convention shall be settled by the decision of the International Commission for Air Navigation by a majority of votes.

In case the difference involves the question whether the interpretation of the Convention or that of a regulation is concerned, final decision shall be made by arbitration as provided in the first paragraph of this Article.

ARTICLE 38

In case of war, the provisions of the present Convention shall not affect the freedom of action of the contracting States either as belligerents or as neutrals.

ARTICLE 39

The provisions of the present Convention are completed by the Annexes A to H, which, subject to Article 34(c), shall have the same effect and shall come into force at the same time as the Convention itself.

ARTICLE 40

The British Dominions and India shall be deemed to be States for the purposes of the present Convention.

The territories and nationals of protectorates or of territories administered in the name of the League of Nations shall for the purposes of the present Convention be assimilated to the territory and nations of the Protecting or Mandatory States.

ARTICLE 41

States which have not taken part in the war of 1914-1919 shall be permitted to adhere to the present Convention.

This adhesion shall be notified through the diplomatic channel to the Government of the French Republic, and by it to all the signatory or adhering States.

ARTICLE 42

A State which took part in the war of 1914-1919 but which is not a signatory of the present convention may adhere only if it is a member of the League of Nations or until January 1st, 1923, if its adhesion is approved by the Allied and Associated Powers signatories of the Treaty of Peace concluded with the said State. After January 1st, 1923, this adhesion may be admitted if it is agreed to by at least three-fourths of the signatory and adhering States voting under the conditions provided by Article 34 of the present convention.

Applications for adhesions shall be addressed to the Government of the French Republic, which will communicate them to the other contracting Powers. Unless the State applying is admitted *ipso facto* as a member of the League of Nations, the French Government will receive the votes of the said Powers and will announce to them the result of the voting.

ARTICLE 43

The present Convention may not be denounced before January 1st, 1922. In case of denunciation, notification thereof shall be made to the Government of the French Republic, which shall communicate it to the other contracting parties. Such denunciation shall not take effect until at least one year after the giving of notice, and shall take effect only with respect to the Power which has given notice.

EDITOR'S NOTE.— A postscript to the Convention provides that:

"The present Convention shall be ratified.

"Each Power will address its ratification to the French Government, which will inform the other signatory Powers.

"The ratifications will remain deposited in the archives of the French Government.

"The present Convention will come into force for each signatory Power, in respect of other Powers which have already ratified, forty days from the date of the deposit of its ratification."

There follow the signatures of the representatives of the signatory Powers.

ANNEX A

THE MARKING OF AIRCRAFT

SECTION I.

GENERAL

(a) The nationality mark shall be represented by capital letters in Roman characters, *e. g.*,

France.....F.

The registration mark shall be represented by a group of four capital letters; each group shall contain at least one vowel, and for this purpose the letter Y shall be considered as a vowel. The complete group of five letters shall be used as a call sign of the particular aircraft in making or receiving signals by wireless telegraphy or other methods of communication, except when opening up communication by means of visual signals, when the usual methods will be employed. The nationality and registration marks are assigned in accordance with the table contained in section VIII. of this Annex.

(b) On aircraft other than State and commercial, the registration mark shall be underlined with a black line.

(c) The entry in the register and the certificate of registration shall contain a description of the aircraft and shall indicate the number or other identification mark given to it by the maker; the nationality and registration marks mentioned above; the usual station of the aircraft; the full name, nationality, and residence of the owner and the date of registration.

(d) All aircraft shall carry affixed to the car or to the fuselage in a prominent position a metal plate, inscribed with the names and residence of the owner and the marks of nationality and registration.

CERTIFICATE OF REGISTRATION

(Provisional Form)

Nationality
 Nationality mark
 Registration marks
 Date of registration.....

Type of Aircraft.....

Tourist }
 Commercial }
 State }

Maker
 Maker's number
 Description
 Owner's full name
 Owner's residence
 Owner's nationality
 Station of the aircraft.....

Signature and seal of }
 authority issuing this }
 certificate }

SECTION II.

LOCATION OF MARKS

The nationality and registration marks shall be painted in black on a white ground in the following manner:—

(a) *Flying Machines.*—The marks shall be painted once on the lower surface of the lower main planes and once on the upper surface of the top main planes, the top of the letters to be towards the leading edge. They shall also be painted along each side of the fuselage between the main planes and the tail planes. In cases where the machine is not provided with a fuselage the marks shall be painted on the nacelle.

(b) *Airships and Balloons.*—In the case of airships the marks shall be painted near the maximum cross section on both sides and on the upper surface equidistant from the letters on the sides.

In the case of balloons the marks shall be painted twice near the maximum horizontal circumference, as far as possible from one another.

In the case both of airships and balloons the side marks shall be visible both from the side and ground.

SECTION III.

ADDITIONAL LOCATION OF NATIONALITY MARKS

(a) *Flying Machines and Airships.*—The nationality mark shall also be painted on the left and right sides of the lower surface of the lowest tail planes or elevators and also on the upper surface of the top tail planes or elevators, whichever is the larger. It shall also be painted on both sides of the rudder, and on the outer sides of the outer rudders if more than one rudder is fitted.

(b) *Balloons.*—The nationality mark shall be painted on the basket.

SECTION IV.

MEASUREMENTS OF NATIONALITY AND REGISTRATION MARKS

(a) *Flying Machines*.—The height of the marks on the main planes and tail planes respectively shall be equal to four-fifths of the chord, and in the case of the rudder shall be as large as possible. The height of the marks on the fuselage or nacelle shall be four-fifths of the depth of the narrowest part of that portion of the fuselage or nacelle on which the marks are painted.

(b) *Airships and Balloons*.—In the case of airships, the nationality marks painted on the tail plane shall be equal in height to four-fifths of the chord of the tail plane and in the case of the rudder the marks shall be as large as possible. The height of the other marks shall be equal to at least one-twelfth of the circumference of the maximum transverse cross section of the airship.

In the case of balloons the height of the nationality mark shall be four-fifths of the height of the basket, and the height of the other marks shall be equal to at least one-twelfth of the circumference of the balloon.

(c) *General*.—In the case of all aircraft the letters of the nationality and registration marks need not exceed 2.5 metres in height.

SECTION V.

MEASUREMENT, TYPE OF LETTERS, &C.

(a) The width of the letters shall be two-thirds of their height and the thickness shall be one-sixth of their height. The letters shall be painted in plain block type and shall be uniform in shape and size. A space equal to half the width of the letters shall be left between the letters.

(b) In the case of underlined letters the thickness of the line shall be equal to the thickness of the letter and the space between the bottom of the letters and the line shall be equal to the thickness of the line.

SECTION VI.

SPACING BETWEEN NATIONALITY AND REGISTRATION MARKS

Where the nationality and registration marks appear together, a hyphen of a length equal to the width of one of the letters shall be painted between the nationality mark and registration mark.

SECTION VII.

MAINTENANCE

The nationality and registration marks shall be displayed to the best possible advantage, taking into consideration the constructional features of the aircraft. The marks must be kept clean and visible.

SECTION VIII.

TABLE OF MARKS

The nationality mark of each State named below applies to the aircraft of its Dominions, Colonies, Protectorates, dependencies, or of countries over which it is the Mandatory State.

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, PURN.
British Empire....	G	
France	F	All combinations made with B as first letter.
Italy	I	
Japan	J	All combinations made with C as first letter.
Bolivia	C	
Cuba	C	All combinations made with P as first letter.
Portugal	C	
Roumania	C	All combinations made with R as first letter.
Uruguay	C	
Czecho-Slovakia ..	L	All combinations made with U as first letter.
Guatemala	L	
Liberia	L	All combinations made with B as first letter.
Brazil	P	
Poland	P	All combinations made with G as first letter.
Belgium	O	
Peru	O	All combinations made with L as first letter.
China	X	
Honduras	X	All combinations made with B as first letter.
Serbia-Croatia-Slavonia	X	
Haiti	H	All combinations made with P as first letter.
Siam	H	
Ecuador	E	All combinations made with C as first letter.
Greece	S	
Panama	S	All combinations made with H as first letter.
Hedjaz	A	
Nicaragua	A	All combinations made with H as first letter.
		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 materials 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.

SECTION II.
AIRCRAFT LOG

This is obligatory only in the case of aircraft carrying passengers or goods for hire, 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) Type and series number of engine; type of propeller showing number, pitch, diameter and maker's name.

(c) Type of wireless apparatus fitted.

(d) Table showing the necessary rigging data for the information of persons in charge of the aircraft and of its maintenance.

(e) A fully detailed engineering record of the life of the aircraft, including all acceptance tests, overhauls, replacements, repairs and all work of a like nature.

SECTION III.
ENGINE LOG

This is obligatory only in the case of engines installed in aircraft carrying passengers or goods for hire, and in such cases a separate log book shall be kept for each engine and shall always accompany the engine. It shall contain the following particulars:—

(a) Type of engine, series number, maker's name, power, normal maximum revolutions of engine, date of production and first date put into service.

(b) Registration mark and type of aircraft in which the engine has been installed.

(c) A fully detailed engineering record of the life of the engine, including all acceptance tests, hours run, overhauls, replacements, repairs, and all work of a like nature.

SECTION IV.
SIGNAL LOG

This is obligatory only in the case of aircraft carrying passengers or goods for hire, 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.

(b) Place, date, and time of the transmission or reception of any signal.

(c) Name or other indication of the person or station to whom a signal is sent or from whom a signal is received.

SECTION V.

INSTRUCTIONS FOR USE OF LOG BOOKS

(a) The constructor shall fill in and sign the original entries in the log books, as far as he is in a position to do so. Subsequent entries shall be made and signed by the pilot or other competent person.

(b) A copy of the certificate of airworthiness shall be kept in the pocket of the aircraft log book.

(c) All entries to be in ink, except in the case of journey and signal log books; the entries for these may be made in pencil in a rough note book, but shall be entered in ink in the log book every 24 hours. In the event of any official investigation the rough note book may be called for.

(d) No erasures shall be made in, nor pages torn from, any log book.

(e) A copy of these instructions shall be inserted in each log book.

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.

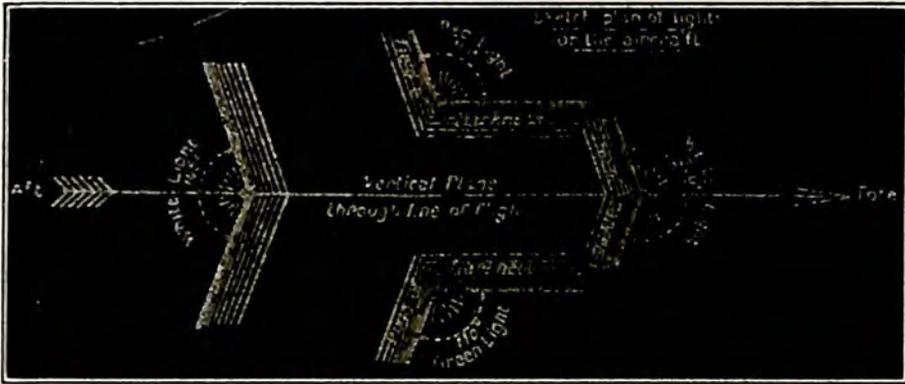
RULES AS TO LIGHTS

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 manoeuvring 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.



"Sketch Plan for Lights on Aircraft."

(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.

4. An airship, when being towed, shall carry the lights specified in paragraph 3, and, in addition, those specified in paragraph 6 for airships not under control.

5.—(a) A flying machine, or airship, when on the surface of the water, and when not under control, that is to say, not able to manœuvre as required by the Regulations for the Prevention of Collisions at Sea, shall carry two red lights not less than 2 metres apart one over the other, and of such a character as to be visible all around the horizon at a distance of at least 3 kilometres.

(b) The aircraft referred to in this paragraph, when not making way through the water, shall not carry the side lights, but when making way shall carry them.

6. An airship which from any cause is not under control, or which has voluntarily stopped her engines shall, in addition to the other specified lights, display conspicuously two red lights, one over the other, not less than 2 metres apart, and constructed to show a light in all directions, and of such a character as to be visible at a distance of at least 3 kilometres.

By day an airship, when being towed, which from any cause is not under control, shall display conspicuously two black balls or shapes, each 60 cms. in diameter, placed one over the other not less than 2 metres apart.

