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The Measurement and Analysis of Small Pressure Fluctuations

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Dr Keliher, who was with the NOAA Environmental Research Laboratory and is presently a visiting Research Fellow at the Department of Meteorology University of Melbourne, opened his talk with a series of slides showing various billow clouds seen from both the ground and satellites; it is considered that these billows are due to internal gravity waves, which were the subject of some of the speaker's previous work. The wave lengths of most of these visible phenomena, except possibly some seen by satellites, are too short to be detected by microbarographs at the earth's surface because of attenuation by the atmosphere. However, the pictures are still useful in illustrating the source of small pressure fluctuations.

The types of instruments used in measurement of small pressure variations were described. Originally they consisted essentially of a pipe about 500 m long attached to a pressure transducer and recording instrument. The equipment is sensitive to fluctuations of at least 0.01 Pa (1 pascal is 10 microbars). The pipes have the effect of damping out unwanted high frequency fluctuations. The data were originally recorded on paper strip charts and analogue magnetic tape. The latter was processed on a special analogue computer. More recent equipment records the data digitally for processing on a digital computer. This system will not use the physical filters of the earlier method as filtering can be done numerically. Consequently it is a more flexible approach.

The theory of pressure waves in the atmosphere was discussed. These are mainly acoustic or internal gravity waves. The acoustic waves have periods less than 5 minutes and travel with the speed of sound, gravity waves have periods greater than 6 minutes and travel at about a tenth the speed of sound at the earth's surface, increasing with altitude as air density decreases. Dr Keliher presented a table that summarised the sources of various pressure waves and described their characteristics. The sources included seismic or volcanic activity (giving pressure fluctuations at the surface of the earth of 0.1 to 1 Pa), meteor shock waves and auroral and air-sea interaction sources (0.1 to 0.5 Pa), frontal passages (100 to 200 Pa), severe weather - including tornadoes, which may be detected thousands of kilometres from the observers - (0.5 to 0.3 Pa) and wind shear instabilities in the jet stream and boundary layer (5 to 20 Pa). Examples of records of pressure fluctuation eventions - called microbaroms - associated with various sources were shown. It was pointed out that studies of these phenomena extend back to 1929, although most work has only been done in the last decade or so.

Analysis of the physics of gravity waves indicates that they are stable if the Richardson's number (the ratio of the square of the Brunt-Vaisala frequency to the square of the magnitude of the vertical wind shear) is greater than 0.25. Experimental work at NOAA using data from sites near Washington D.C. and at Boulder has examined this and other aspects of the physics of the gravity waves. Rawinsonde data taken near the time of microbaroms were examined to compare theory and observations. It was pointed out that there are some practical problems in using these data, particularly in that their vertical resolution is rather poor and the period between flights is much greater than the duration of most of the events. However, the data did show some correlation with the theory. Analysis of the most enigmatic source of infrasound, that associated with certain mountainous regions, was also presented; it indicated that the mechanism is related to some complex interaction between the mountains and winds of 45 $m\ s^{-1}$ or greater.

R.R.B.

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