INSTRUCTION IN METEOROLOGY FOR AVIATORS.

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The Weather Bureau was recently requested by the United States Air Service to furnish a course of lectures on meteorology to pilots at certain aviation fields in California. The first step in planning such a course is to prepare a suitable outline or to adopt one already in existence. In this case, none of those heretofore used seemed quite satisfactory, since these earlier ones were designed for more extended and complete courses than here contemplated. The chief requirements of a course for aviators under present conditions are that the lectures should be few in number, should be brief and to the point, should be illustrated copiously with lantern slides and, while containing enough information on *general* meteorology to make possible a logical development of the entire subject, should be *mainly* devoted to those features which are of most concern in actual flying. To meet these requirements the suggested outline or syllabus, given at the end of this note, was prepared, and suitable lantern slides were furnished. It is believed that a course of this kind should have not less than ten lectures, but, if that many can not be arranged for, some of those given in the outline can be consolidated. On the other hand, several of the lectures can be subdivided, in case arrangements can be made for a more extended course. In all cases the subject of the tenth lecture would be changed to suit the region in which the pilots would do most of their flying.

SUGGESTED OUTLINE OF COURSE OF LECTURES FOR AVIATORS.

I. General meteorology.
   A discussion of the planetary distribution of surface pressure, temperature, moisture, cloudiness, precipitation, and wind. Climatic zones, their extent and their interrelations.

II. Instruments and methods of observation.
   (*a*) At the surface (all instruments used).
   (*b*) In the upper levels:
      Kites and meteorographs.
      Pilot balloons and theodolites.

III. Physical properties of the atmosphere.
   (*a*) Constituents and their relative importance (the atmosphere is a mixture).
   (*b*) Vertical structure—troposphere and stratosphere—characteristics of each. (Troposphere a region of decreasing temperature and considerable cloudiness; stratosphere, of little change in temperature and no cloudiness. Boundary plane between the two about 17 kilometers in Tropics; about 12 at latitude 45° and about 11 at latitude 50°.)
   (*c*) Decrease of pressure with altitude. Hypsometry (half of earth's atmosphere is within 5½ kilometers, or 3½ miles, of surface).
   (*d*) Change of temperature with altitude, normally a decrease in troposphere, but inversions are frequent in winter and during clear nights, particularly in the interior of the country.
   (*e*) Change of humidity with altitude. Absolute humidity normally decreases owing to lower temperatures in upper levels. Relative humidity on the average also decreases somewhat, but varies greatly according to conditions of cloudiness.

IV. Winds.
   (*a*) Direction.
      Gradient versus actual.
      Change with altitude—normally turn clockwise, except winds from north to east, which turn counterclockwise. Large percentage of west component in upper levels.
   (*b*) Velocity.
      Gradient versus actual.
      Change with altitude, normally an increase of about 100 per cent in first half kilometer, more gradual increase at higher levels, but there is much variation.
      Change with seasons, much higher in winter than in summer, owing to steeper poleward temperature gradient.
      Change with direction, much higher with west than with east winds.

V. Thunderstorms.
   (*a*) Processes of formation.
   (*b*) Frequency, seasonal, diurnal and geographic.

VI. Fogs and clouds.
   (*a*) Fogs, processes of formation; frequency, seasonal, diurnal and geographic.
   (*b*) Clouds, processes of formation; types and approximate mean and limiting altitudes; frequency, seasonal, diurnal, and geographic.

VII. Cyclones and anticyclones.
   Characteristics of each; distribution of pressure, temperature, cloudiness, wind and precipitation; frequency, seasonal and geographic; direction and rate of travel, "storm paths."

VIII. Forecasting.
   (*a*) Assembling the data.
   (*b*) Forecasts made:
      Surface weather.
      Surface temperature.
      Surface winds.
      Upper air winds.

IX. Meteorology and aviation.
   (*a*) Review of preceding lectures, particularly IV to VII, with special reference to their application to aviation, stressing:
      1. Importance of knowing the winds along a flying route, thus enabling an aviator to know at what altitude he can make most progress.
      2. Importance of knowing weather conditions along a route, especially the existence of thunderstorms, fogs, precipitation, etc.
   (*b*) Gustiness: its causes,—local heating more pronounced over a black soil than over a light one; over a plowed field than over a pasture, etc., thus giving rise to vigorous convection—a dangerous condition; buildings and topographic irregularities produce eddies and gusts, their influence extending to a considerable height, on the average about four times that of the height of the obstruction itself above the general level of the earth's surface in its vicinity; gustiness especially vigorous near cumuli; flying close to them should be avoided.

X. California weather and climate and their relation to aviation.