An airship moored, or under way but having voluntarily stopped its engines, shall display conspicuously by day a black ball or shape, 60 cms. in diameter, and shall be treated by other aircraft as being not under control.

7. A free balloon shall carry one bright white light below the car at a distance of not less than 5 metres, and so constructed as to show an unbroken light in all directions, and of such a character as to be visible at a distance of at least 3 kilometres.

8. A fixed balloon shall carry in the same position as the white light mentioned in paragraph 7, and in lieu of that light, three lights in a vertical line one over the other, not less than 2 metres apart. The highest and lowest of these lights shall be red, and the middle light shall be white, and they shall be of such a character as to be visible in all directions at a distance of at least 3 kilometres.

In addition, the mooring cable shall have attached to it at intervals of 300 metres, measured from the basket, groups of three lights similar to those mentioned in the preceding paragraph. In addition, the object to which the balloon is moored on the ground shall have a similar group of lights to mark its position.

By day the mooring cable shall carry in the same position as the groups of lights mentioned in the preceding paragraph, and in lieu thereof, tubular streamers not less than 20 cms. in diameter and 2 metres long, and marked with alternate bands of white and red, 50 cms. in width.

9. An airship when moored near the ground shall carry the lights specified in paragraphs 2 (a) and (e) and 3.

In addition, if moored but not near the ground, the airship, the mooring cable, and the object to which moored, shall be marked in accordance with the provisions of paragraph 8, whether by day or by night.

Sea anchors or drogues used by airships for mooring purposes at sea are exempt from this regulation.

10. A flying machine stationary upon the land or water but not anchored or moored shall carry the lights specified in paragraph 2.

11. In order to prevent collisions with surface craft:—

(a) A flying machine when at anchor or moored on the water shall carry forward, where it can best be seen, a white light, so constructed as to show an unbroken light visible all round the horizon at a distance of at least 2 kilometres.

(b) A flying machine of 50 metres or upwards in length, when at anchor or moored on the water, shall, in the forward part of the flying machine, carry one such light, and at or near the stern of the flying machine, and at a height that it shall not be less than 5 metres lower than the forward light, another such light.

The length of a flying machine shall be deemed to be the overall length.

(c) Flying machines of 50 metres or upwards in span, when at anchor or moored in the water, shall in addition carry at each lower wing tip one light as specified in (a) of this paragraph.

The span of a flying machine shall be deemed to be the maximum lateral dimension.

12. In the event of the failure of any of the lights specified under these rules to be carried by aircraft flying at night, such aircraft shall land at the first reasonably safe opportunity.

13. Nothing in these rules shall interfere with the operation of any special rules made by any State with respect to the additional station or signal lights for two or more military aircraft, or for aircraft in formation, or with the exhibition of recognition signals adopted by owners of aircraft which have been authorized by their respective Governments and duly registered and published.

SECTION II.

RULES AS TO SIGNALS

14.—(a) An aircraft wishing to land at night on aerodromes having a ground control shall before landing:—

Fire a green Very's light or flash a green lamp, and in addition shall make by international Morse code the letter-group forming its call-sign.

(b) Permission to land will be given by the repetition of the same call-sign from the ground, followed by:—

A green Very's light or flashing a green lamp.

15. The firing of a red Very's light or the display of a red flare from the ground shall be taken as an instruction that aircraft are not to land.

16. An aircraft compelled to land at night shall, before landing, fire a red Very's light or make a series of short flashes with the navigation lights.

17. When an aircraft is in distress and requires assistance, the following shall be the signals to be used or displayed, either together or separately:—

(a) The international signal, S O S, by means of visual or wireless signals.

(b) The international code flag signal of distress, indicated by NC.

(c) The distant signal, consisting of a square flag having either above or below it a ball, or anything resembling a ball.

(d) A continuous sounding with any sound apparatus.

(e) A signal, consisting of a succession of white Very's lights fired at short intervals.

18. To warn an aircraft that it is in the vicinity of a prohibited zone and should change its course, the following signals shall be used:—

(a) By day: three discharges, at intervals of 10 seconds, of a projectile showing, on bursting, white smoke, the location of the burst indicating the direction the aircraft should follow.

(b) By night: three discharges, at intervals of 10 seconds, of a projectile showing, on bursting, white stars, the location of the burst indicating the direction the aircraft should follow.

19. To require an aircraft to land, the following signals shall be used:—

(a) By day: three discharges, at intervals of 10 seconds, of a projectile showing or bursting black or yellow smoke.

(b) By night: three discharges, at intervals of 10 seconds, of a projectile showing on bursting red stars or lights.

In addition, when necessary to prevent the landing of aircraft other than the one ordered, a searchlight which shall be flashed intermittently shall be directed towards the aircraft whose landing is required.

20.—(a) In the event of fog or mist rendering aerodromes invisible, their presence may be indicated by a balloon acting as an aerial buoy and (or) other approved means.

(b) In fog, mist, falling snow or heavy rainstorm, whether by day or night, an aircraft on the water shall make the following sound signals with a sound apparatus:—

(1) If not anchored or moored, a sound at intervals of not more than two

minutes, consisting of two blasts of above five seconds' duration with an interval of about one second between them.

(2) If at anchor or moored, the rapid ringing of an efficient bell or gong for about five seconds at intervals of not more than one minute.

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 side lights, 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 givingway 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 recognized air route every aircraft, when

it is safe and practicable, shall keep to the right side 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.

RULES FOR AIR TRAFFIC ON AND IN THE VICINITY OF AERODROMES

36. At every aerodrome there shall be a flag hoisted in a prominent position which shall indicate that if an aircraft about to land or leave finds it necessary to make a circuit, or partial circuit, such circuit shall be left-handed (anti-clockwise) or right-handed (clockwise), according to the color of the flag. A white flag shall indicate a right-handed circuit, *i.e.*, that the flag is kept to the right side or side which carries the green light of the aircraft, and a red flag shall indicate a left-handed circuit, *i.e.*, that the red flag is kept to the left side or side which carries the red light of the aircraft.

37. When an airplane starts from an aerodrome it shall not turn until 500 metres distance from the nearest point of the aerodrome, and the turning then must conform with the regulations provided in the preceding paragraph.

38. All airplanes flying between 500 and 1,000 metres distance from the nearest point of an aerodrome shall conform to the above-mentioned circuit law, unless such airplanes are flying at a greater height than 2,000 metres.

39. Acrobatic landings are prohibited at aerodromes of contracting States used for international aerial traffic. Aircraft are prohibited from engaging in aerial acrobatics within a distance of at least 2,000 metres from the nearest point of such aerodromes.

40. At every recognized aerodrome the direction of the wind shall be clearly indicated by one or more of the recognized methods, *e.g.*, landing tee, conical streamer, smudge fire, &c.

41. Every airplane when taking off or alighting on a recognized aerodrome used for international air traffic shall do so up-wind, except when the natural conditions of the aerodrome do not permit.

42. In the case of airplanes approaching aerodromes for the purpose of landing, the airplanes flying at the greater height shall be responsible for avoiding the airplane at the lower height, and shall as regards landing observe the rules of paragraph 28 for passing.

43. Airplanes showing signals of distress shall be given free way in attempting to make a landing on an aerodrome.

44. Every aerodrome shall be considered to consist of three zones when looking up-wind. The right-hand zone shall be the taking-off zone, and the left-hand shall be the landing zone. Between these there shall be a neutral zone. An airplane when landing should attempt to land as near as possible

to the neutral zone, but in any case on the left of any airplanes which have already landed. After slowing up or coming to a stop at the end of its landing run, an aeroplane will immediately taxi into the neutral zone. Similarly, an airplane when taking off shall keep as far as possible towards the right of the taking-off zone, but shall keep clear to the left of any airplanes which are taking off or about to take off.

45. No airplane shall commence to take off until the preceding airplane is clear of the aerodrome.

46. The above rules shall apply equally to night landings on aerodromes, when the signals shall be as follows:—

(a) A red light shall indicate a left-hand circuit, and a green light shall indicate a right-hand circuit (*see* paragraph 36). The right-hand zone will be marked by white lights placed in the position of an "L," and the left-hand zone will be similarly marked. The "L's" shall be back to back, that is to say, the long sides of the "L's" will indicate the borders of the neutral zone, the direction of landing shall invariably be along the long arm of the "L," and towards the short arm. The lights of the "L's" should be so placed that the lights indicating the top extremity of the long arm shall be the nearest point on the aerodrome upon which an airplane can safely touch ground. The lights indicating the short arm of the "L" should indicate the limit of safe landing ground for the airplanes, that is, that the airplane should not over-run the short arm.

(b) Where it is desired to save lights and personnel the following system may be used:—

Two lights shall be placed on the windward side of the aerodrome to mark the limits of the neutral zone mentioned in paragraph 44, the line joining the lights being at right angles to the direction of the wind. Two more lights shall be placed as follows: one on the leeward side of the aerodrome on the line drawn parallel to the direction of the wind and passing midway between the two lights on the windward side to show the extent of the aerodrome and the direction of the wind, and the other shall be placed midway between the two lights marking the limits of the neutral zone.

Additional lights may be symmetrically put along the boundary lines of the neutral zone, and on the ends of the taking-off and landing zones on the line through the three lights on the windward side.

47. No fixed balloon, kite, or moored airship shall be elevated in the vicinity of any aerodrome without a special authorization, except in the cases provided for in paragraph 20.

48. Suitable markings shall be placed on all fixed obstacles dangerous to flying within a zone of 500 metres of all aerodromes.

SECTION VI.

GENERAL

49. Every aircraft manœuvring under its own power on the water shall conform to the Regulations for Preventing Collisions at Sea, and for the purposes of these regulations shall be deemed to be a steam-vessel, but shall carry the lights specified in the preceding rules, and not those specified for steam-vessels in the Regulations for Preventing Collisions at Sea, and shall not use, except as specified in paragraphs 17 and 20 above, or be deemed to hear the sound signals specified in the above-mentioned Regulations.

50. Nothing in these rules shall exonerate any aircraft, or the owner, pilot or crew thereof, from the consequences of any neglect to carry lights or signals, or of any neglect to keep a proper lookout, or of the neglect of any

precaution which may be required by the ordinary practice of the air, or by the special circumstances of the case.

51. Nothing in these rules shall interfere with the operation of any special rule or rules duly made and published relative to navigation of aircraft in the immediate vicinity of any aerodrome or other place, and it shall be obligatory on all owners, pilots, or crews of aircraft to obey such rules.

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 1,500 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 Aerodromes. 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 certificate 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 at points 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, submit 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 Aerodromes.

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 landing. 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

1. *Practical Tests:*

The candidate must have completed the following certified ascents—

1. By day: 3 ascents under instruction.

1 ascent in control under supervision.

1 ascent alone in the balloon.

2. By night: 1 ascent alone in the balloon.

Each ascent shall be of at least two hours' duration.

2. *Theoretical Tests:*

Elementary aerostatics and meteorology.

3. *Special Requirements:*

General knowledge of a balloon and its accessories; inflation: rigging; management of an ascent; instruments; precautions against cold and high altitudes.

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

Practical knowledge of international air legislation. Map reading and orientation.

SECTION III.

CERTIFICATES FOR AIRSHIP OFFICER PILOTS

Every airship officer pilot shall have qualified as pilot of a free balloon.

There shall be 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 metres capacity.

The holder of a third-class certificate is qualified to command airships under 6,000 cubic metres capacity.

All military and naval airship officer pilots are entitled to a third-class certificate.

All military and naval airship officer pilots who have commanded airships over 6,000 cubic metres capacity are entitled to a first-class certificate.

QUALIFICATIONS FOR THIRD-CLASS CERTIFICATE

Practical Tests:

(a) Twenty certified flights (three of which shall be by night) in an airship, each flight being of at least one hour's duration. In at least four of these flights the candidate must have handled the airship himself, under the supervision of the commanding officer of the airship, including ascent and landing.

(b) One cross-country flight on a predetermined course of at least 100 kilometres, terminating with a night landing, and made with a duly authorized inspector on board.

Theoretical Examination:

Aerostatics and meteorology. (Density of gases, laws of Mariotte and of Gay-Lussac; barometric pressure, Archimedes principle; confinement of gases; interpretation and use of meteorological information and of weather charts.)

Physical and chemical properties of light gases, and of materials used in the construction of airships.

General theory of airships.

Dynamic properties of moving bodies in air.

General Knowledge:

Elementary knowledge of internal combustion engines.

