this type must be expected if the streamline pattern changes so fundamentally with height as indicated by the comparison of the 20,000 ft. level (Fig. 1 of this issue) and the 40,000 ft. level (Fig. 1 of the last issue).

Airspeed Fluctuations and Turbulence

Figure 3 shows what happened to the B-29 while crossing the Sierra Nevada westwards with constant power settings at a constant height of 20,000 ft. (altitude controlled by auto-pilot). The airspeed dropped close to the stalling speed while passing through the downdraft of the first wave and rose 115 knots while traversing the main updraft of the first wave. Comparisons with Fig. 1 indicate that the airspeed extremes are reached a short time after passing the maxima and minima of vertical motions (as should be expected). The aircraft crossed one wavelength in approximately 1½ minutes, which is more than three times the aircraft's natural period due to longitudinal stability ("phugoid motion"). At this wavelength the sensitivity of the response of the aircraft was of the order of 30 ft. per min. vertical motion per knot airspeed variation. However the wave of Fig. 1 is not harmonic in character and the windspeed fluctuations were in phase with the vertical wave so as to accentuate the airspeed variations. All factors considered (which cannot be discussed at this point) indicate that the accuracy of this type of aircraft in measuring vertical motions of the air will be of the order of 50 to 100 fpm. In this respect powered aircraft will be inferior to sailplanes for some time to come.

The hazards involved in these speed fluctuations are obvious. As they occur gradually in very smooth air only the change in noise level will warn a pilot who is not constantly watching the instruments. If, on the other hand, the autopilot is not altitude, but attitude controlled, a change of thousands of feet in height may go unnoticed and provoke an even more serious hazard.

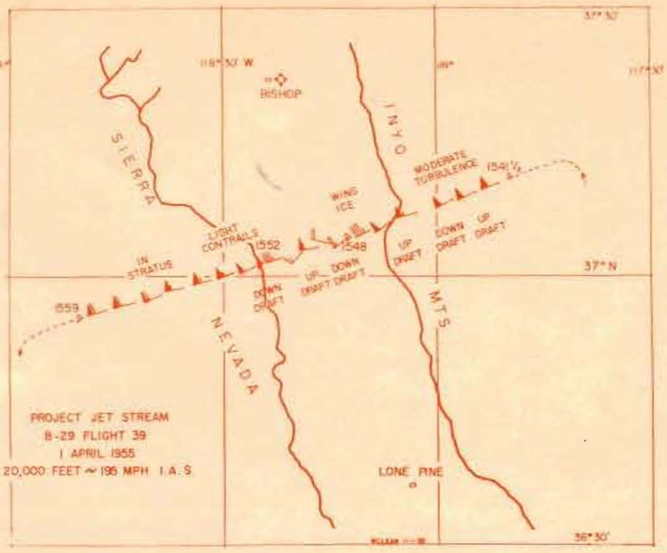
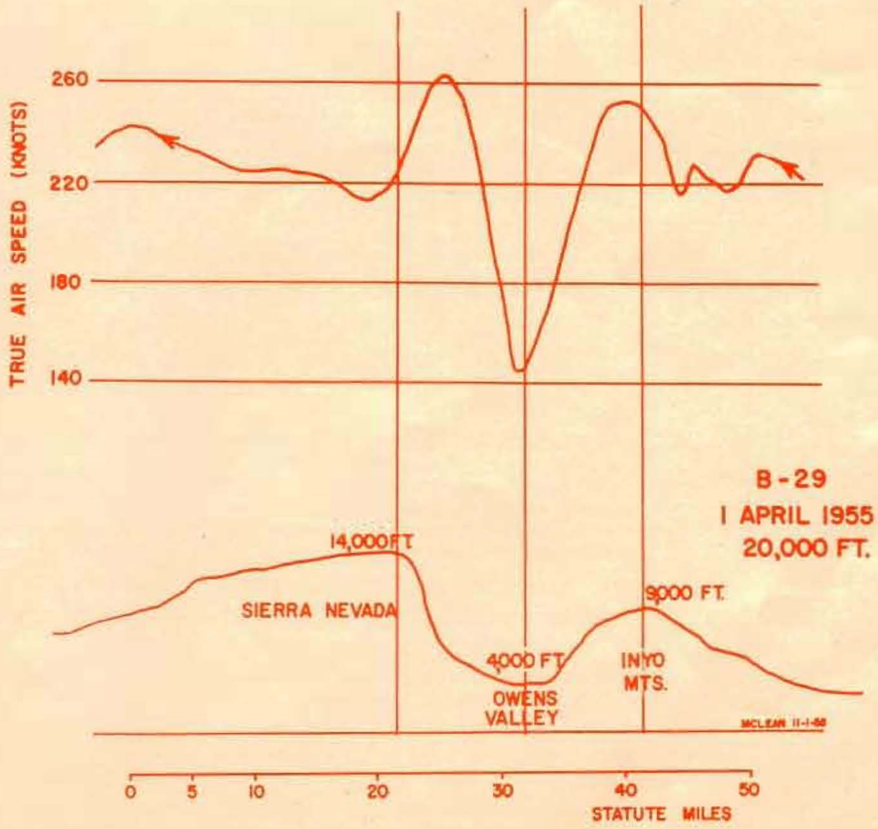


Fig. 2 (Above)—Wind variations at 20,000 feet along B-29 traverse over Sierra Nevada, as recorded automatically by Doppler Radar, 1 April 1955.

Fig. 3 (Below) — Variations of true airspeed during constant-level-constant-power flight of B-29 at 20,000 feet over Sierra Nevada, 1 April 1955. Aircraft was flying from right to left. Wind flow from left to right. Over Owens Valley the stalling speed is approached.



To supplement the earlier discussion of turbulence in the roll cloud area we bring in Fig. 4 a plot of the "derived" vertical gust velocities. These were measured by the flight analyzer instruments of the B-29 in less than one minute in a traverse over Bishop described in part 1. The quick succession of severe negative and positive gusts at about 17,000 ft. is not unusual in the lower wave levels. The magnitudes, which by no means represent the extreme conditions, will be of some interest to aircraft designers and airlines. If the "non-undular jump type" of rotor flow occurs (see part I, page 24 and part II, Fig. 5) gusts may reach a multiple of those recorded in Fig. 4.

We will now stress some peculiarities of high level airflow which present unforeseen difficulties to the navigation of sailplanes.

Navigational Problems in Glider Flight Above 40,000 Ft.

Descent from a height between 40,000 and 45,000 ft. can be a major problem if the spoilers or dive brakes of a sailplane are inoperative due to low temperatures. As shown in Fig. 1, part II, of our report the updraft area, at this level, is very wide and useful downdrafts are not found either upwind or downwind of the area due to the 'step-type flow' at

(Continued on Next Page)