



THE CHINA CLIPPER FLYING OVER SAN FRANCISCO, California, at the start of a flight to Manila, capital of the Philippine Islands. The distance flown on this journey is over 8,000 miles, about a third of the distance round the world at the Equator. During the voyage the International Date Line is crossed, and passengers travelling westwards lose a day. On the eastward flight a day is gained. The actual time for the crossing from San Francisco to Manila is five days.

## ACROSS THE PACIFIC

*The Famous "Clipper" Flying Boat Service from California, U.S.A., to the Philippine Islands*

FROM San Francisco, on the Pacific coast of the United States, to Manila, capital of the Philippine Islands, a regular service of flying boats is maintained by Pan American Airways. The route followed is not direct, as certain islands—some of them famous, others scarcely known to Europeans—are used to divide the distance into relatively short stages. Even so, none of these stages is less than 1,200 miles long and the longest is 2,410 miles. The stopping places are Honolulu, capital of the Hawaiian Islands, Midway Island, Wake Island and Guam, a stronghold of the U.S. Navy. The total distance flown is over 8,000 miles—more than double the distance across the Atlantic and about one-third of the circumference of the Earth at the Equator. At Manila the air passenger may continue his journey in one of the Sikorsky flying boats which connect the Philippine Islands with Hong Kong and other cities in China. The voyage from

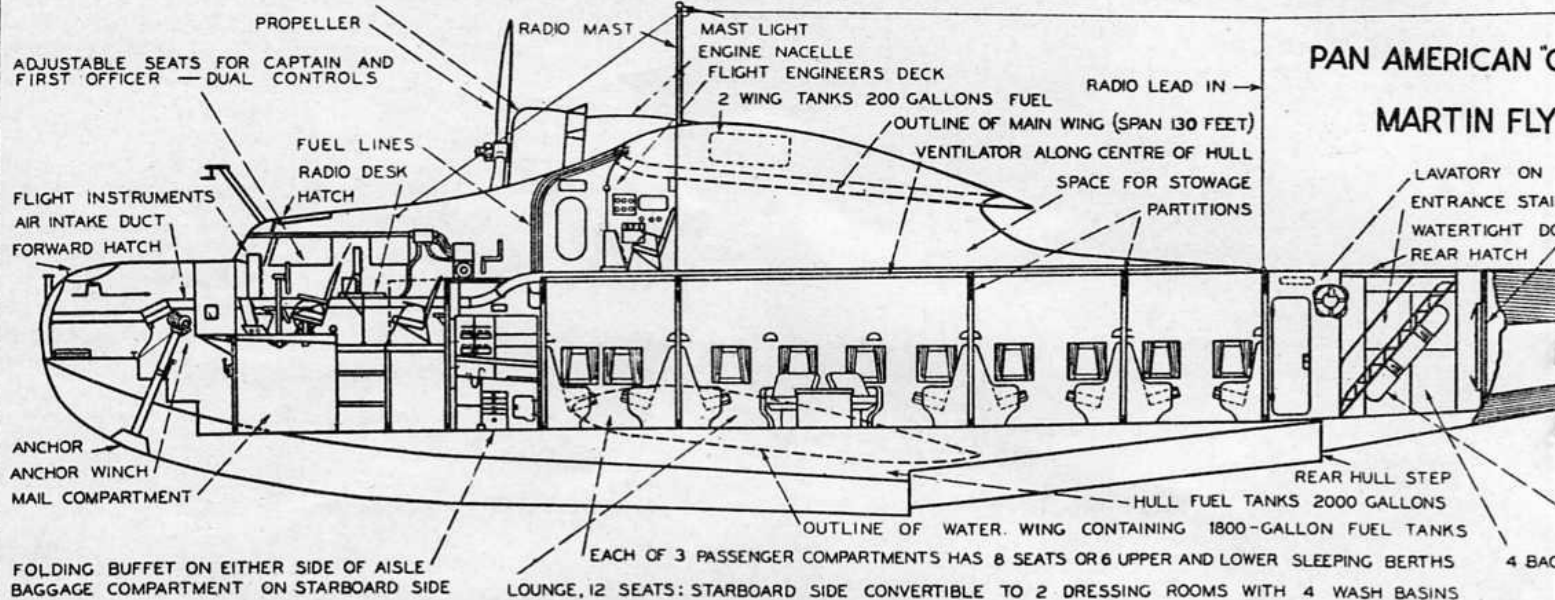
San Francisco to Manila takes five days in fact, and six days by the calendar. A flying boat leaves Alameda, San Francisco Bay, on a Wednesday afternoon and flies through the night to Pearl Harbour, Honolulu, where a halt of nearly twenty-four hours is made. On the Friday morning she leaves for Midway Island, reached the same afternoon. During the third stage, from Midway Island to Wake Island, the International Date Line is crossed, so that, although the flying boat is in the air for only part of a day, she leaves on Saturday morning and arrives on Sunday afternoon. The stage from Wake Island to Guam takes the morning and afternoon of Monday and that from Guam to Manila the morning and afternoon of Tuesday.