Elementary navigation; use of the compass; location of position.

Inflation; stowage; rigging; handling; controls and instruments.

QUALIFICATIONS FOR SECOND-CLASS CERTIFICATE

Practical Tests:

To be eligible for a second-class certificate a candidate must be holder of a third-class certificate and have at least four months' service as a third-class officer on an airship, and also have completed at least 10 flights as third-class officer on an airship of capacity above 6,000 cubic metres, in which he has handled the airship himself including ascent and landing, under the supervision of the commanding officer of the airship.

Theoretical Examination:

Advanced knowledge of the subjects required for the third-class certificate.

QUALIFICATIONS FOR FIRST-CLASS CERTIFICATE

Practical Tests:

To be eligible for a first-class certificate a candidate must be holder of a second-class certificate, have at least two months' active service as a second-class officer on an airship, and also have completed at least five flights as second-class officer of an airship of capacity of 20,000 cubic metres, in which

he has handled the airship himself, including ascent and landing, under the supervision of the commanding officer of the airship. Each flight must be at least of one hour's duration with a minimum of 15 hours for the five flights.

Theoretical Examination:

As required for a second-class certificate.

SECTION IV.

CERTIFICATE FOR NAVIGATORS

Aircraft used for public transport carrying more than 10 passengers and having to make a continuous flight between two points more than 500 kilometres apart overland, or a night flight, or a flight between two points more than 200 kilometres apart over sea, must have on board a navigator who has been granted a certificate as such after passing a theoretical and practical examination in the following:—

1. *Practical Astronomy:*

True and apparent movements of the celestial bodies. Different aspects of the celestial sphere.

Hour angles, mean, true, and astronomical time.

Shape and dimensions of the earth.

Star globes and maps.

Method of determining latitude, longitude, time and azimuth.

2. *Navigation:*

Maps and charts—how to read them.

Compass, magnetic meridian, variation, deviation.

Courses, bearings, and their corrections.

Compensation of compasses (technical and practical).

Calculations of azimuth.

Flight by dead reckoning, measure of the relative speed, drift, traverse table.

Chronometer, chronometer rate, comparisons.

Sextants, adjustments.

Nautical almanac.

Determination of positions by means of bearing and altitude of stars.

Knowledge of great circle navigation.

Aeronautical navigational instruments.

3. *General Knowledge:*

International rules for air and maritime navigation.

International air legislation.

Practical knowledge of meteorology and of weather charts.

SECTION V.

MEDICAL CERTIFICATES

International Medical Requirements for Air Navigation

1. Every candidate before obtaining a license as a pilot, navigator or engineer of aircraft engaged in public transport will present himself for examination by specially qualified medical men (flight surgeons), appointed by or acting under the authority of the contracting State.

2. Medical supervision, both for the selection and the maintenance of efficiency, shall be based upon the following requirements of mental and physical fitness:—

(a) Good family and personal history, with particular reference to nervous stability. Absence of any mental, moral or physical defect which will interfere with flying efficiency.

(b) The minimum age for pilots and navigators engaged in public transport shall be nineteen (19) years.

(c) *General Surgical Examination.*—The aeronaut must neither suffer from any wound, injury or operation nor possess any abnormality, congenital or otherwise, which will interfere with the efficient and safe handling of aircraft.

(d) *General Medical Examination.*—The aeronaut must not suffer from any disease or disability which renders him liable suddenly to become incompetent in the management of aircraft. He must possess heart, lungs, kidneys, and nervous system capable of withstanding the effects of altitude and also the effects of prolonged flight.

(e) *Eye Examination.*—The aeronaut must possess a degree of visual acuity compatible with the efficient performance of his duties. No pilot or navigator shall have more than two (2) dioptries of latent hypermetropia; muscle balance must be good and commensurate with the refraction. He must have a good field of vision in each eye and must possess normal color perception.

(f) *Ear Examination.*—The middle ear must be healthy. The aeronaut must possess a degree of auditory acuity compatible with the efficient performance of his duties.

(g) The vestibular mechanism must be intact and neither unduly hypersensitive nor hyposensitive.

(h) *Nose and Throat Examination.*—The aeronaut must possess free nasal air entry on either side and not suffer from serious acute or chronic affections of the upper respiratory tract.

3. Each contracting State shall for the present fix its own methods of examination until the detail of tests and the minimal standard of requirements have been finally settled by the authorized medical representatives of the International Commission for Air Navigation.

4. The successful candidate will receive a medical certificate of acceptance, which must be produced before the license can be issued.

5. In order to insure the maintenance of efficiency, every aeronaut shall be re-examined periodically, at least every six months, and the findings shall be attached to his original record. In case of illness or accident also, an aeronaut shall be re-examined and pronounced fit before resuming air duties. The date and result of each re-examination shall be recorded on the aeronaut's flying certificate.

6. No aeronaut who, before the date of the present Convention, has given proof of his flying ability, shall, so long as he retains such ability, be necessarily disqualified because he fails to fulfil all of the above requirements.

7. Each contracting State may raise the conditions set forth above, as it deems fit, but these minimal requirements shall be maintained internationally.

ANNEX F

INTERNATIONAL AERONAUTICAL MAPS AND GROUND MARKINGS

International maps shall be made and ground marks established in accordance with the following general principles:—

SECTION I.

MAPS

1. Two types of aeronautical maps shall be used. They are hereafter mentioned as *general* maps and *local* maps.

2. The index scheme for the aeronautical maps, both general and local, shall be based on the index scheme adopted for the "International 1: 1,000,000 scale map" by the official International Congress convened for the purpose in London in 1909 and in Paris in 1913.

NOTE.—Extract from the resolutions adopted by the Conferences at London and Paris;

The sheets of the International 1: 1,000,000 scale map shall include 6 degrees of longitude and 4 degrees of latitude. The limiting meridians of the sheets shall be at successive intervals, reckoning from Greenwich, of 6 degrees, and the limiting parallel, reckoning from the Equator, shall be at successive intervals of 4 degrees.

The longitudinal sectors, from longitude 180° E. or W. of Greenwich, are given numbers from 1 to 60, increasing in an easterly direction.

The 22 zones of 4 degrees in depth, extending from the Equator on each side to 88° latitude, are given letters from A to V.

The polar areas, extending for 2 degrees, are lettered Z.

In the northern hemisphere each sheet shall bear a descriptive symbol composed of the letter N, followed by the zone letter and sector number corresponding to its position, thus N.K.—12.

In the southern hemisphere the letter S shall replace the letter N. Example, S.L.—28.

3. The metre shall be used as the standard of measurement for lengths, distances, heights and depths, reserving for each nation the right to add figures expressing these quantities in its own units.

4. The colors, symbols, and arrangements for production adopted for the International 1: 1,000,000 scale map shall be used as far as practicable on the aeronautical maps.

5. The general maps shall be drawn on Mercator's projection and shall be to a scale of 1 degree of longitude equals 3 centimetres. The general maps shall have marked on them in fine lines the meridians and parallels of each degree, and the meridians and parallels limiting the unit sections of the 1: 1,000,000 map shall be accentuated. The same designation of unit sections shall be used as for the 1: 1,000,000 map.

6. Each general (Mercator) map shall bear the French heading *Carte Générale Aéronautique Internationale*, and under it a translation of this heading in the language of the country publishing the map. It shall also bear an appropriate geographical name.

Each sheet shall show at least the following: principal physical features and geographical names, wireless stations, marine lighthouses (height and range at sea level, color and character of the light); national frontiers, prohibited areas, principal air routes, lines of equal magnetic variation, South Polar distance, latitude, old and new notation of longitude (*see* paragraph 7), with an outer margin containing letters and numbers referring to the index of the 1: 1,000,000 map, legend of symbols in English or French and in the language of the country publishing the maps, publisher's name, and date of publication and of successive editions.

7. The local maps shall be drawn to a scale of 1: 200,000.

NOTE.—For local aeronautical maps of sparsely inhabited countries, the scale of 1: 500,000 or 1: 1,000,000 as appropriate, may be used.

In addition to the customary latitude and longitude notations, the local

aeronautical maps shall bear numbers enclosed in rectangles, corresponding to a new system of co-ordinate reckoning based on the antimeridian of Greenwich and the South Pole. The new *grid* reckoning, with regard to latitude, shall commence with the South Pole as zero and increase northward by degrees and minutes to 180° at the North Pole, and with regard to longitude shall commence with the antimeridian of Greenwich as zero and run eastward by degrees and minutes to 360° .

8. Each unit sheet of the local aeronautical maps shall bear the French hearing *Carte Normale Aéronautique Internationale*, and under it a translation of this heading in the language of the country publishing the map. It shall comprise one degree of latitude and one degree of longitude, and shall be designated by a locality name and by the new co-ordinates (described in paragraph 7) of the south-west corner of the sheet, the unit digits being accentuated. In these designating co-ordinates, the figures referring to the South Polar distance shall invariably be written first.

EXAMPLES.—The sheet whose southern boundary is 49° N. (i.e., 139° South Polar distance) and western boundary 2° E. (i.e., 182° from the antimeridian of Greenwich) will be numbered 139-182.

Or the sheet whose southern boundary is 36° S. (i.e., 54° South Polar distance) and western boundary 7° W. (i.e., 173° from the antimeridian of Greenwich) will be numbered 54-173.

9. The local aeronautical unit sheets shall show, as far as the data is known, the following:—

(a) *Within the limiting Meridians and Parallels.*—Twenty-minute projection grid; roads divided into two classes according to their relative visibility from the air; railways of all kinds, cities and towns in outline and the plan of the principal public roads crossing them (villages similarly if practicable, otherwise their positions indicated); principal features of the surface water system; woodlands and other areas unsuitable for landing, aerodromes, hangars for airships, plants for balloon inflation, permanent landing places on ground and water, aeronautical ground marks (beacons and fixed navigational lights); marine lighthouses (height, range at sea level, color and character of the light); wireless stations, meteorological stations, overhead electric power lines; remarkable objects; national frontiers; the frontier crossings for customs purposes prescribed by Annex H. (Art. 2); prohibited areas; principal air routes; names of important bodies of water; towns, and important villages; the topographical relief by shading and figures indicating heights, the most important of which to be surrounded by an oval ring as



(b) *Outside the limiting Meridians and Parallels.*—A title, consisting of the name designating the locality and the index numbers of the sheet; a border scale graduated to minutes; the names of the neighboring sheets; latitude, South Polar distance, old and new notation of longitude (see paragraph 7); scale of kilometres; legend of symbols in English or French and in the language of the country publishing the map; magnetic variation diagram; key map showing abridged numbers of the sheet concerned and the eight surrounding sheets; frontiers and the names of the countries, parts of which are embraced by the key map; publisher's name and date of publication.

10. The forms of the general and local maps, titles, marginal notations, diagrams, and legends, shall be as shown by the accompanying illustrations.¹

11. The general and local aeronautical maps and guide books of the areas traversed by the most important routes which may be established by international agreement shall be prepared first.

¹ The plates referred to have not been reproduced.—*Editor.*

NOTE.—On account of the inadequacy of the usual methods of topographic mapping for making aeronautical maps, it is strongly recommended that steps be taken to survey from the air the areas along the most important international routes. Such surveys would furnish indispensable information regarding the features necessary to be shown on the maps the aviator is to use.

SECTION II.

UNIVERSAL SYSTEM OF GROUND MARKS

1. All ground marks shall conform with the scheme of numbering adopted for the unit sheets of the local international aeronautical maps.

For this purpose each mark shall show:—

- (a) The abridged number which designates the sheet within which it lies;
- (b) An open rectangle, whose short sides shall be oriented north-south; the frames shall be open towards the opposite half of the unit sheet;
- (c) A dot indicating the approximate position of the mark on the north or south half of the corresponding unit sheet.

The numbers shall be placed close to the frame at the top, bottom or sides, but not inside.

Where marks are placed so close to each other as to admit of possible confusion, the round dot may be replaced by a square, triangular or star-shaped dot.

It is recommended that the minimum dimensions of the marks be those indicated in the sketches.

2. Special attention shall be given to the distribution of marks along chosen international routes.

NOTE.—Steps to establish suitable marks for landing at night shall be eventually taken, in accordance with the decision of the International Commission for Air Navigation.

ANNEX G

COLLECTION AND DISSEMINATION OF METEOROLOGICAL INFORMATION

1. *Nature and object of meteorological information to be furnished by Contracting States.*

(A) "Statistical" is required for the purpose of indicating the degree of safety and convenience of different routes or aerodromes for different types of aircraft.

