

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 chartered 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.

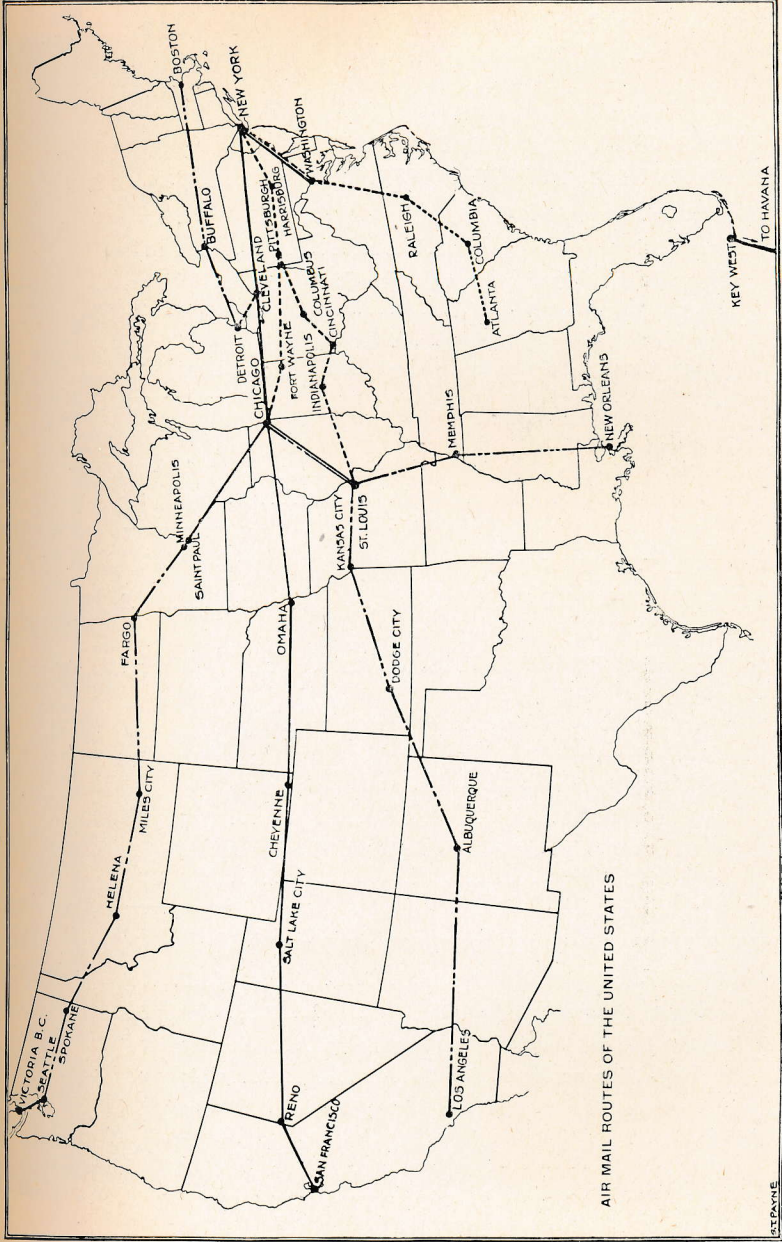
The Curtiss mail plane that left Curtiss Field, Long Island, on the morning of September 8th, carried many hundreds of pounds of mail. Another ship was sent out of San Francisco with New York mail at the same time. Despite heavy storms and fog, these planes brought the mails through in 20 hours less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

SEPPANE

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.

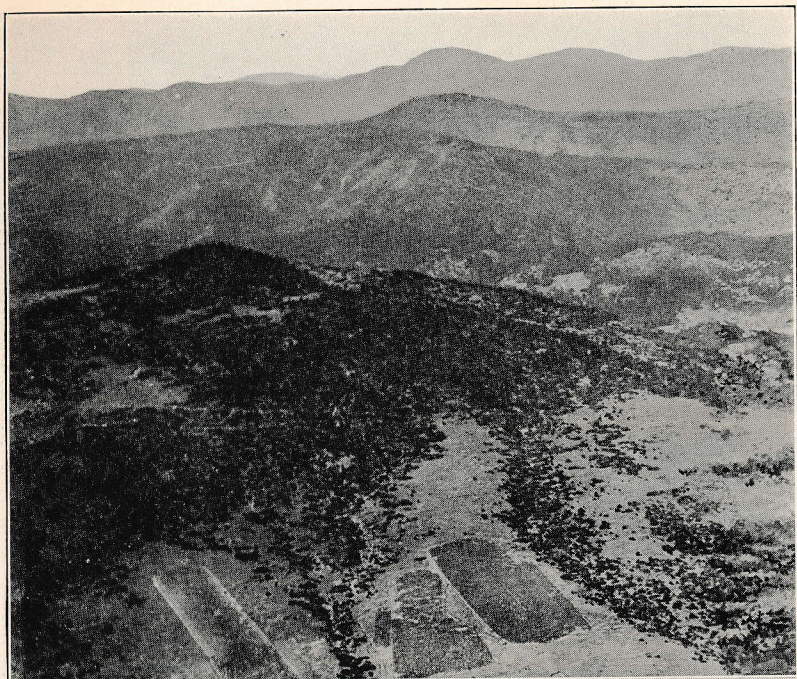
Two patrols operated daily out of Mather Field. One flew to Red Bluff, covering the north half of the Eldorado, Tahoe, Plumas and part of the Lassen forests; the second to Cooperstown, covering the south half of the Eldorado and the Stanislaus. Two planes were operated out of Fresno each day, one flying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

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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 wirelessly 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.