

## CHAPTER XX

### AERIAL NAVIGATION

302. The development of aircraft of great cruising radius, and successful explorations in the field of long-distance flights, have brought about the need for careful study of the subject of aerial navigation, by those who may be called upon, at any time, to conduct aircraft on long over-sea passages out of sight of land or over strange terrain. Since the atmosphere is a far more unstable element than the sea, and its varying changes in velocity and density cannot be predetermined or calculated with a great degree of certainty, aerial navigation, at the present time, cannot be brought to the same degree of accuracy that is possible in surface navigation. While it is true that under favorable conditions of visibility the aerial navigator may be satisfied with positions which are approximately correct, without incurring undue risk of missing land-falls or points of destination, the uncertainties of weather are such that the constant aim should be to achieve the greatest possible accuracy in position keeping at all times. Direct and safe passages from place to place mean economy in time and fuel. This cannot be accomplished without thorough knowledge of approved navigational methods and constant practice in the use of navigational instruments and appliances.

303. Navigation and pilotage, as applied to the safe conduct of a vessel at sea and in sight of land, are both applicable in principle to similar work in aircraft. However, as stated above, the unstable condition of the atmosphere presents to the aerial navigator many difficulties some of which may be explained as follows:

A powered surface vessel travels through the water on a given course, and at a speed, known within close limits of accuracy. While ocean currents and winds may carry it from its course, these elements, likewise, can be estimated with relative precision and due allowance made for their effect. In aerial navigation, however, this is far from true. The high rates of speed of aircraft; the speed of movement of the supporting medium; the impossibility of charting the wind as ocean currents are charted; the dangers of landing in fog and darkness; and added difficulties imposed by operating in a three-dimensional medium all tend to make the navigation of aircraft more difficult and more hazardous than the navigation of surface craft.

The percentage of dead calm days for any locality is exceedingly small. The airplane is carried with the wind, at its velocity and from its direction. The course on which an aircraft is headed, and the resultant course actually made good over the ground, may vary between wide limits, the greatest discrepancies occurring when the true wind is at right angles to the heading.

The surface craft navigator has comparatively correct data for his dead reckoning and his astronomical observations. The air navigator may not have these, because of his inability to determine accurately the speed and direction of the air currents in which he is carried along. Furthermore, the surface craft navigator usually has a good horizon and a stable platform for taking his sights, whereas the aircraft navigator may, and usually does, have to rely upon an artificial horizon sextant, or octant, for his observations which, in the majority of cases, are taken in disturbed air.