

JET STREAM PROJECT

(Continued from Previous Page)

- B-29 traverses at 25,000 ft. aborted on climb to 30,000 ft. with cracks in nose window and propeller.
- B-47 traverses at 30,000, 35,000 and 40,000 ft. on schedule.
- 2-25 flights cancelled on account of 7 g encountered by P-R in tow.

Some preliminary results of importance are:

1) The speed variations at constant power setting and pressure altitude flight exceeded anticipations

to and fro in a weak summer breeze. (I think that this describes the high level turbulence better than the well known cobble-stone street analogy.) It lasted only for a minute or so at a time.

We did not encounter the severe high altitude turbulence which bothered us at several flights of the Sierra Wave Project, but we saw cloud situations of this type from the ground.

In lower levels we had some bad experiences with roll cloud turbulence. In agreement with the hydraulic jump analogy (frequently proposed for the 'rotor-cloud' phenomena) the area downwind and below the first rotor-

2-25. The calculated value for the equivalent gust velocity of 100 to 150 ft./sec. should be of considerable interest to aircraft design and flying safety.

THE AIRFLOW OVER THE MOUNTAINS

An unforeseen wealth of information on this matter was gained during the project. The vertical soundings through the up and down-draft sections of the wave reached greater heights and were more complete than ever before. One of the best flights in this respect was the record flight of Betsy Woodward on which she gave perfect radio reports of all instruments at intervals of a thousand feet from 4 to 40,000 ft. up and down. A few of our preliminary results may be mentioned:

1) On the 29th of March the first definite proof was found that a strong wave can form without any indication of a "rotor" developing. Up to this time there had been some doubt that this is possible. The wave was smooth from bottom to top and had a tremendous wavelength. (20 miles). The first wave updraft was more than 10 miles back from the Sierra at a position over the Inyo Mountains and was reached in tow at 8500 ft. Maximum lift was in the middle of the troposphere and moderate. The result is of interest to theory and practice.

2) As mentioned before the rotor phenomenon (visible in the roll cloud) has frequently been interpreted as a hydraulic jump in the lower cold airflow which spills over the lee slope. There are many indications that this analogy is indeed correct. However, due to flight difficulties in this dangerous area little has been known of the actual airflow. One of the peculiarities of the rotor flow seemed to be that it has always a periodic pattern similar to the so-called 'undulatory hydraulic jump' which so far lacks a satisfactory explanation. It is known however that this type of pressure jump occurs with relatively weak flows while stronger flows form an 'aperiodic' jump. Why does the atmosphere not show 'aperiodic' jump? The case of the 25th of April (repeated on the 28th) proves that it does and that this rare type of rotor flow is the one to be avoided. On these days (and according to Bob Symons on some of his most turbulent flights) there is an immense roll cloud which extends far to the lee, even beyond the Inyo Mountains, and whose leading edge does not follow the individ-



L to R, Betsy Woodward, O. Schwartzberger, Dr. Kuettner, Larry Edgar, Harold Klieforth and Al Langenheim.

and reached dangerous values. On the 1st of April, for example, the indicated speed of the B-29 varied as much as 100 knots at 20,000 ft. and came near stalling speed, while at 40,000 ft. the B-47 approached high speed buffet conditions. The operational significance of these flights is obvious.

2) Evaluation of vertical motions of less than 2 ft./sec. appears to be possible now in the range of the wavelengths encountered. (See previous article).

3) The recording of the (true) temperature by means of the vortex thermometers turned out to be a powerful method of airflow measurement. On the 1st of April the 40,000 ft. traverse of the B-47 showed an abrupt temperature change of 15°C over the Sierra crest. To our knowledge nothing of this magnitude has ever been measured at the 200 mb level.

TURBULENCE

Some of our more important results concern turbulence encounters. In general there was a slight rocking turbulence at the tropopause. It resembles the feeling one has if sitting in a boat drifting leisurely in the middle of a pond and rocking slightly

cloud is generally wildly agitated, with a maximum of turbulence near the cloud base and its leading edge. On the 1st of April, a day not considered particularly turbulent by wave flight standards, the B-29 stayed about an hour between 10,000 and 20,000 ft. over Bishop and obtained good turbulence recordings. Preliminary evaluation of the flight-analyzer record shows severe turbulence at 17,000 ft. Derived vertical gust velocities * in excess of 30 ft./sec. occurred 13 times within 50 seconds, the maximum measured gust being 67 ft./sec. negative.

Incomparably more violent was the turbulence on the 10th and 25th of April. On the first of these days the accelerometer on the P-R (Edgar-Woodward) showed plus 7.3 g in tow#. On the 25th the accident of Larry Edgar occurred which has been described by him in an earlier issue of this magazine. In a later article some interpretations of this accident will be given, based on several expert opinions and the simultaneous flight of the

*According to NACA's new gust formula.

#Indicated on an accelerometer which overshoots slightly.