The International Date Line is necessary for the following reasons. The Earth rotates from west to east, making a complete rotation on its axis in twenty-four hours, a rate equivalent to  $15^{\circ}$  in

one hour. Thus a place  $15^{\circ}$  east of Greenwich will have noon one hour before Greenwich and a place  $15^{\circ}$  west will have noon an hour after Greenwich. The discrepancy increases until, half-way round the Earth, the meridian of  $180^{\circ}$  is reached. There noon is both twelve hours earlier (reckoning east) and twelve hours later (reckoning west) than at Greenwich. To overcome this difficulty, the device of the International Date Line has been adopted. Anyone crossing this line from east to west loses a day; anyone crossing it from west to east gains a day. For political reasons, the International Date Line is not fixed at  $180^{\circ}$ , but is a sinuous line which reaches  $172\frac{1}{2}^{\circ}$  W. in the southern hemisphere and  $169^{\circ}$  E. in the northern hemisphere.

On the return voyage from Manila, the five days of flying become four days by the calendar, because in this direction the aircraft gains a day when crossing the International Date Line. Thus a

PRATT & WHITNEY 14-CYLINDER 2-ROW RADIAL WASP ENGINE, 830 H.P. (ONE OF FOUR)



PAN AMERICAN  
MARTIN FLY

flying boat leaving Manila on a Friday reaches Alameda the following Tuesday.

The distance from Manila to Hong Kong is flown in a morning and an afternoon, so that the entire air voyage from the United States to China is completed in about six days. Except for the San Francisco-Honolulu stage—the first on the outward and the last on the homeward voyage—there is no night flying.

The building up of this transoceanic service is one of the greatest achievements of aviation. It has included the surveying and preliminary flights, the building of magnificent four-engined flying boats, the creation of island airports and the establishment of weather stations to furnish vital information.

### Survey Flights

SURVEY flights were made in 1935 by a flying laboratory, the Sikorsky S-42 flying boat. This craft, weighing nineteen tons, was manned by aviators who had had considerable experience of flying on the Pan American Caribbean services. While she was making her preliminary flights three flying boats, destined to operate the regular service, were being built by the Glenn L. Martin Company at Baltimore, Maryland. They were christened *China Clipper*, *Philippine Clipper* and *Hawaii Clipper*. These aircraft, Model 130, were specially designed for the route.

The weight of each flying boat when loaded is 52,000 lb., or just over 23 tons. The machine is a high-wing monoplane, with a wing span of 130 feet. The length is 90 ft. 7½ in., the height 24 ft. 7 in. and the total lifting area, including the seawings, 2,315 square feet. The sea-

wings take the place of floats and provide lateral buoyancy.