It consists of:—

(a) Analysis and summaries of past meteorological records.

(b) Summaries of current observations.

(B) "Current" is required for the purpose of:—

(a) Keeping a current record of the weather.

(b) Making forecasts.

It consists of:—

1. The results of daily observations.

2. Lists of active stations at which these observations are taken.

(C) "Forecasts" are for the purpose of telling all concerned when and where flying is possible and the best conditions for the same. They are statements of conditions anticipated:—

- (a) "Short period" during the next three or four hours.
- (b) "Normal" during the next 20 to 30 hours.
- (c) "Long period" during the next two or three days.
- (d) "Route" for particular region or route during the next six hours.

2. *Methods and times of furnishing the different types of information.*

(A) "Statistical" is furnished by Central Meteorological Offices for general information.

(a) Analysis and summaries of past records — by the publication of special handbooks giving averages, frequencies and extremes of the principal meteorological elements, together with charts and diagrams; prominence to be given to meteorological conditions of areas known to have special meteorological peculiarities.

(b) Summaries of current observations — by the monthly publication of the information obtained each month.

(B) "Current" is furnished by meteorological offices to meteorological offices.

(a) Results of daily observations — telegraphically by:—

1. Regular reports at fixed hours (*see* Appendix I.) and
2. By special reports at intermediate times when requested (*see* Appendix II.).

(b) Lists of stations whenever necessary, to keep other countries informed where observations are being taken, giving also local and topographical details affecting weather conditions at each station.

(c) "Forecasts" are furnished by Meteorological Offices for general information by publication in the public Press, telegraphically to other countries if required, or any other, the best, means to bring them to the notice of those requiring them (*see* Appendix III.).

APPENDIX I. REGULAR REPORTS

These are of two kinds:—

1. Individual station reports.
2. Collective station reports.

1. Individual station reports are the results of observations of individual stations, taken at 0100, 0700, 1300, and (1800 or) 1900 G.M.T. The reports are made as soon as the observation has been taken and are rendered to a central collecting station or office; where reports for only two of these hours are possible or sufficient, the hours should be separated by an interval of twelve hours. (It is recommended that the standard hours be changed to 0300 0900, 1500 and 2100 G.M.T. by international agreement.)

Reports will give information on the following, whenever possible:—

1. Wind.
2. Pressure.
3. Temperature and humidity.
4. Fog and visibility.
5. Clouds.
6. Precipitation.
7. Thunderstorms, hurricanes, tornadoes, dust-storms.
8. Other weather phenomena.
9. State of sea,

and also on upper air currents and upper air temperature and humidity, from stations where facilities are available for observation.

Reports will be made in the general form and in the codes given in Appendix IV.

2. Collective reports are a collection of the individual reports received by a central station or office and transmitted to other central offices. They are of three classes:—

Class 1.—The central office in this case is usually the main office of a country; it transmits its reports, within 1½ hours of the time the observations are taken at the individual stations, to all main offices of other countries within a radius of 1,500 kilometres.

Class 2.—These are reports made for the purpose of giving countries over 1,500 kilometres distant information essential to making their own forecasts. The central office is that of a selected State which possesses a high-power wireless station capable of worldwide ranges (minimum range 3,000 kilometres). The report is made within three hours of the observations, and is a collection of reports selected from the Class 1 reports and abridged (*see* Appendix IV.). It should include a forecast of conditions in the country of origin.

Class 3.—These are local reports made by local centers to other local centers (any within 500 kilometres). The report is a collection of reports, selected from the Class I. reports from stations in the vicinity and abridged (*see* Appendix IV.). It is made within 30 minutes of the time of observation.

APPENDIX II.

SPECIAL REPORTS

Special reports give the results of continuous observations at aerodromes having meteorological stations on recognized air routes. They are to be rendered within thirty minutes of a request from a central office on a specified aerodrome on the route. The maximum distance from which these reports will be required is 500 kilometres. The requests may take the form of a demand for hourly reports.

The reports are rendered by telephone or wireless, and may be from one country to another in the case of an international air route. The reports when made by telegram will be in the form and code given in Appendix IV.

APPENDIX III.

FORECASTS

Short-period forecasts covering three to four hours will give a statement of the anticipated conditions of cloud, weather, surface wind and visibility, together with direction and speed of wind at heights of 1,000 and 2,000 metres, and an estimate of meteorological fitness for different types of aircraft.

Normal forecasts for twenty to thirty hours will give similar information, but in more general terms.

Long-period forecasts give a general statement of the prospects for the next two or three days.

Route forecasts are made twice daily by central offices from information received from individual stations and will give a statement of conditions anticipated in the different regions or routes of the country for about six hours ahead.

APPENDIX IV.

GENERAL FORM IN WHICH REPORTS ARE TO BE RENDERED
AND CODES FOR THEIR TRANSMISSION

Individual stations will be allotted station call signs, *i.e.*, an index group of letters or figures which will be used in all reports to indicate the station, and will also serve as the wireless call sign. These should be internationally distinct.

The general form is given in meteorological symbols or letters. For purposes of transmission an appropriate figure value is given to each symbol or letter in accordance with the codes given below.

METEOROLOGICAL SYMBOLS OR LETTERS AND THEIR
SIGNIFICATION*Standard symbols.*

- BBB = barometer reduced to sea-level and expressed in millibars and tenths, *i.e.*, corrected for temperature gravity and index error. The initial 9 or 10 is omitted.
- DD = direction of wind (true direction as distinguished from magnetic) at a height of 10-15 metres above the surface expressed on scale 1-72 (*see* Code X.).
- F = force of wind on Beaufort scale (wind above force 9 to be specially noted at end of telegram).
- ww = present weather (Code I.).
- TT = temperature in degrees A (0° A = -273° C, 273° A = 0° C), first figure omitted.
- A = form of low cloud (Code III.).
- L = amount of low cloud (in tenths of sky covered, amount 10 telegraph as 0).
- B = form of medium or high cloud (Code III.).
- M = amount of medium or high cloud in tenths.
- h = height of base of low cloud (Code IV.(a)).
- WW = past weather (Code II.).
- V = visibility (Code V.).
- H₁ = relative humidity (Code VI.).
- S = state of sea (Code VII.).
- β = characteristic of barometric tendency (Code IX.).
- bb = amount of barometric tendency in half millibars per 3 hours; 50 added for negative tendencies.
- F₁ = fitness of weather conditions for flying machines (Code VIII.(a)).
- F₂ = fitness of weather conditions for airships (Code VIII.(b)).
- RR = rainfall: (i) in day, (ii) in night; in millimetres and tenths.
- MM = maximum temperature in the day.
- mm = minimum temperature in the night.
- X = reserve figure.

SPECIAL SYMBOLS FOR UPPER AIR CURRENTS

- H = height (Code IV.(b)).
- DD = direction on scale 1-72 (*i.e.*, to nearest 5° (*see* Code X.)).
- VV = speed in kilometres per hour (for speed above 99 K/hr use three figures).

SPECIAL SYMBOLS FOR UPPER AIR TEMPERATURE AND HUMIDITY

p = height or pressure (Code IV. (c)).
 HH = actual percentage of relative humidity.

SPECIAL SYMBOL FOR COLLECTIVE REPORTS. CLASS 2

B = barometer in whole millibars with the initial 9 or 10 omitted.

GENERAL FORMS OF MESSAGES IN METEOROLOGICAL SYMBOLS

REGULAR REPORTS.

1. *Individual Station Reports.*—Station call sign followed by the following groups:—

BBBDD. FwwTT. ALBmH. wwVHS. β bbF₁F₂.
 RRRMX (or RRmmX).

Additional two groups for reports from Stations having facilities for observations of upper air currents; the first of these being:—

A five-figure group to indicate that upper air current information is contained in the group which follows and which has the general form HDDVV.

Additional two groups for reports from stations having facilities for observations of upper air temperature and humidity; the first of these being:—

A five-figure group to indicate that upper air temperature and humidity information is contained in the group which follows and which has the general form ρ TTHH.

(NOTE.—These indicative five-figure groups would be better, from a signalling point of view, as a special Morse signal.)

2. *Collective Station Reports, Class 1.* The individual station reports are given in sequence in the same general form as above. Upper air conditions are given at the end for those stations for which available: upper air currents being given only for the following heights, 500, 1,000, 2,000, 5,000 metres (see Code IV. (b)).

Example of general form of collective report (Class 1) giving information from four stations, A, B, C, D, of which stations B, C have given upper air currents, and stations B, D upper air temperatures and humidity.

Call sign for "A"—BBBDD—FwwTT—ALBmH—
 wwVHS— β bbF₁F₂.

Call sign for "B"—BBBDD—FwwTT—ALBmH—
 wwVHS— β bbF₁F₂.

Call sign for "C"—BBBDD—FwwTT—ALBmH—
 wwVHS— β bbF₁F₂.

Call sign for "D"—BBBDD—FwwTT—ALBmH—
 wwVHS— β bbF₁F₂.

Group or signal indicating that upper air current information follows.

Call sign for "B"—HDDVV.

Call sign for "C"—HDDVV.

Group indicating that upper air temperature and humidity information follows.

Call sign for "B"— ρ TTHH.

Call sign for "D"— ρ TTHH.

3. *Collective Station Reports, Class 2.*—The individual station reports are given in sequence in an abridged form, as follows: Call sign for station—
 BBBDDF—wwTTh—AL β bb.

Upper air currents are given at the end of the telegram for heights 2,000 and 5,000 metres for selected stations.

Example of general form of collective report (Class 2) giving information from four stations A, B, C, D, of which stations "B," "C" are selected for upper air current conditions.

Call sign for "A" — BBDDF — wwTTh — ALβbb.

Call sign for "B" — BBDDF — wwTTh — ALβbb.

Call sign for "C" — BBDDF — wwTTh — ALβbb.

Call sign for "D" — BBDDF — wwTTh — ALβbb.

Group indicating that upper air current information follows.

Call sign for "B" — HDDVV.

Call sign for "C" — HDDVV.

Forecast of conditions in country of origin.

4. *Collective Station Reports, Class 3.*—The individual station reports are given in sequence in an abridged form as follows:—

Call sign of stations — DDF₁F₂ — ALBMh — wwWWV.

NOTE 1.—The general form for transmission "of special reports" and of forecasts has not yet been formulated.

NOTE 2.—Observations from ships at sea and the transmission of such observations require special arrangements which it has not yet been possible to formulate. Similarly for observations from aircraft and their transmission.

CODES

Code I.—Present Weather.—ww.

Note.—00 to 49 weather without precipitation.

50 to 70 and 77 to 97 with precipitation.

In Codes I and II, r = rain, d = drizzle, h = hail, s = snow, rs = sleet.
tlr = thunderstorm, e = wet air, f = fog (*see* Code V).

No Mist or Fog.

Code figure.	Code figure.
00 Absolutely cloudless.	17 — 4f.
01 Cloud less than 1/2.	18 — 5f.
02 About 1/2 clouded.	19 — 6f.
03 About 3/4 clouded.	20 — 7f.
04 Overcast, but small amount of blue visible.	21 — 8f.
05 Absolutely overcast.	22 Mist 1fe.
	23 — 2fe.
	24 Fog 3fe.
	25 — 4fe.
	26 — 5fe.
	27 — 6fe.
	28 — 7fe.
	29 — 8fe.
<i>Haze, Mist or Fog, but no precipitation.</i>	
06 Overcast and 1f.	
07 — — 2f.	
08 — — 3f.	
09 — — 4f.	
10 — — 5f.	
11 — — 6f.	
12 — — 7f.	
13 — — 8f.	
14 Haze 1f.	
15 — 2f.	
16 Fog 3f.	

Special Phenomena without precipitation.

- 30 e (wet air).
- 31 Exceptional visibility.
- 32 Dust Haze.
- 33 Dew.
- 34 Hoar Frost.

Code
figure.

- 35 Rime.
- 36 Glazed Frost.
- 37 Glazed Roads.
- 38 Solar Halo.
- 39 Lunar Halo.
- 40 Solar Corona.
- 41 Lunar Corona.
- 42 Aurora.
- 43 Squalls.
- 44 Gale.
- 45 Gloom.
- 46 Ugly: threatening.
- 47 Thunder.
- 48 Lightning.
- 49 Thunder and Lightning.

