

flight may not refer to the conditions while en route, but in the forecast for the long flight which may occupy from five to seven hours, or even 16 hours, from sunrise to sunset, the forecaster and airplane pilots should be in intimate contact, so that the forecaster and the pilots may consult with each other, as to the best time to take off; and then the forecaster may formulate a forecast covering the weather generally over the entire route, which must further be amplified to indicate the weather which will be experienced by the aviator as he arrives at the various points along his route. The weather elements most affecting the flight of the airplane are wind direction, wind velocity at various altitudes, precipitation, temperature, conditions at the landing fields and visibility. —(*Author's Abstract*).

Discussion—MR. H. H. CLAYTON had always supposed that a round-the-world flight, when undertaken, would be so planned as to take advantage of the prevailing winds, yet this one followed a course from east to west, *against* the prevailing winds. He also remarked that the dependence of aviation upon weather is decreasing as aircraft speed increases.

MR. E. B. CALVERT, referring to the forecasts furnished Capt. Thiesen by the Weather Bureau forecasters at Washington for the flight from Greenland to Labrador and thence to the United States, inquired as to the accuracy of those forecasts.

CAPT. THIESSEN, in reply, stated that the forecasts were generally satisfactory and of the utmost value. Some slight amplification was necessary at times, as the result of information gained locally from the natives as to the relation between wind direction and the occurrence of fogs on the coast of Labrador.

Some Meteorological Encounters of the *Shenandoah*

By Lieut. J. B. Anderson, U. S. N.

The rigid airship *Shenandoah*, built at the Naval Aircraft Factory, Philadelphia, was commissioned as a United States Naval vessel in October, 1923. During the fifteen months of her operation up to the present time, she has demonstrated an airworthiness highly gratifying to her designers and surprising to the millions of people who have followed her air voyages with keenest interest. She has outridden gale and storm with as much ease and greater comfort to passengers than the largest ocean vessel.

The first encounter of the *Shenandoah* with heavy weather was on January 16th, 1924. The ship was taken to its mooring mast for tests on Saturday, the 12th. On Monday the weather forecast indicated the probable formation of a depression which would bring gale winds to Lakehurst on the 16th or 17th. Inasmuch as winds of about sixty miles per hour were desired for the mooring test, it was decided to leave the ship at the mast. On Tuesday local winds of 55 mph., or more were forecast for Wednesday. About 6.45 P. M., a gust of 78 mph., wrenched the ship from her mooring mast and damaged her nose. In this crippled condition she outrode winds which at flying altitudes must have

been considerably over 78 mph., and in a few hours was back at her hangar with no injury to personnel.

In May, 1924, the *Shenandoah* flew to Buffalo. On the return flight, thunderstorm conditions were encountered, as forecast, after dark. A large thunderstorm appeared which the ship quickly put in the rear, but two more large storms developed ahead. The ship successfully drove between these two storms and outdistanced them. Next morning she rode over a dense fog until she reached her hangar.

On August 8, 1924, the *Shenandoah* was successfully moored to the *U. S. S. Patoka*, the first time an airship was ever moored to a floating mast. On this day again, thunderstorms were expected, and sharp look-out was kept. Around noon cumulo-nimbus were sighted in the northwest and the clouds took on the aspect of a line squall. The ship immediately left her mast and subsequently encountered some very interesting cloud formations and air conditions in running southward along the Jersey coast to find an opening in the line squall which developed.

A few days later, on August 15, the *Shenandoah* flew several hundred miles to sea toward Bermuda on a scouting problem. On the return voyage a secondary disturbance which had not appeared on previous weather maps was encountered, and the ship's course was altered to avoid the worst of the wind and rain, based upon the information furnished by the meteorological officer aboard after a study of wind circulation and cloud forms.

The real assurance of the airworthiness of the *Shenandoah* was established by her behavior on the recent epochal trans-continental voyage to San Diego and the far Northwest. The choice of favorable weather conditions was made secondary to the desire to maintain schedule, and the ship flew several of the legs of this voyage under very adverse conditions. A meteorological officer was aboard continuously, and the meteorological information furnished was sufficient safeguard against the ship's undertaking the impossible. Her successful flight against fresh and strong head winds for a large part of the voyage and her admirable behavior in heavy storms, among them a snow storm in the mountains and a sandstorm at 7000 feet over the desert leaves no doubt of the fact that airships with proper meteorological advice can weather storms and gales and many times turn to favorable account air conditions which are unfavorable for surface ships.—*F. W. R.*

The Variation of the Wind With Height

By *W. J. Humphreys*

The speaker called attention first to the mathematical paper by Ekman, published in 1905, dealing with the effect of a steady wind on the movement of water.

This effect is to cause the surface water in mid-ocean to drift at an angle of forty-five degrees to the right (in the northern hemisphere, left in the southern) of the direction of the wind with reference to that drifting surface: and to cause each deeper and feebler layer to bear this same relation to the one next above it. He next showed that if the