A VORTEX POSSIBILITY OF THE SIERRA WAVE

By BILL JACOBY

Using rules of thumb meteorology, I have developed what appears to be a reasonable explanation of the so-called Sierra Wave, and with the hope that the theory may be in the right direction, I am submitting this written explanation plus a few sketches.

I will assume in this explanation that the flow is across the Sierra from the west and that the general air mass has a temperature inversion that renders its lower layer extremely stable.

The "wave" begins when heavier air from west of the Sierra spills over the passes and ridges with great velocity. Entering the Owens Valley, this heavier air is trapped by the White Mts., and with diminishing forward speed begins to fill the valley. As the level of this air rises, there develops a conflict at some point (see fig. 1) (Actual location dependent upon the values of density and wind velocity) where the relatively stagnant heavy air is under-cut by high velocity cold air from the slope and tends to fall back upon itself. It is met and resisted at this point by lighter air of much higher velocity which tends to develop a near vertical wall or discontinuity. This wall would be marked by extreme turbulence and some mixing of the two components but most of the lighter air would sweep upward and conform its flow to the shape of this fluid obstruction. In response to the pressure exerted by the lighter air, this windward sector of heavy air would tend to elongate vertically and a rolling motion would be imparted to it. (See fig 2) The lighter air will still be conforming to the outlines of the developing roll and will tend to depress the heavy air to leeward of the first roll. Thus initiating the second roll through a process similar to the first. The obstruction wave in the lighter air works upward through the general air mass until the wave matures according to its potential. (See fig. 3) The alto cumulus roll clouds would develop if saturation conditions were satisfied in the rolls. These clouds would indicate the upper limits of the heavier air roll.

From the foregoing development it might be concluded that the "wave" is made up of a number of primary vortices and their companion obstruction waves. The rolls might be thought of as solid barriers if one considers their effects upon the flow of the general air mass.

Basically it would appear that there must be some means to retard the flow of heavy air. In the Owens Valley, the White Mountains serve. A gradual ascending slope might well achieve the same purpose in another locality. This retardation and subsequent vortex could be influenced in many ways by local variations in topography of the mountain chains. For example, in a case where heavier air is channeled through a windward pass or gap, exceptionally high relative velocities may be attained. The velocity, expansion and deceleration factors might well be responsible for positive irregularities in the wave. Down wind passes and depressions in the second obstruction range might be negative factors in development by permitting heavy air to escape the generation area. Another interesting point to determine would be the effect of peaks extending through the inversion layer. It appears likely that, due to deflection, secondary turbulence areas would be set up in many places between the Sierra ridges and the first roll. There are probably many such special cases that serve to confuse the basic phenomena.

Systematic investigation of surface velocities across the affected area could be determining, especially if made during the actual formation period before the development of the altocumulus roll cloud. A strong smoke source might provide progressive information on the level of the inversion and the flow within it. Perhaps a location on or near the slopes of the obstructing White Mountains would be best. These checks should be made in the general stage indicated by figure 1.

Because of a lack of information, (surface velocity sequences, pressure distribution, and positioning of known wave irregularities in relation to surface topography) these developments are necessarily general. The basic idea, however, seems to be borne out by such information as has been available in "Soaring," various aviation periodicals, and movies shown by Bob Symons at the joint technical meeting in Grand Prairie. This explanation was suggested by an observation of wave activity in surface run-off during a Texas rain squall.

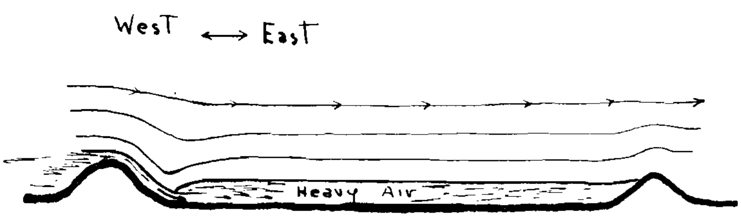


Fig. 1

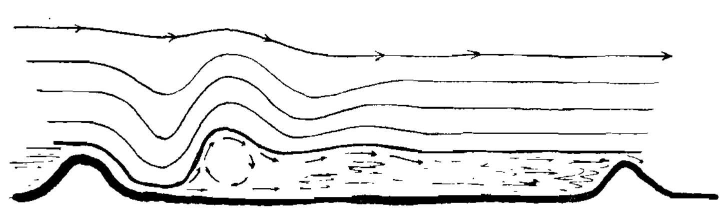
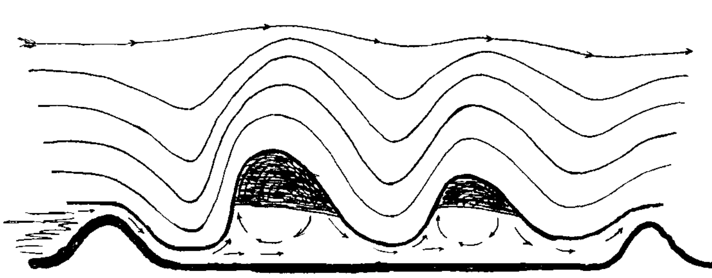


Fig. 2



Mature wave and vortex condition

Fig. 3

ANOTHER RECORD?

Anyone who can read or hear the radio has by now found out that Robert Symons, with Dr. Joachim Kuettner as passenger, took his Pratt-Read to 38,000 feet over Bishop on March 4. Robert Symons, who lives at Bishop, is one of gliding's old timers. Dr. Kuettner, a German meteorologist attached to the U. S. Air Force research at Cambridge, Mass., is currently working on the Sierra Wave Project.