Precipitation and Fog (50-58).

- 50 Slight r
 - 51 Moderate r
 - 52 Heavy r
 - 53 Slight r
 - 54 Moderate r
 - 55 Heavy r
 - 56 Slight r
 - 57 Moderate r
 - 58 Heavy r
- } 2f. or 3f.
- } 4f. or 5f.
- } 6f. to 8f.

Precipitation and Squalls of Wind (59-70).

- 59 Slight r.
- 60 Moderate r.
- 61 Heavy r.
- 62 Slight h.
- 63 Moderate r and h.
- 64 Heavy r and h.
- 65 Slight rs.

Code
figure.

- 66 Moderate rs.
- 67 Heavy rs.
- 68 Slight s.
- 69 Moderate s.
- 70 Heavy s.

Snow Covering.

- 71 s over whole country.
- 72 s with bare patches.
- 73 Deep drifts.
- 74
- 75 } Reserve figures.
- 76 }

Precipitation (77-97).

- 77 Slight d.
 - 78 Moderate d.
 - 79 Thick d.
 - 80 Slight r.
 - 81 Moderate r.
 - 82 Heavy r.
 - 83 Slight h.
 - 84 Moderate h.
 - 85 Heavy h.
 - 86 Slight rs.
 - 87 Moderate rs.
 - 88 Heavy rs.
 - 89 Slight s.
 - 90 Moderate s.
 - 91 Heavy s.
 - 92 Slight tlr
 - 93 Moderate tlr
 - 94 Heavy tlr
 - 95 Slight tlr
 - 96 Moderate tlr
 - 97 Heavy tlr
 - 98 } Reserve figures.
 - 99 }
- } Without hail.
- } With hail.

Code II.—Past Weather.—WW.

Note.—00-49 Weather without precipitation.
50-97 Weather with precipitation.

- No Precipitation or Fog (00-14).* 08 — c and o; low cloud.
- 00 equals Cloudless. 09 — c and o; mixed cloud.
- 01 — b and bc; med. or high cloud. *Overcast, with Blue Patches (10-12).*
- 02 — b and bc; low cloud. 10 equals med. or high cloud.
- 03 — b and c; mixed cloud. 11 — low cloud.
- 04 — bc and c; med. or high cloud. 12 — mixed cloud.
- 05 — bc and c; low cloud. 13 — completely overcast; low or mixed cloud.
- 06 — bc and c; mixed cloud.
- 07 — c and o; med. or high cloud. 14 — b and o; low or mixed cloud.

Fog with Cloud above (15-19).

Code figure.
 15 equals overcast and 1f.
 16 — overcast and 2f.
 17 — overcast and 3f.
 18 — overcast and 4f or 5f.
 19 — overcast and 6f to 8f.

Haze or Fog (20-24).

20 equals Haze 1f.
 21 — Haze 2f.
 22 — Fog 3f.
 23 — Fog 4f. or 5f.
 24 — Fog 6f. to 8f.

Wet Fog or Mist (25-29).

25 equals Mist 1fe.
 26 — Mist 2fe.
 27 — Fog 3fe.
 28 — Fog 4fe. or 5fe.
 29 — Fog 6fe. to 8fe.

Special Phenomena without Precipitation (30-49).

30 equals e (wet air).
 31 — Exceptional visibility.
 32 — Dust Haze.
 33 — Dew.
 34 — Hoar Frost.
 35 — Rime.
 36 — Glazed Frost.
 37 — Glazed Roads.
 38 — Solar Halo.
 39 — Lunar Halo.
 40 — Solar corona.
 41 — Lunar corona.
 42 — Aurora.
 43 — Squalls.
 44 — Gale.
 45 — Gloom.
 46 — Ugly; threatening.
 47 — Thunder.
 48 — Lightning.
 49 — Thunder and lightning.

Precipitation.

Passing Showers (50-61).

50 of slight }
 51 of moderate } rain.
 52 of heavy }
 53 of slight }
 54 of moderate } hail or r and h.
 55 of heavy }

Code figure.

56 of slight }
 57 of moderate } rs or r and rs.
 58 of heavy }
 59 of slight — snow.
 60 of moderate — snow.
 61 of heavy — snow.

Occasional Precipitation (62-76).

62 occasional slight d.
 63 — moderate d.
 64 — thick d.
 65 — slight r.
 66 — moderate r.
 67 — heavy r.
 68 — slight r and h.
 69 — moderate r and h.
 70 — heavy r and h.
 71 — slight }
 72 — moderate } rs or r and rs.
 73 — heavy }
 74 — slight s.
 75 — moderate s.
 76 — heavy s.

Continuous or nearly Continuous Precipitation (77-91).

77 slight }
 78 moderate } drizzle.
 79 thick }
 80 slight }
 81 moderate } rain.
 82 heavy }
 83 slight }
 84 moderate } r and hail.
 85 heavy }
 86 slight }
 87 moderate } rs or r and rs.
 88 heavy }
 89 slight }
 90 moderate } snow.
 91 heavy }

Thunderstorms (92-97).

92 slight tlr }
 93 moderate tlr } without hail.
 94 heavy tlr }
 95 slight tlr }
 96 moderate tlr } with hail.
 97 heavy tlr }
 98 } Reserve Numbers.
 99 }

Code III.—Form of Cloud. { Low Cloud.—A.
Medium or High Cloud.—B.

- Low Cloud: 1 equals Facto Cumulus.
2 — Mammato Cumulus.
3 — Low Strato Cumulus (below 1200 m.).
4 — High Strato Cumulus (above 1200 m.).
5 — Nimbus.
6 — Cumulus.
7 — Cumulo Nimbus.
8 — Stratus.

- High Cloud: 1 — Cirrus.
2 — Cirro Stratus.
3 — Cirro Cumulus.
4 — False Cirrus.

- Medium Cloud: 5 — Thin Alto Stratus (Sun or Moon visible).
6 — Thick Alto Stratus.
7 — Alto Cumulus (low) (below 3 km.).
8 — Alto Cumulus (high) (above 3 km.).

Code IV (a), (b), (c) — Heights and Pressures of Upper Air Reports.

Code IV (a).—Height of base of Low Cloud.—h. Code IV (b).—Height of Upper Wind.—H.

Code figure.	Metres.	Code figure.	Metres.
0 equals cloud below	150	9 equals no low cloud.	
1 — cloud below	150-300	1 equals 200	
2 — cloud below	300-500	2 — 500	
3 — cloud below	500-750	3 — 1000	
4 — cloud below	750-1000	4 — 1500	
5 — cloud below	1000-1500	5 — 2000	
6 — cloud below	1500-2000	6 — 3000	
7 — cloud below	2000-2500	7 — 4000	
8 — cloud below	2500-3000	8 — 5000	

Code IV (c).—Height or Pressure to which Temperature and Humidity Values refer.—p.

Code figure.	4 equals pressure of 900 mb.
—	5 — pressure of 850 mb.
0 equals surface.	6 — pressure of 800 mb.
1 — 300 metres above surface.	7 — pressure of 750 mb.
2 — pressure of 1000 mb.	8 — pressure of 700 mb.
3 — pressure of 950 mb.	9 — pressure of 600 mb.

Code V.—Surface Visibility and Fog.—V.

Code figure.	Most distant object visible.	Description.	Code figure.	Most distant object visible.	Description.
0	less than 25 metres	8 f	4	2000 metres	2 f or 3 V
	25 metres	7 f	5	4000 —	2 f or 4 V
1	50 —	6 f	6	7000 —	1 f or 5 V
	100 —	5 f	7	12000 —	1 f or 6 V
2	200 —	4 f	8	20000 —	7 V
	500 —	3 f or 1 V		30000 —	8 V
3	1000 —	3 f or 2 V	9	above 30000 and clear air	9 V

Code VI.—Relative Humidity.—H.

Code figures.	Code figure.
0 equals 95 — 100 per cent.	5 equals 50 — 59 per cent.
9 — 90 — 94 —	4 — 40 — 49 —
8 — 80 — 89 —	3 — 30 — 39 —
7 — 70 — 79 —	2 — 20 — 29 —
6 — 60 — 69 —	1 — 10 — 19 —

Code VII.—State of Sea.—S.

Code figure.	Description.	Code figure.	Description.
0 equals	Calm — glassy.	5 equals	Rather rough—much furrowed.
1 —	Very smooth—slightly rippled.	6 —	Rough—deeply furrowed.
2 —	Smooth—rippled.	7 —	High rollers, steep fronts.
3 —	Slight — rocks buoy.	8 —	Very high rollers, steep fronts.
4 —	Moderate furrowed.	9 —	Phenomenal — precipitous.

Code VIII. (a) and (b).—Fitness for Flying.

*Code VIII. (a).—Fitness for
Aeroplane*

*Code VIII. (b).—Fitness for
Airships.*

Code figure.	Code figure.
0 equals entirely unfit: fog.	0 equals entirely unfit: fog.
1 — entirely unfit: rain and low cloud.	1 — entirely unfit: rain, wind, and low cloud.
2 — entirely unfit: gales.	2 — entirely unfit: gales.
3 — very risky: mist.	3 — very risky: high wind.
4 — very risky: wind and weather.	4 — very risky: occasional squalls.
5 — risky: mist.	5 — risky: strong wind.
6 — risky: wind and weather.	6 — risky: slight squalls.
7 — fit.	7 — fit.
8 — very fit.	8 — very fit.
9 — perfect.	9 — perfect.

Code IX.—Characteristic of Barometric Tendency.—β

Code figure.	Code figure.
0 equals steady.	6 equals steady, then falling.
1 — unsteady.	7 — falling, now steady
2 — rising.	8 — rising, now steady or falling.
3 — falling.	9 — line squall; sudden rise with marked change of wind and weather.
4 — falling, then rising.	
5 — steady, then rising.	

Code X.—Direction of Wind.—DD.

Direction is specified to the nearest 5° by use of the numbers 1—72. The numbers corresponding with the usual "even" points of the old telegraphic scale are as follows:—

04 equals NNE.	49 equals WSW.
09 — NE.	54 — West.
13 — ENE.	58 — WNW.
18 — East.	63 — NW.
22 — ESE.	67 — NNW.
27 — SE.	72 — North.
31 — SSE.	
36 — South.	
40 — SSW.	
45 — SW.	

To express directions calculated in degrees in this scale, divide the number of degrees by 5 (or multiply by 2 and divide by 10).

e.g., 17° equals 03; 53° equals 11; 257° equals 51; 313° equals 63.

ANNEX H.

CUSTOMS

GENERAL PROVISIONS

I.

Any aircraft going abroad shall depart only from aerodromes specially designated by the customs administration of each contracting State, and named "customs aerodromes."

Aircraft coming from abroad shall land only in such aerodromes.

2.

Every aircraft which passes from one State into another is obliged to cross the frontier between certain points fixed by the contracting States. These points are shown on the aeronautical maps.

3.

All necessary information concerning customs aerodromes within a State, including any alterations made to the list and any corresponding alterations necessary on the aeronautical maps and the dates when such alterations become valid, and all other information concerning any international aerodromes which may be established, shall be communicated by the States concerned to each other and to the International Commission for Air Navigation, which shall notify such information to all of the contracting States. The contracting States may agree to establish international aerodromes at which there may be joint customs services for two or more States.

4.

When, by reason of a case of *force majeure*, which must be duly justified, an aircraft crosses the frontier at any other point than those designated, it shall land at the nearest customs aerodrome on its route. If it is forced to land before reaching this aerodrome it shall inform the nearest police or customs authorities.

It will only be permitted to leave again with the authorization of these authorities, who shall, after verification, stamp the log book and the manifest provided for in paragraph 5: they shall inform the pilot of the customs aerodrome where he must necessarily carry out the formalities of customs clearance.

5.

Before departure, or immediately after arrival, according to whether they are going to or coming back from a foreign country, pilots shall show their

log books to the authorities of the aerodrome and, if necessary, the manifest of the goods and supplies for the journey which they carry.

6.

The manifest is to be kept in conformity with the attached form N° 1.

The goods must be the subject of detailed declarations in conformity with the attached form N° 2, made out by the senders.

Every contracting State has the right to prescribe for the insertion either on the manifest or on the customs declaration of such supplementary entries as it may deem necessary.

7.