The flying boat is all-metal, being built of riveted aluminium alloy. The two-step hull has four watertight compartments. The monoplane type tail unit has a single fin and rudder. Each of the four Pratt and Whitney Twin-Wasp air-cooled radial engines gives 830 horse-power. Folding platforms built into the leading edge of the wing on either side of each engine nacelle give access to the engines. Special attention must be given to engine overhaul on this arduous route, and two of the four engines are changed every three trips.

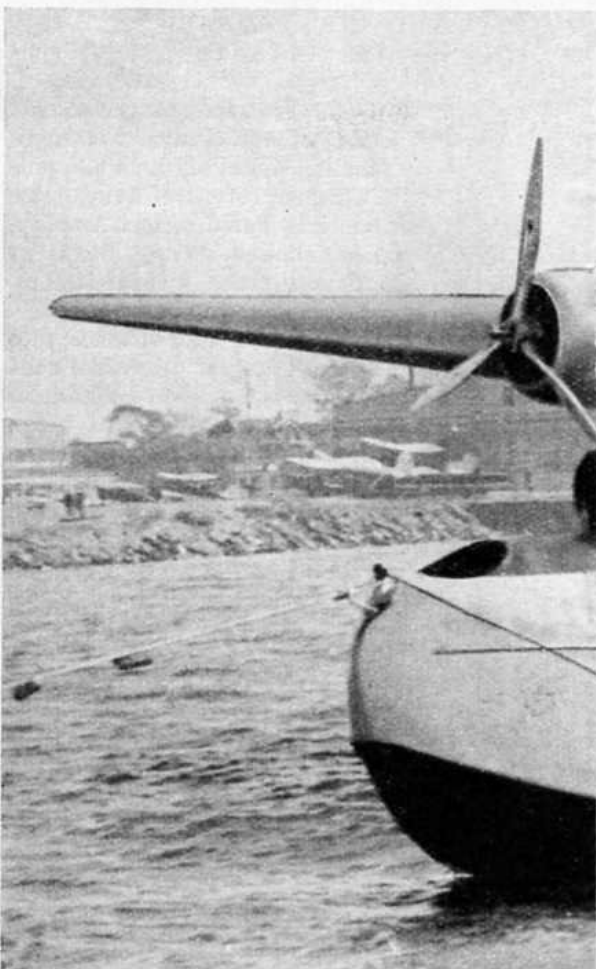
About 3,800 U.S. gallons of petrol are carried, giving the clipper a range of 3,200 miles. (The U.S. gallon is five-sixths of the British gallon.) The top speed is 180 miles an hour at 7,000 feet; cruising speed at 10,000 feet is 130 miles an hour, and 163 miles an hour at 7,000 feet at 60 per cent of the full power. Surface ceiling is 17,000 feet. The climb from sea level is 557 feet a minute. The structural weight of the clipper, empty, is 23,400 lb., and disposable load 28,600 lb. Wing loading is 23.96 lb. per square foot, and power loading 15.66 lb. per horse-power.

In the raised control cabin are seats for the captain and the first officer, side by side; behind them sits the radio officer. The flight engineer is housed aft of this cabin in the superstructure

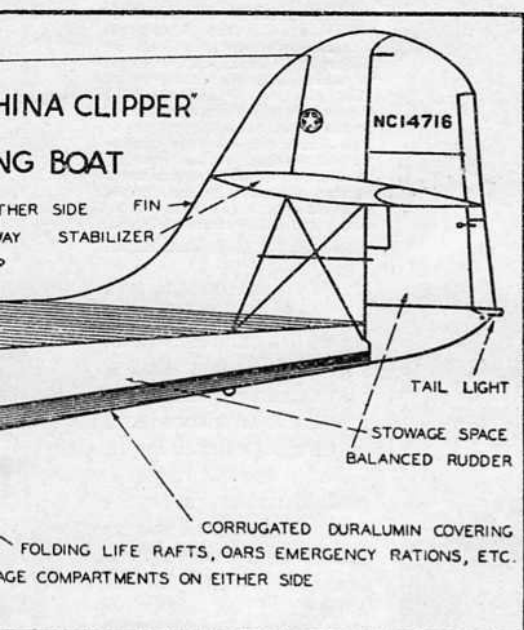
**SEAWINGS PROVIDE STABILITY** when the aircraft is on the water. The seawings are the fins which project from the sides of the hull at the height of the waterline. The *China Clipper* is one of the Martin Model 130 seaplanes specially designed for the transoceanic service. In the drawing at the top of this page the accommodation for passengers and crew is shown in detail.

