JOINT SSA-AMS MEETING

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On January 25, 1956, at the Barbizon-Plaza Hotel in New York, the SSA and AMS had a joint session on "The Mountain Wave." The meeting was well attended by meteorologists (some credit could be given to the fact that it was the only session in the week of meetings when there was no conflicting session) and a good group of soaring enthusiasts was also there. The principal stimulus for the session can be credited to Dr. Joachim Kuettner. The chairman was Dr. Paul B. MacCready, Jr., president of Meteorology Research, Inc., in Pasadena and a research associate of the Munitalp Foundation.

The first paper was given by Dr. Robert Long, of Johns Hopkins University. The movies he showed of model experiments on the wave were most spectacular, exhibiting amazing similarity to the actual mountain wave flow.

Laboratory Model of the Bishop-Wave Phenomenon

A description is given of a laboratory model simulating the flow of air over the Sierra Nevada mountains near Bishop, California. A barrier resembling the topography in this area is towed at the bottom of a channel containing a gravitationally stable mixture of water and salt. With respect to a coordinate system moving with the barrier, the effect is that of a west wind crossing the mountain ridge. At values of the internal Froude number corresponding to high wind velocities in the atmosphere, the resulting flow resembles the observed flow, at least in the lower layers. In particular, a circulation resembling the rotor cloud is present.

A motion picture of the experiment shows the flow patterns for several values of the internal Froude number.

The second talk combined two papers into one and was given partly by Dr. Kuettner and partly by Mr. Robert Rados. Dr. Kuettner of the Geophysics Research Directorate is the project scientist on the mountain wave project, and has been active in all phases of the research including the flying. He is also the scientific director of the Mt. Washington Observatory. Mr. Rados, also from GRD, has been field director of the Jet Stream Project, directed the GRD-Florida State Hurricane Project, and is presently on loan to the U. S. Weather Bureau as director of flight activities for the USWB Hurricane Project. The two papers were:

The Structure of the Mountain Wave in the Stratosphere

Traverses by instrumented B-29 and B-47 aircraft through powerful mountain waves over the Sierra Nevada and supplementary soundings by sailplanes give a picture of the stratosphere air flow over the mountains.

The vertical wave pattern of the troposphere vanishes in the stratosphere where streamlines resemble closely a mirror image of the ground contours. The disturbance of the air flow extends far upwind of the crestline. Total vertical displacements of the stratosphere air reached 5,000 feet and vertical velocities 1,000 feet per minute at 40,0000 feet.

New Observations on the Rotorflow and Severe Turbulence in the Lee of Mountains

Observations during April 1955 of the so-called "rotor-flow" in the lee of the Sierra Nevada showed the existence of three types of air flow:

1) Roll cloud development resembling the "undulatory hydraulic jump" with a definite wave pattern.

2) Roll cloud development resembling the "breaking jump."

3) Leewave development without roll cloud.

The second type is rare and connected with destructive turbulence. In the case of the third, which is very unusual, a smooth leewave of great amplitude and wavelength may extend from the ground into the stratosphere.

Turbulence records of the B-29 and the destruction of a sailplane indicate that the gust velocities reach values dangerous to any aircraft passing through the leading edge of the roll cloud at about the level of the mountain crest.

Mr. Harold Klieforth then gave results of some of the analyses of wave days. He has worked for UCLA on the field and analysis stages of the wave since the start of the Wave Project, and with Larry Edgar is co-holder of the international sailplane altitude record of almost 45,000 feet.

Small-Scale Cross-Sections of the Air Flow Over the Sierra Nevada

Some results of the 1951-52 Mountain Wave Project were presented in the form of streamlines of the air flow in vertical cross-sections over the Sierra Nevada and Owens Valley. The reduction of the sailplane flight and tracking data and the synthesis of the meteorological fields were explained. Each of the cross-sections was discussed together with the corresponding upwind (Merced or Oakland) temperature sounding and wind velocity profile. It was concluded that the streamlines derived from the horizontal and vertical wind components show most clearly a "synoptic" picture of the wave motion while the analyses of the fields of temperature, potential temperature, and pressure (D values) present more complicated and somewhat confused patterns because of their greater sensitivity to time and space (north-south) variations in the course of the flight. The streamliners and upwind soundings and velocity profiles are being used for a comparison with theoretical lee wave models and for the study of important operational problems regarding aircraft flights through mountain lee waves.

The final paper was presented by Prof. M. G. Wurtele, now at the Meteorology Project, the Institute for Advanced Study, Princeton. When at ULCA he worked on the theory of Mountain waves for the Mountain Wave Project and his paper described the continuation of that work. The paper was essentially mathematical, but Prof. Wurtele gave excellent physical interpretations of the results.

The Wave in the Lee of an Isolated Mountain

The model is an isothermal atmosphere with no shear in the basic current. If the perturbations are assumed small, vertical velocities due to a circular mountain may be computed at distances from the mountain greater than one stationary wave length (about five kilometers). In vertical planes parallel to the basic current the pattern is like that of the two-dimensional case studied by Lyra and Queney; the tilt of wave crests decreases with increasing distance from the plane through the center of the mountain. In horizontal planes the model lines of vertical velocity are hyperbolas with transverse axis along the wind direction; areas of up-motion are crescent-shaped, concave downwind, as often observed by pilots.