In the case of an aircraft transporting goods the customs officer, before departure, shall examine the manifest and declarations, make the prescribed verifications and sign the log book as well as the manifest. He shall verify his signature with a stamp. He shall seal the goods or sets of goods, for which such a formality is required.

On arrival the customs officer shall ensure that the seal is unbroken, shall pass the goods, shall sign the log book and keep the manifest.

In the case of an aircraft with no goods on board, the log book only shall be signed by the police and customs officials.

The fuel on board shall not be liable to customs duties provided the quantity thereof does not exceed that needed for the journey as defined in the log book.

8.

As an exception to the general regulations, certain classes of aircraft, particularly postal aircraft, aircraft belonging to aerial transport companies regularly constituted and authorized and those belonging to members of recognized touring societies not engaged in the public conveyance of persons or goods, may be freed from the obligation of landing at a customs aerodrome and authorized to begin or end their journey at certain inland aerodromes appointed by the customs and police administration of each State at which customs formalities shall be complied with.

However, such aircraft shall follow the normal air-route, and make their identity known by signals agreed upon as they fly across the frontier.

REGULATIONS APPLICABLE TO AIRCRAFT AND GOODS.

9.

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

If they are to be re-exported, they shall have the benefit of the regulations as to permit by bond or deposit of the taxes.

In the case of the formation between two or more countries of the Union of touring societies, the aircraft of the said countries will have the benefit of the regulations of the "Tryptique."

10.

Goods arriving by aircraft shall be considered as coming from the country where the log book and manifest have been signed by the customs officer.

As regards their origin and the different customs régimes, they are liable to the regulations of the same kind as are applicable to goods imported by land or sea.

11.

With regard to goods exported in discharge of a temporary receiving or

bonded account or liable to inland taxes, the senders shall prove their right to send the goods abroad by producing a certificate from the customs of the place of destination.

AIR TRANSIT.

12.

When an aircraft to reach its destination must fly over one or more contracting States, without prejudice to the right of sovereignty of each of the contracting States, two cases must be distinguished:—

1. If the aircraft neither sets down nor takes up passengers or goods, it is bound only to keep to the normal air route and make itself known by signals when passing over the points designated for such purpose.

2. In other cases, it shall be bound to land at a customs aerodrome and the name of such aerodrome shall be entered in the log book before departure. On landing, the customs authorities shall examine the papers and the cargo, and take, if need be, the necessary steps to ensure the re-exportation of the craft and goods or the payment of the dues.

The provisions of paragraph 9 (2) are applicable to goods to be re-exported.

If the aircraft sets down or takes up goods, the customs officer shall verify the fact on the manifest, duly completed, and shall affix, if necessary, a new seal.

VARIOUS PROVISIONS.

13.

Every aircraft during flight, wherever it may be, must conform to the orders from police or customs stations and police or customs aircraft of the State over which it is flying.

14.

Customs officers and excise officials, and generally speaking the representatives of the public authorities shall have free access to all starting and landing places for aircraft; they may also search any aircraft and its cargo to exercise their rights of supervision.

15.

Except in the case of postal aircraft, all unloading or throwing out in the course of flight, except of ballast, may be prohibited.

16.

In addition to any penalties which may be imposed by local law for infringement of the preceding regulations, such infringement shall be reported to the State in which the aircraft is registered, and that State shall suspend for a limited time, or permanently, the certificate of registration of the offending aircraft.

17.

The provisions of this Annex do not apply to military aircraft visiting a State by special authorization (Articles 31, 32, and 33 of the Convention), nor to police and customs aircraft (Articles 31 and 34 of the Convention).

NOTE.—The manifest should not bear on it erasures or corrections except those approved by the proper customs officials, nor contain interlineations or several articles entered on the same line. As many extra sheets may be added as are necessary.

AIR NAVIGATION

MANIFEST

OR GENERAL DECLARATION OF CARGO.

Space reserved for entries by Customs Officers.

MACHINE.....	{	Registration Mark.
COMMANDING OFFICER.	{	Name: Residence: Nationality: Number of License:
GOODS.....	{	Place of departure: Country: Place of destination: Country: Number of annexed declarations:

The Commanding Officer guarantees the accuracy of the contents of this manifest under penalties provided by law. Consequently he has dated and signed this document immediately below the last entry.

File Number of Document.	Marks and Numbers on the Parcels.	Number (in Figures and Letters) and descriptions of Parcels.	Nature of the Goods.	Weight.	Observations.

AIR NAVIGATION

Place of departure

Place of departure:

Customs declaration made by M.

for the following goods:

Parcels.		Nature of Goods.	Detailed Description of Contents.	Country of Origin.	Value.	Weight.		Observations.
Marks and Numbers.	Number.					Gross.	Net.	

At _____ the _____ day of _____ 19____

Consignor,

AERIAL LAW RESOLUTION BY AMERICAN LEGION

The American Legion, at its National Convention in Cleveland, September 27, adopted the following resolution:

WHEREAS, the United States of America has, at the present time, no federal legislation affecting the manufacture, flying or landing of aircraft, and

WHEREAS, a lack of such legislation leads to extremely dangerous confusion and retards the development of aircraft, which is of vital importance to the national defense, therefore,

Be It Resolved, That the American Legion, in national convention assembled, does hereby request the Congress of the United States of America at once to enact legislation which has for its object a development of the art and industry of flying by passing proper laws regarding it; this legislation to cover the licensing of aircraft for air worthiness; periodic inspection and reinspection of aircraft while in service; the initial examination and licensing of pilots for various types of flying, and periodic re-examination of such pilots in order to determine their continued fitness for flying; and the definition and specification of what constitute proper landing fields.

NEW YORK STATE AERIAL LAW RESOLUTION

The New York State Assembly passed the following resolution in February, 1920:

WHEREAS, aviation and aerial navigation has passed the experimental stage and is now recognized as a useful, safe and practicable method of the transportation of both person and merchandise; and

WHEREAS, little, if any, legislation has been enacted either by the individual states or by the United States of America, governing the use, control and development of aircraft and aerial navigation; and

WHEREAS, it appears self evident by reason of the intricacies of the aerial problem of the necessity of a uniform law in all of the United States of America, creating certain fundamental propositions defining, limiting and extending the use, control and development of said aerial navigation by the citizens of the respective states; and

WHEREAS, the sovereign state of New York has long past recognized the need of immediate federal legislation providing for such regulation and development of this modern method of transportation and that the said State is now preparing to enact legislation along similar lines, as hereinbefore set forth.

Now, Therefore, Be It Resolved (if the Senate concur), That the legislature of the State of New York respectfully urge the congress of the United States to enact such laws as they may deem proper and expedient for the regulation of the use, control and development of all air craft and aerial navigation in and through all the states and territories of the United States of America, pertaining and applicable to all private individuals, associations and corporations.

Further Resolved, That a copy of this resolution be transmitted in due form, by the clerks of the legislature to the respective clerks of the Senate and House of Representatives of the Congress of the United States.

AIRCRAFT INSURANCE

Although aircraft insurance has been written in the United States since 1912, it was not until 1920 that protection against loss or damage by operation was

available. Insurance companies from the beginning have recognized the importance of covering all possibilities, but they have been handicapped by the lack of proper Federal Laws, the danger of local or state legislation, and by the consequent inability to collate accurate, comprehensive statistics.

In March, 1920, the National Aircraft Underwriters Association was formed, including within its membership the following firms: Aetna Life Insurance Co.; Aetna Casualty and Surety Co.; Automobile Insurance Co. of Hartford, Conn.; National Liberty Insurance Co.; Firemen's Fund Insurance Co.; Home Insurance Co., and the Globe and Rutgers Insurance Co. The Travelers Insurance Co., which is not a member, also offers aircraft insurance. These companies are now writing various kinds of aircraft insurance on 95% of the total number of insured planes in the United States. In the organization there are also seventeen associate member companies which plan eventually to write aircraft insurance. Many of these are life insurance companies seeking pilots' records and fatality and accident reports for use in their regular business.

The National Aircraft Underwriters' Association is co-operating with the Underwriters' Laboratories of Chicago and with the Manufacturers' Aircraft Association, in compiling data, which will include causes of accidents, physical characteristics and flying ability of machines, air port facilities, etc.

At its first annual meeting, November 30, 1920, the National Aircraft Underwriters' Association, through its Executive Committee, of which Edmund Ely is chairman, went on record as urging the immediate formulation and enactment of a Federal aerial code. The report declared: "While we are engaged in the insurance of aircraft, presumably, in the face of all experience, to derive a profit for our companies, I conceive a different aspect to our province. Granting that proper insurance protection is essential to successful and widespread commercial operation of aircraft, it should be borne in mind that the passenger-carrying ship in time of peace is the potential bomber in time of war. In the face of intensive cultivation of the art of flying abroad, it is the plainest common sense as well as a patriotic duty for the insurance interests to devote such time and thought to the subject as will enable us to assist in the establishment of equal standards here. Considerations of commerce, national pride and national safety urge us to give all possible furtherance to flying development in this country and we solicit the continued and whole-hearted support of our membership and the entire insurance fraternity toward this end."

Following are the officers of the National Aircraft Underwriters' Association: Edmund Ely (Aetna Life), President; E. Stockton Martin (Home), Vice-president; Charles H. Payne (National Liberty), Secretary; J. D. Lester (Globe and Rutgers), Treasurer, and R. J. Smith, Assistant Secretary. Mr. Smith has charge of the association offices at 132 Nassau Street, New York City, and invites correspondence.

As of December, 1920, the following lines of aircraft insurance are available:

Fire: Covering all loss by fire to the machine itself while in the air, on the ground, in the hangar or in any location.

Collision: Based on the ability of the pilot, condition of the machine and motor, uses to which the plane will be put, territory over which it will be operated, etc. Permission is given to carry passengers, do cross-country flying, photography and advertising, each at an additional premium. Cargo is insurable, but this field has been limited, so far. Life insurance on the pilot or passenger is written either through an accident ticket for one day

or on a yearly basis. Accident insurance is obtainable at a slight increase over the regular rates.

Public Liability: Covering the assured against all law suits arising from injury to persons outside of the plane, and property damage, covering all damage to property owned by others, such as crops, etc.

CUSTOMS REGULATIONS

Quarantine rules for aircraft, as promulgated by the Public Health Service are given in the Aerial Legislative Section of the Appendix.

General customs regulations for aircraft are nebulous as yet. The Chief, Division of Customs, Treasury Department, states, as of December 1, 1920:

"There are no customs laws on the statute books relating particularly to the importation or exportation of merchandise by aircraft, and there are no regulations covering the subject generally. However, merchandise imported or exported by aircraft would be subject to the same laws, regulations and duties as if imported or exported by vessel, train, automobile or other vehicle, and under these regulations the craft would be required to land at the port of entry nearest to the point at which it entered the United States, in order that customs formalities might be complied with. Whether the craft itself would be subject to duty, if a foreign production, would depend on whether it was owned by a regular transportation company and operated as a common carrier. If so, it would not be subject to duty, otherwise it would be. The Department has, however, ruled that airplanes of foreign manufacture may be brought into the United States under their own power free of duty for a period of thirty days for touring purposes, under article 422 of the Customs Regulations of 1915. This would also apply to any other form of aircraft brought in for a similar purpose.

"As stated above, the craft would be required to land at the port of entry nearest to the point at which the same entered the United States. If the aerodrome, or landing field, should be situated within the limits of such port, the customs examination and supervision of arrivals and departures would be without expense to the owner of the vessel, but if situated outside the limits of the port examination and supervision of arrivals and departures would be at the expense of the parties in interest.

"The requirements under the Passport Control Act of May 22, 1918, and the President's Proclamation of August 8, 1918, made in pursuance thereof, would be applicable to arrivals and departures of persons by aircraft, the same as to arrivals and departures of persons by vessel or vehicle. The regulations regarding export declarations covering shipments by land or sea would also be applicable to exportations by aircraft."

The U. S. Coast Guard is charged with the prevention of smuggling as well as the enforcement of the navigation and customs laws in general.

RECORDS, ETC.

LIST OF WORLD AERONAUTICAL RECORDS

All records to be official must be homologated by the Federation Aeronautique Internationale. The F. A. I., in transmitting the latest data to the European correspondent of the Manufacturers' Aircraft Association, advised, under date of Nov. 26, 1920: "You will find enclosed the official list of world records from the 6th of January, 1920. (There was none from the 1st of August, 1914, to the 5th of January, 1920.) These will permit you to complete your list."