between the hull and the wings. Below him is the steward's galley, and aft of this are the passenger compartments. The lounge, seating twelve, is the largest of these. There are seats in the smaller compartments for twenty-four passengers; these seats can be converted into eighteen berths for sleeping. Fold-back basins, with hot and cold running water, are fitted in the lounge. All the furnishings can be removed swiftly to make room for mail.

A new clipper, the Martin Model 156, has been built which carries a much







greater payload. The passenger accommodation is forty-six and the number of sleeping berths has been increased from eighteen to twenty-six. The hull has been modified and a twin rudder tail has been substituted for the previous type. Fuel is not carried in integral tanks between the floor of the cabin and the bottom of the hull, but in the seawings, so that there is no possibility of petrol fumes entering the cabin space. A lighter type of patent anchor saves weight. Curved surfaces, providing an elliptical section, have

added to the storage space and given room for two crew bunks instead of one. Changes in the wings have also increased the efficiency of the new flying boat. These include alterations in the aerodynamic section and the addition of flaps. The flaps are fitted with an "anti-drag" shutter, and the ailerons are much shorter than in the earlier clippers.

Watertight compartments have been provided in either wingtip, as a precaution against the risk of the seawings being damaged. Each seawing has two fuel tanks, one containing 870 gallons and the other 1,260 gallons, and the fuel is pumped from these into two 100-gallon service tanks in the wings.

Four 1,000 horse-power Wright Cyclone engines are installed. The propellers are of the 12-foot, three-bladed Hamilton standard constant-speed type. Goodrich de-icing equipment is provided.

The wing span is 157 feet, the overall length 91 ft. 10 in. and the gross weight 62,000 lb., or nearly 28 tons. The structural weight empty is 29,691 lb. and the disposable load 32,309 lb. Cruising speed is from 140 to 156 miles an hour; maximum speed at sea level is 175 miles an hour. The altitude at which level flight can be maintained with only three engines operating at the normal rated power for that altitude is 10,000 feet. The alighting speed (62,000 lb.) is 70 miles an hour. Take-off time, from full throttle, with normal gross weight, is 35 seconds. The

