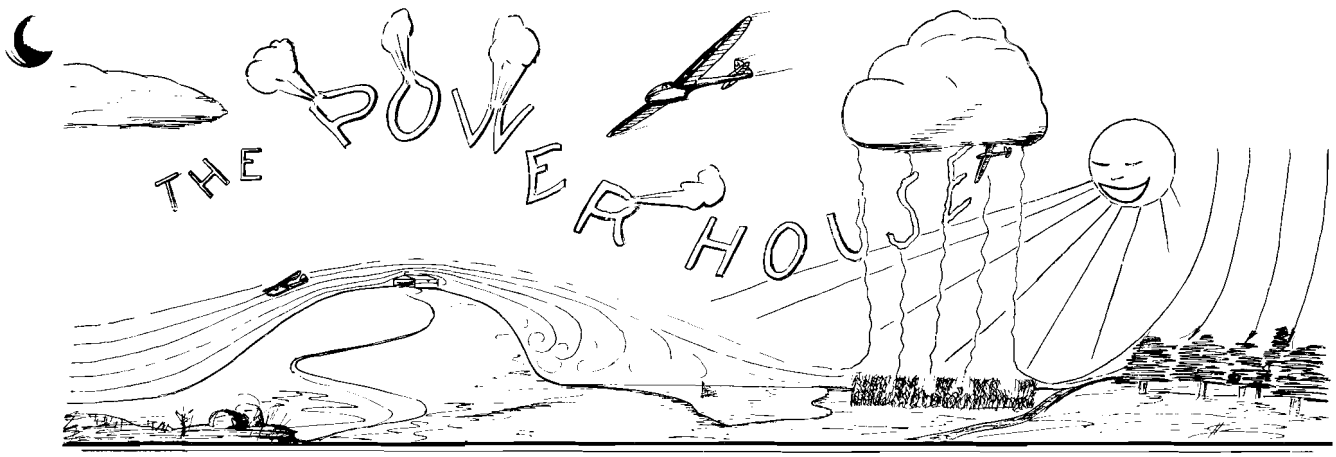

Conducted by Barney Wiggin of the U. S. Weather Bureau

Atmospheric TURBULENCE

Beginning in this issue, and to continue in serial form, is an article on atmospheric turbulence written by Mr. L. P. Harrison of the U. S. Weather Bureau. It was originally written for power plane pilots. Except for minor changes the presentation here will be the same as appeared in the official organ of the Air Line Pilots Association. A great deal of our present knowledge in this field is brought together in a non-mathematical treatment. It should be of interest and of real value to all glider and sailplane enthusiasts. Comments on it are welcomed.—Editor's Note.

INTRODUCTION: It is essential to pilots to have a good comprehension of atmospheric turbulence owing to the influence of irregular air motions upon gust loads imposed on wings, etc., controlability of the aircraft, and passenger comfort. Hence it is of the utmost importance to avoid piloting a ship into conditions where the actual gust-loads will exceed the design gust-loads and serious damage could be caused by turbulence, or where the plane might be driven out of control; and pilots should be familiar with the circumstances under which turbulence of severe intensity might be experienced. Reports of severe turbulence and its effects are of inestimable value in providing a basis for the safe conduct of future aerial operations and the design of aircraft to withstand the gust-loads met with in practice.

The purpose of this article is twofold: (1) to describe the meteorological aspects of turbulence and (2) to promote discussion among pilots regarding scales and terminology suitable for reporting turbulence encountered during flight.

Following one major airplane crash, the Civil Aeronautics Board recommended the development of a generally accepted scale of measurement of turbulence, and a standard terminology for the various types of turbulence. It was further recommended that methods should be developed for collecting and correlating the experiences that pilots may have with exceptional turbulence or other unusual atmospheric conditions.

Standard terms, capable of translation into fairly precise data, are required by both meteorologists and aeronautical engineers. The subject of scales and terminology appears at the end of this article. First a review of turbulence.

DEFINITION OF TURBULENCE: Turbulence may be defined as irregular motion of the atmosphere produced when air flows over uneven surfaces, around obstacles, or when two currents of air flow past or over each other in different directions or at different speeds. The term "turbulence" is applicable to the irregular motions associated with vertical as well as horizontal currents of air. "Bumpiness" is a common term for small scale turbulence; "Thermals" for larger scale turbulence.

BASIC TYPES OF TURBULENCE: Turbulence can be classified according to cause as—*mechanical* or *thermal. Mechanical turbulence* may be regarded as due to the forced departure from smooth flow by the disturbing action of irregularities on the surface over which the air is passing, or of irregularities in adjacent bodies of air. On a sub-microscopic scale, mechanical turbulence is dependent upon friction or viscosity between adjacent streams of air molecules moving relative to one another. On the vastly larger scale with which the pliot is concerned the surface irregularities involved range from blades of grass to mountains.

Thermal turbulence may be regarded as due either to (1) the vertical motions of bodies of air which are lighter (less dense) than their surroundings because of higher temperatures acquired in some manner. They ascend because of buoyancy. (2) The vertical motions of bodies of air which are heavier (more dense) than their surroundings because of lower temperatures acquired in some manner. They descend because of the action of gravity.

All turbulence in the atmosphere involves both mechanical and thermal processes so that it is not always possible to draw a definite line of distinction between the two basic types under consideration. The fundamental thermal process which controls the thermal turbulence is thermal convection. (*Continued on page* 11)