B indicates biplane.
M indicates monoplane.
T indicates triplane.

FIRST AIRPLANE FLIGHTS

Name	Airplane	Engine	Place	Date
B Orville Wright	Wright	16 h.p. Wright	Kitty Hawk, N. C.	Dec. 17, 1903
B Wilbur Wright	Wright	16 h.p. Wright	Kitty Hawk, N. C.	Dec. 17, 1903

ALTITUDE — (Pilot Alone)

Name	Airplane	Engine	Place	Date	Height	
					Metres	Feet
B Wilbur Wright	Wright	24 h.p. Wright	Auvours, Fr.	11-13-08	25	82
B Henry Farman	Voisin	40 h.p. Vivinus	Issy, Fr.	11-13-08	25	82
B Wilbur Wright	Wright	24 h.p. Wright	Auvours, Fr.	12-18-08	110	361
B Louis Paulhan	Voisin	50 h.p. Gnome	Douai, Fr.	7-18-09	150	492
M Hubert Latham	Antoinette	50 h.p. Antoinette	Rheims, Fr.	8-29-09	155	508
B Rougier	Voisin	50 h.p. E.N.V.	Brescia	9-20-09	193	633
B DeLambert	Wright	24 h.p. Wright	Juvisy, Fr.	10-18-09	300	984
M Hubert Latham	Antoinette	50 h.p. Antoinette	Chalons, Fr.	12- 1-09	453	1486
M Hubert Latham	Antoinette	50 h.p. Antoinette	Chalons, Fr.	1- 7-10,	1050	3445
B Louis Paulhan	H. Farman	50 h.p. Gnome	Los Angeles. Cal.	1-12-10	1269	4164
B Walter Brookins	Wright	40 h.p. Wright	Indianapolis	6-14-10	1335	4380
M Hubert Latham	Antoinette	50 h.p. Antoinette	Rheims, Fr.	7- 7-10	1384	4541

	Name	Airplane	Engine	Place	Date	Height	
						Metres	Feet
B	Walter Brookins	Wright	40 h.p. Wright	Atlantic City	7-10-10	1990	6259
M	Armstrong Drexel	Bleriot	50 h.p. Gnome	Lanark, Scotland	8-11-10	2013	6605
M	Leon Morane	Bleriot	50 h.p. Gnome	LeHavre, Fr.	8-29-10	2150	7054
M	Leon Morane	Bleriot	50 h.p. Gnome	Deauville, Fr.	9- 3-10	2582	8471
M	Geo. Chavez	Bleriot	50 h.p. Gnome	Issy, Fr.	9- 8-10	2587	8487
B	Henry Wijnmalen	H. Farman	50 h.p. Gnome	Mourmelon, Fr.	10- 1-10	2780	9121
B	Ralph Johnstone	Wright	60 h.p. Wright	Belmont Park	10-31-10	2960	9712
M	Geo. Legagneux	Bleriot	50 h.p. Gnome	Pau, Fr.	12- 9-10	3110	10204
B	Arch. Hoxsey	Wright	60 h.p. Wright	Los Angeles	12-26-10		11474
B	Loridan	H. Farman	70 h.p. Gnome	Buc, Fr.	7- 9-11	3200	10499
M	Capt. Felix	Bleriot	70 h.p. Gnome	Etampes, Fr.	8- 5-11	3350	10991
B	Lincoln Beachy	Curtiss	60 h.p. Curtiss	Chicago		3527	11573
M	Roland Garros	Bleriot	70 h.p. Gnome	St. Malo, Fr.	9- 4-11	3950	12960
M	Roland Garros	Bleriot	70 h.p. Gnome	Dinard, Fr.	9- 6-11	4960	16274
M	Geo. Legagneux	Morane	80 h.p. Gnome	Issy, Fr.-Villacoublay	9-17-12	5450	17891
M	Roland Garros	Morane	80 h.p. Gnome	Tunis	12-11-12	5610	18406
M	Edouard Perryon	Bleriot	80 h.p. Gnome	Buc, Fr.	3-11-13	5880	19325
B	Geo. Legagneux	Nieuport	60 h.p. LeRhône	St. Raphael Fr.	12-29-13	6120	20080
B	Gino Linnekogel	Rumpler	100 h.p. Mercedes	Johannisthal, Ger.	7- 9-14	6600	21654
B	Harry Oelerich	D.F.W.	100 h.p. Mercedes	Leipzig, Ger.	7-14-14	7850	25755
B	R. W. Schroeder	Lepere	400 h.p. Liberty, with supercharger	Dayton, O.	2-27-20	10093	33114

DISTANCE -- (Airplanes)

(closed circuit?)

	Name	Airplane	Engine	Place	Date	Distance	
						Yards	Metres
M	Santos Dumont	Santos Dumont	50 h.p. Mercedes	Bagatelle, Fr.	9-14-06	8.6	7.8
M	Santos Dumont	Santos Dumont	50 h.p. Mercedes	Bagatelle, Fr.	11-12-06	244.4	220.
B	Henry Farman	Voisin	40 h.p. Vivinus	Issy, Fr.	10-26-07	855.5	770.
B	Henry Farman	Voisin	50 h.p. Antoinette	Issy, Fr.	1-13-08	Miles 0.625	Kilos. 1.
B	Henry Farman	Voisin	50 h.p. Antoinette	Issy, Fr.	3-21-08	1.25	2
B	Leon Delagrangé	Voisin	40 h.p. Vivinus	Issy, Fr.	4-11-08	2.50	4
B	Leon Delagrangé	Voisin	50 h.p. E.N.V.	Issy, Fr.	5-20-08	7.7	13
B	Leon Delagrangé	Voisin	40 h.p. Vivinus	Issy, Fr.	9-6-08	15.3	24
B	Wilbur Wright	Voisin	40 h.p. Vivinus	Issy, Fr.	9-17-08	41.5	67
B	Wilbur Wright	Wright	24 h.p. Wright	Auvours, Fr.	9-21-08	60.9	974
B	Wilbur Wright	Wright	24 h.p. Wright	Auvours, Fr.	12-18-08	62.	100
B	Henry Farman	H. Farman	50 h.p. Gnome	Auvours, Fr.	12-31-08	77.5	125
B	Henry Farman	H. Farman	50 h.p. Gnome	Rheims, Fr.	8-26-09	112.	180
M	Jan Olieslaegers	Bleriot	50 h.p. Gnome	Mourmelon, Fr.	11-3-09	150.	240
M	Jan Olieslaegers	Bleriot	50 h.p. Gnome	Rheims, Fr.	7-10-10	139.5	225
B	Maurice Tabuteau	M. Farman	70 h.p. Renault	Rheims, Fr.		245.	393
B	Maurice Tabuteau	M. Farman	70 h.p. Renault	Etampes, Fr.	10-28-10	290.	465
M	Jan Olieslaegers	Bleriot	50 h.p. Gnome	Etampes, Fr.	12-30-10	362.7	585
B	Georges Fourny	M. Farman	70 h.p. Gnome	Kiewitt	7-16-11	393.7	635
B	Andre Gobe	Nieuport	70 h.p. Gnome	Buc, Fr.	9-1-11	448.3	723
B	Georges Fourny	M. Farman	70 h.p. Gnome	Pau, Fr.	12-24-11	460.	740
B	Landmann	Albatross	100 h.p. Mercedes	Etampes, Fr.	9-11-12	633.	1017
B	Boussoutrut	Farman		Johannisthal, Ger.	6-28-14	1178	1900
B	Jean Bernard	Goliath	2-260 h.p. Salmson	Villesauvage-la Marmogne, Fr.	6-3/4-20	1915	1190

DURATION

Name	Airplane	Engine	Place	Date	Time		
					Hrs.	Min.	Sec.
M Santos Dumont	Santos Dumont	50 h.p. Antoinette	Bagatelle, Fr.	11-12-06	0	0	21
B Henry Farman	Voisin	40 h.p. Vivinus	Issy, Fr.	10-26-07	0	0	52
B Henry Farman	Voisin	50 h.p. Antoinette	Issy, Fr.	1-13-08	0	1	28
B Henry Farman	Voisin	50 h.p. Antoinette	Issy, Fr.	3-21-08	0	3	39
B Leon Delagrangé	Voisin	40 h.p. Vivinus	Issy, Fr.	4-11-08	0	6	39
B Leon Delagrangé	Voisin	50 h.p. E.N.V.	Rome, Italy	5-30-08	0	15	26
B Henry Farman	Voisin	50 h.p. Antoinette	Issy, Fr.	7- 6-08	0	20	19
B Leon Delagrangé	Voisin	40 h.p. Vivinus	Issy, Fr.	9- 6-08	0	29	53
B Wilbur Wright	Wright	24 h.p. Wright	Auvours, Fr.	9-21-08	1	31	25
B Wilbur Wright	Wright	24 h.p. Wright	Auvours, Fr.	12-18-08	1	54	53
B Wilbur Wright	Wright	24 h.p. Wright	Auvours, Fr.	12-31-08	2	30	23
B Louis Paulhan	Voisin	50 h.p. Gnome	Betheny, Fr.	8-27-09	2	43	24
B Henry Farman	H. Farman	50 h.p. Gnome	Betheny, Fr.	8-27-09	3	4	56
B Henry Farman	H. Farman	50 h.p. Gnome	Mourmelon, Fr.	11- 3-09	4	17	53
M Labouchère	Antoinette	50 h.p. Antoinette	Rheims, Fr.	7- 9-10	4	19	0
M Jan Olieslaegers	Bleriot	50 h.p. Gnome	Rheims, Fr.	7-10-10	5	3	5
B Maurice Tabuteau	M. Farman	70 h.p. Renault	Etampes, Fr.	10-28-10	6	0	0
B Henry Farman	H. Farman	50 h.p. Gnome	Etampes, Fr.	12-18-10	8	12	23
B Georges Fourny	M. Farman	70 h.p. Renault	Buc, Fr.	9- 1-11	11	1	20
B Georges Fourny	M. Farman	70 h.p. Renault	Buc, Fr.	9-11-11	13	17	57
B Langer	L.F.G. Roland	100 h.p. Mercedes	Johannisthal, Ger.	2- 4-14	14	7	0
B Poulet	Caudron	50 h.p. Gnome	Etampes, Fr.	4-24-14	16	28	56
B Bassier	Rumpler	100 h.p. Mercedes	Johannisthal, Ger.	6-24-14	18	10	0
B Landmann	Albatross	100 h.p. Mercedes	Johannisthal, Ger.	6-28-14	21	50	0
B Boehm	Albatross	100 h.p. Mercedes	Johannisthal, Ger.	7-10-14	24	12	0
B Boussoutrot	Farman		Villesauvage-				
Jean Bernard }	Goliath	2-260 h.p. Salmson	la Marmogne, Fr.	6-¼-20	24	19	7

SPEED

Name	Airplane	Engine	Place	Date	Speed per Hr.	
					Miles	Kilos.
B Wilbur Wright	Wright	24 h.p. Wright	Auvours, Fr.	9-21-08	27.2	44
B Leon Delagrangé	Voisin	45 h.p. Antoinette	Juvisy, Fr.	5-31-09	27.9	45
B Capt. Ferber	Voisin	45 h.p. Antoinette	Juvisy, Fr.	9-3-09	29.7	48
M Bleriot	Bleriot	60 h.p. E.N.V.	Rheims, Fr.	8-28-09	47.7	77
B Glenn H. Curtiss	Curtiss	50 h.p. Curtiss	Rheims, Fr.	8-29-09	47	
M Alfred Leblanc	Bleriot	100 h.p. Gnome	Belmont Park	10-29-10	67.5	109
B C. Weymann	Nieuport	100 h.p. Gnome	Eastchurch, Eng.	7-1-11	79.5	125
M Jules Vedrines	Deperdussin	100 h.p. Gnome	Chicago	9-9-12	105	170
M Marcel Prevost	Deperdussin	100 h.p. Gnome	Rheims, Fr.	9-29-13	124.5	204
B Jean Casale	Spad	300 h.p. Hispano-Suiza	Villacoublay, Fr.	2-28-20	176.111	283
B De Romanet	Spad	300 h.p. Hispano-Suiza	Buc, Fr.	10-9-20	181.93	
B Sadi Lecointe	Nieuport	300 h.p. Hispano-Suiza	Buc, Fr.	10-10-20	184	296
B Sadi Lecointe	Nieuport	300 h.p. Hispano-Suiza	Villacoublay, Fr.	10-10-20	188	302