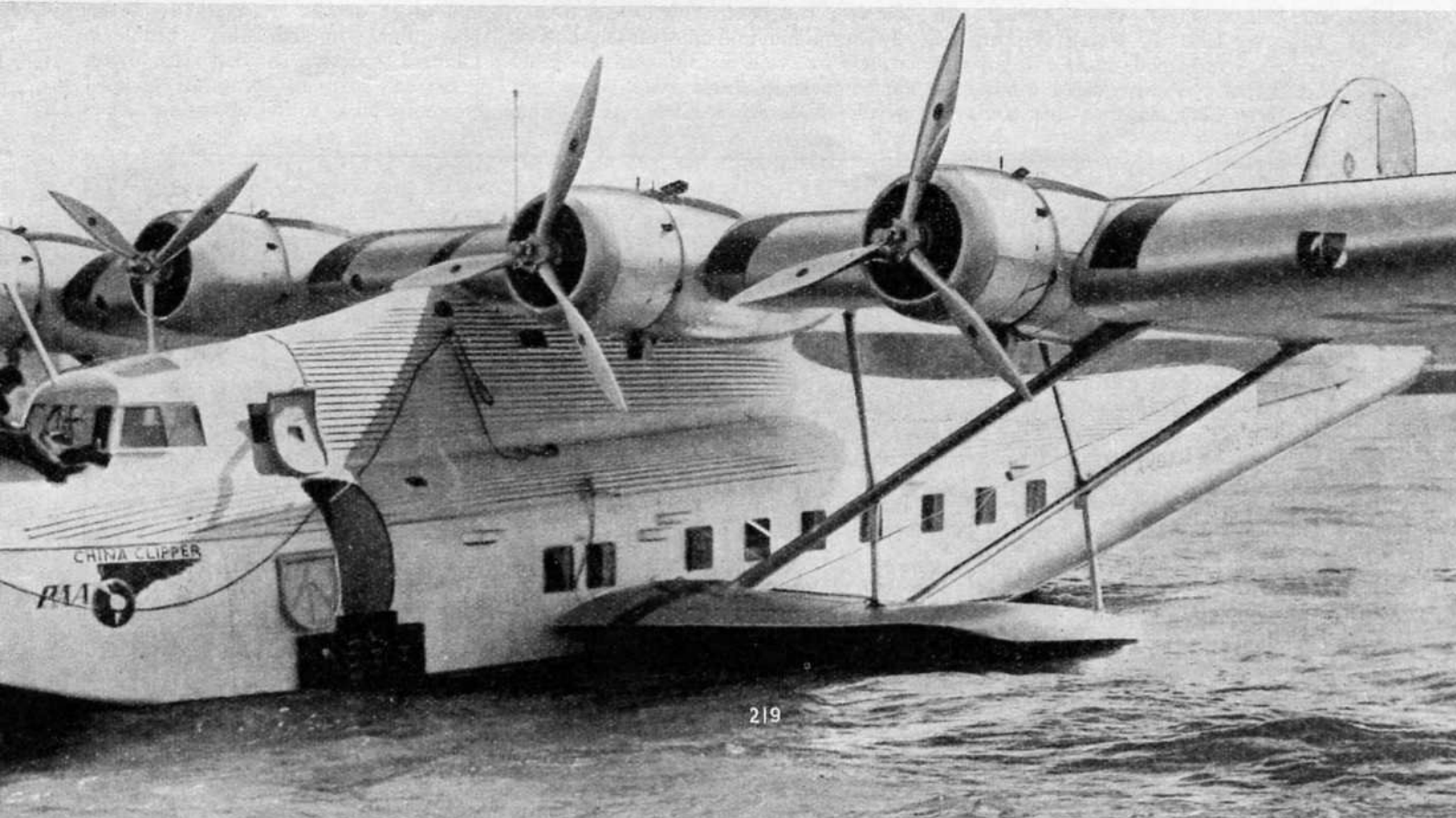
maximum range is from 3,500 route miles to 5,000 miles in still air.

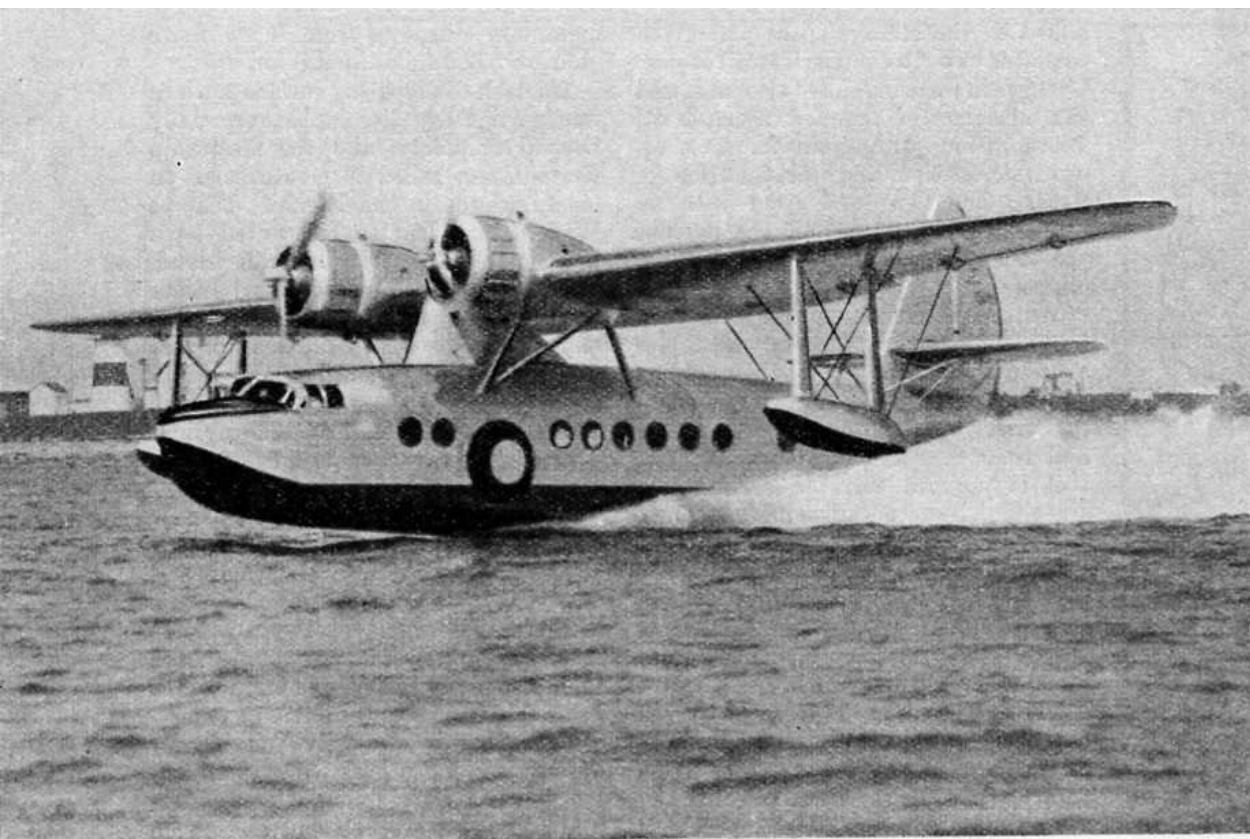
The task of preparing surface stations was particularly formidable, especially beyond Honolulu, and the steamship *North Haven* sailed to create bases on lonely islands in the Pacific. That at Wake Island had to be erected on a previously uninhabited coral island. The vessel carried sectionalized homes for the work party and for the future passengers, as well as plant for the weather and radio stations and equipment for the airports. Two small towns had to be built at Midway and Wake Islands from material carried in the ship.

### Typhoon Warnings

THE vessel made several voyages, and modern airports for the clippers arose in the middle of the Pacific to provide stores and supplies for the clippers and their passengers and also to fill in blanks in the chart of the weather.

Data that were partly suitable for aircraft were available from meteorological stations at Manila, Guam, Honolulu and San Francisco, but there were gaps between that were blank except for reports from ships and these were of little use to the projected air service. To obtain data about the upper air, pilot balloons were sent up from the shore stations. Vessels of the Matson Line were supplied with balloons and instruments and the officers sent the balloons up and cooperated in this essential work. Flying began before





**INTER-ISLAND COMMUNICATIONS** in the Hawaiian Islands have been provided by Sikorsky S-43 amphibians, one of which is seen taking off in this picture. Honolulu, the capital of the Hawaiian Islands, is the first stopping place of Pan American Airways' trans-Pacific air line. From Manila, at the end of the transoceanic route Sikorsky flying boats provide connexion with Hong Kong and other cities of China.

of collecting information from weather stations in North America, Asia, Japan and various Pacific islands, and of charting the weather to be encountered on each leg of each flight.

Even on the long leg of 2,410 miles over the ocean between Alameda and Honolulu the clippers average within a few minutes of the time estimated for the flight before they take off. The flying time varies from eighteen to twenty hours, according to the wind. Before the take-off the latest weather reports

all the data could be obtained, and the information from the earlier trips showed the difficulties that required solution.