MISCELLANEOUS

SPEED OVER A 100-KILOMETER COURSE (62.15 MILES)

Name	Airplane	Engine	Place	Time	
				Min.	Sec.
B DeRomanet	Spad	300 h.p. Hispano-Suiza	France	23	16½
B Kirsch	Nieuport	300 h.p. Hispano-Suiza	France	22	18
B Sadi Lecointe	Nieuport	300 h.p. Hispano-Suiza	France	21	28

SPEED OVER A 200-KILOMETER COURSE (124.30 MILES)

Gordon Bennett Cup Race

Name	Airplane	Engine	Place	Date	Time	
					Min.	Sec.
B Kirsch	Nieuport	300 h.p. Hispano-Suiza	Etampes, France	9-28-20	48	52¾
B DeRomanet	Spad	300 h.p. Hispano-Suiza	Etampes, France,	9-28-20	46	7
B Sadi Lecointe	Nieuport	300 h.p. Hispano-Suiza	Etampes, France	9-28-20	43	42¾

SPEED OVER A 1000-KILOMETER COURSE (621.504 MILES)

B	Name	Airplane	Engine	Place	Date	Hrs.	Min.	Sec.
	Lucien Boussoutrot Jean Bernard	Farman Goliath	2-260 h.p. Salmson	Villesauvage- la Marmogne, Fr.	6-3/4-20	10	19	46

SPEED OVER A 1500-KILOMETER COURSE (932.356 MILES)

B	Name	Airplane	Engine	Place	Date	Hrs.	Min.	Sec.
	Lucien Boussoutrot Jean Bernard	Farman Goliath	2-260 h.p. Salmson	Villesauvage- la Marmogne, Fr.	6-3/4-20	16	42	8

RECORDS OF USEFUL LOADS CARRIED

ALTITUDE

B	Name	Airplane	Load	Place	Date	Height	
						Metres	Feet
	Capt. C. T. R. Hill	Handley-Page W-8	1500 kilos.	Cricklewood, England	5-4-20	4267	15137

RECORDS OF USEFUL LOADS CARRIED

DURATION

B	Name	Airplane	Load	Place	Date	Time	
						Hrs.	Min.
	Capt. C. T. R. Hill	Handley-Page W-8	1500 kilos.	Cricklewood, England	5-4-20	1	20

REMARKABLE AERONAUTICAL PERFORMANCES

It is understood that efforts will be made, particularly in the case of American pilots, to have the performances between Aug. 1, 1914, and Jan. 6, 1920, homologated. Therefore certain notable ones listed below, although unofficial as yet, according to the latest data transmitted to the Manufacturers' Aircraft Association by the Federation Aeronautique Internationale, probably will be officially accepted during the year.

B indicates biplane
M indicates monoplane
T indicates triplane

- 1903
B Dec. 17 Orville Wright made first airplane flight at Kitty Hawk, N. C., in biplane designed by himself and brother Wilbur. The latter flew the machine again that day, demonstrating that the first flight by man in a mechanically propelled airplane was practical.
- 1908
B July 4 Glenn H. Curtiss won Scientific American trophy with the "*June Bug*," built by Aerial Experiment Association to design of Mr. Curtiss.
B Oct. 31 Farman made first cross-country flight, Chalons to Rheims, 16 miles, in 20 min. Rose 200 feet from course.
- 1909
M July 25 Bleriot crossed Channel, Calais to Dover, in 37 min.
B Sept. 29 Wilbur Wright flew around Statue of Liberty, New York Harbor.
- 1910
B May 28 Curtiss made Albany-Governor's Island flight, 135.4 miles, in 2 hr. 32 min. First flight using river as guide.
B Aug. McCurdy received and sent wireless messages from airplane in flight, at Sheepshead Bay, N. Y.
Sept. 23 Chavez made first flight over Alps.
- 1911
B Jan. 18 Eugene Ely alighted on, and flew from deck of battleship at San Francisco.
B Feb. 23 Curtiss flew from land to water and from water to land, at San Diego, Cal.
- 1912
B Jan. 10 R. C. Fowler flew across continent from Jacksonville, Fla., to San Francisco, 2,232 miles in 151 days. First transcontinental flight.
- 1913
M Sept. 1 Pegoud made first voluntary loop.
- 1914
B July Trials of the "*America*," Curtiss flying boat, built to attempt flight across Atlantic.

- 1916
- B Apr. 26 Harry Hawker in Sopwith reached 24,408 feet.
- B June Lieut. A. Marchal, flying Nieuport, covered 807 miles from Nancy, France, to Cholm, Poland.
- B Nov. 19 Ruth Law flew from Chicago to Hornell, N. Y., 509 miles.
- 1917
- B Aug. 29 Capt. Laureati, flying S.V.A., covered 920 miles from Turin to Naples and return.
- B Sept. 24 Capt. Laureati, with one passenger in S.V.A. flew from Turin to London, 656¼ miles.
- 1918
- B Sept. 18 R. W. Schroeder in Bristol with 300 h.p. Wright motor climbed 28,900 feet.
- B Nov. 12 Lieut. W. T. Campbell at Texas looped 151 times.
- B Dec. 13-Jan. 16 Four-motored Handley-Page flew 6,500 miles from England to India.
- 1919
- M Jan. 18 R. W. Schroeder in Loening, with one passenger, at Dayton, O., reached 16,000 feet. This monoplane was equipped with Wright motor.
- M Jan. 24 Lieut. T. H. Joyce in Morane with 120 h.p. LeRhône motor looped 300 times at Issoudun.
- B Jan. 26 Lieut. Roget and Capt. Coli piloted French Breguet across Mediterranean Sea, 457 Miles in 5 hrs.
- B Feb. 12 Lt. B. W. Maynard in Sopwith with 160 h.p. Monosoupape motor looped 318 times at Romorantin.
- B Feb. 21 Thomas-Morse Scout, equipped with 300 h.p. Wright motor, attained speed of 164 miles per hr. at Ithaca, N. Y.
- B Apr. 16 Maj. T. C. Macauley, in D.H.-4, made round trip transcontinental flight in 44 hrs. 15 min. His terminals were San Diego, Cal., and Americus, Ga.
- B April 19 Capt. E. F. White, piloting army D.H.-4, made first non-stop flight between Chicago and New York. Average speed of 106 miles per hr. for 727 miles.
- B Apr. 26 U. S. Naval F.-5-L flying boat equipped with two 400 h.p. Liberty motors, carrying crew of four, stayed in air 20 hrs. 19 min.
- B May 8-31 Comm. A. C. Read and crew of five in N.C.-4 flying boat with four 400 h.p. Liberty motors flew from Rockaway, L. I., to Plymouth, Eng., 4,116 miles. First flight across the Atlantic.
- B May 28 J. Casale in Spad with 300 h.p. Hispano-Suiza motor, reached 31,000 feet.
- B June 14-15 Capt. John Alcock and Sir A. W. Brown in Vickers-Vimy with 400 h.p. Rolls-Royce motor flew from St. Johns, N. F., to Clifden, Ireland, 1,936 miles without stop.
- B July 12 Taddioli, Swiss aviator, first flier to cross Alps in seaplane.
- B July 12 Lieut. C. C. Chauncey in Lepere attained altitude of 20,000 feet in night flight at Arcadia, Fla.

- 1919
- B July 16 Lieut. F. Brockpapa flew 950 miles, Rome to England, in 8 hrs. 30 min.
- B July 24-Nov. 9 Lieut. Col. R. L. Hartz and three passengers in Glenn L. Martin twin-400 h.p. Liberty motored bomber made round the rim flight of United States, 9,823 miles.
- T July 30 Roland Rohlf in Curtiss "*Wasp*" equipped with 400 h.p. Curtiss K.-12 motor reached 30,700 feet at Mineola, L. I.
- B Aug. 2 R. W. Schroeder in Lepere with Liberty motor climbed 18,400 feet at speed estimated at 137 miles per hr.
- B Aug. 2 "Tex" Marshall in Thomas-Morse with 80 h.p. LeRhone motor, at Ithaca, N. Y., glided 35 miles.
- B Aug. 11 Farman Goliath carrying ten passengers made 1,116 miles, Paris to Morocco, in 16 hrs. 20 min.
- B Aug. 13 Thirteen army planes flew 4,000 miles through fifteen states to collect landing field and mapping data and stimulate recruiting.
- B Aug. 14 C. J. Zimmerman in Aeromarine model 40 flying boat, made first delivery of mail at sea. Dropped bag on deck of Adriatic 1½ hrs. after she left pier.
- B Sept. 6 R. W. Schroeder in Lepere with 400 h.p. Liberty motor reached 28,250 feet at McCook Field, Dayton, O.
- T Sept. 18 Roland Rohlf in Curtiss "*Wasp*" equipped with 400 h.p. K.-12 motor reached 32,450 feet at Mineola, L. I.
- M Sept. 28 Caleb S. Bragg and one passenger in Loening equipped with 300 h.p. Wright motor reached 18,500 feet.
- B Oct. 8-30 Lieut. B. W. Maynard in D.H.-4 equipped with 400 h.p. Liberty motor flew from New York to San Francisco and return, 5,402 miles.
- B Oct. 24 Curtiss "*Eagle*," eight passenger aerial liner, and first American three-motored machine, made first public flight, Garden City, L. I., to Washington, D. C., and return. While in Washington ten days it made 82 flights and carried 476 people, mostly U. S. government and foreign government officials.
- B Oct. 27-Dec. 3 C. J. Zimmerman in Aeromarine flying boat flew from Keyport, N. J., to Havana and return, 2,842 miles.
- B Nov. 12-Dec. 19 Capt. Ross Smith in Vickers-Vimy equipped with 400 h.p. Rolls-Royce motor flew from London to Port Darwin, Australia, 11,500 miles.

REMARKABLE AIRSHIP PERFORMANCES

- 1917
- Nov. 21-25 L.-59, German dirigible, flew from Jamboli, Bulgaria, to East Africa and return, 6,768 kilometers.
- 1919
- May 14-15 U. S. Navy C.-5, Goodyear dirigible, equipped with two 125 h.p. Union motors, flew from Montauk Point, L. I., to St. Johns, N. F., 1,115 miles.
- July 2-12 British dirigible R.-34, equipped with five 250 h.p. Sun-beam motors, flew from Great Britain to United States and return, 6,330 miles.

GROUND COURSES AND FLYING SCHOOLS

The following colleges and universities offer practical or theoretical courses in aeronautics:

UNIVERSITY OF CALIFORNIA	Berkeley, Cal.
COLUMBIA UNIVERSITY	New York City
CULVER MILITARY ACADEMY	Culver, Ind.
GEORGIA INSTITUTE OF TECHNOLOGY	Atlanta, Ga.
UNIVERSITY OF ILLINOIS	Urbana, Ill.
MASSACHUSETTS INSTITUTE OF TECHNOLOGY	Boston, Mass.
UNIVERSITY OF MICHIGAN	Ann Arbor, Mich.
LELAND STANFORD UNIVERSITY	Palo Alto, Cal.
UNIVERSITY OF WASHINGTON	Seattle, Wash.

Those desirous of taking actual flight instruction are advised to apply to the nearest member of the Manufacturers' Aircraft Association. Addresses may be found in the Industrial Section of the Appendix.

AIRCRAFT EXPORTS

(From Bureau of Foreign and Domestic Commerce)

	1919		Airplane parts	
	No.	Value	No.	Value
January .....	..	\$ .....	..	\$ 77,331
February	2	15,000	..	329,129
March .....	..	.....	..	639,858
April .....	..	.....	..	999,874
May	4	40,000	..	63,483
June	4	28,700	..	967,345
July	1	3,500	..	12,365
August .....	..	.....	..	3,973
September	21	44,700	..	47,054
October	3	23,000	..	30,871
November	1	3,000	..	77,706
December	8	59,100	..	237
	44	\$225,300	..	\$3,249,226
		1920		
January	2	\$ 29,180	..	\$ 43,060
February	3	44,000	..	6,494
March .....	..	.....	..	159,788
April	3	10,214	..	53,651
May	17	214,000	..	198,633
June	4	28,700	..	9,443
July	12	55,110	..	34,174
August .....	..	.....	..	2,120
September	5	17,370	..	9,331
October	10	147,600	..	6,811

THE END