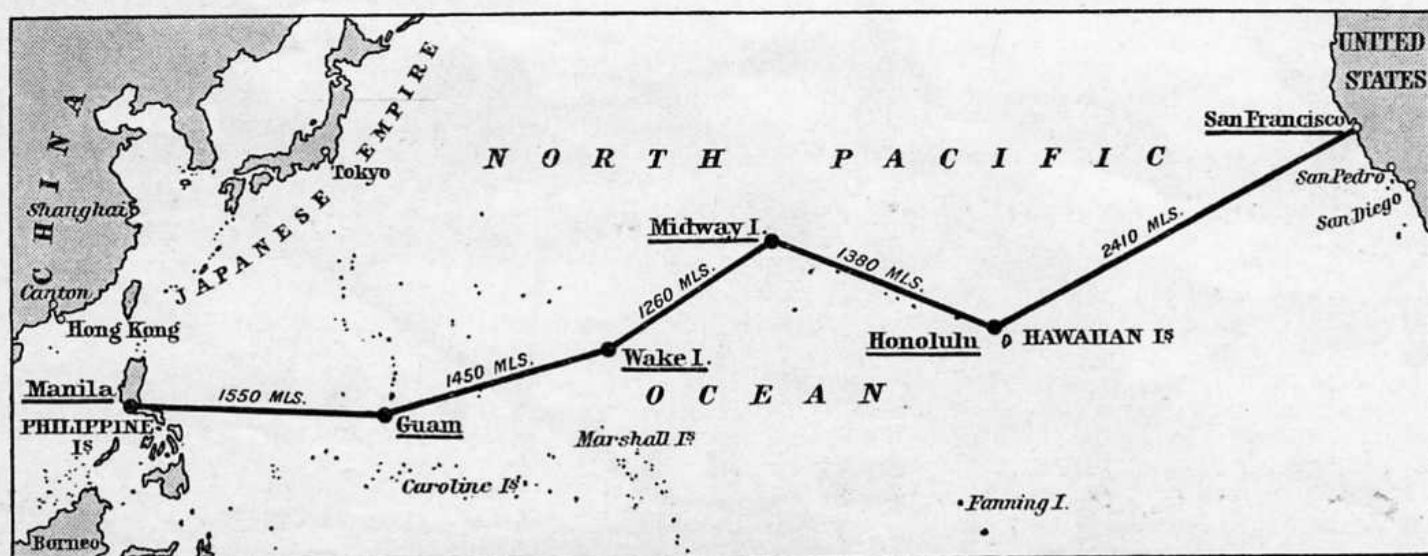
Two clippers made successful round trips in the autumn of 1935. At the end of that year, however, the *China Clipper* left San Francisco for Honolulu, but was compelled to turn back by strong head winds and by radio reports of still stronger winds ahead. In February 1936 the *China Clipper*, her engines overhauled, took off, but was again forced back by head winds. A few days later she was able to begin

a successful round trip. The *Philippine Clipper* followed later, and then the *Hawaii Clipper* took her place in the schedule.

Sometimes the service is interrupted when warning is received of typhoons in the western Pacific. The clippers fly on the chart of the weather and do not adhere strictly to the Great Circle Course, which is the shortest distance between two points. On occasion they fly several hundred miles off the shortest course to avoid an unfavourable wind or to pick up a tail wind. Excellent results have accrued from the system

are analysed. The weather, operating and flying staffs then prepare an estimate of the duration of the proposed flight. They work out the most suitable level of flight for each zone, the Alameda-Honolulu leg having five flight zones.

A system of control is laid out on a blue print for each stage of the flight. For each level in each zone the revolutions of the engine, the throttle settings and other details are marked on the blue print. In flight this schedule is followed strictly, so that the flying personnel keep as accurately to fuel consumption as to the timetable. Thus



**THE ROUTE ACROSS THE PACIFIC** has four stopping places. They are Honolulu, Midway Island, Wake Island and Guam, a stronghold of the U.S. Navy. The station at Wake Island was created on a previously uninhabited coral island. Two small towns had to be built on Wake Island and Midway Island, all the materials for which were transported to these islands by the steamship *North Haven*.