

ATMOSPHERIC WAVES AND CURRENTS RECORDED  
BY ELECTROMAGNETIC BAROGRAPHS

By B. Gutenberg and H. Benioff

Two electromagnetic barographs designed by H. Benioff to respond to pressure variations in the frequency range from five cycles per second to one cycle in thirty seconds approximately and with sufficient sensitivity to record the natural unrest of the atmosphere have been in operation at the California Institute of Technology in Pasadena for approximately two years. These instruments were operated either at the same point with different characteristics or at points separated by distances from a few to more than 100 meters with identical characteristics. In the short period galvanometer combination the response is approximately proportional to the rate of change of pressure. The instruments respond to waves as well as to current variations. Discrimination between these two types of movements is made on the basis of their difference in velocity of propagation, the waves being propagated with the velocity of sound while current variations are propagated with much smaller velocity.

The waves are produced either by natural or artificial causes (airplanes, automobiles, dynamite blasts, gunfire). Waves produced by battleship target practice have been used by Gutenberg to calculate sound velocities and temperatures in the stratosphere. His results agree with those obtained in Central Europe and Novaya Zemlaya. The natural waves have predominant periods of 4, 7 and 20 to several hundred seconds and are largest in winter. They have exhibited no correlation with microseisms.

Air currents produce irregular disturbances throughout the whole range of recorded frequencies. They are due either to ordinary wind or to convection currents resulting from heating of the ground by solar radiation, and ordinarily are not distinguishable from each other in appearance on the records. Both types of movements can be recorded indoors although with smaller amplitude. They are absent on calm, overcast or foggy days. On clear, calm days convection currents are small in winter when they are occasionally recorded here from approximately 11 a.m. to 3 p.m. In April and November they occur from approximately 10 a.m. to 4 p.m., and during June and July they

appear from 7 a.m. to 7 p.m. Strong currents of either type produce strains in the ground rock as recorded by the strain seismograph. Sudden changes in the characteristics of short period movements sometimes accompany the passage of a cold front.

#### DISCUSSION.

H. Arctowski opened the discussion with remarks concerning the results obtained by his assistants, Orkisz and Kochalski, the first on statoscopic record, the second on the results obtained by observing slow ascending balloons and consecutive aeroplane ascents ten minutes up to an altitude of 2500 m and ten minutes down and up again during several consecutive hours.

W. J. Humphreys: May I remind you of a very delicate barograph, a variety of interferometer, devised many years ago by General Squin and described in the Bulletin of the Mount Weather Observatory.

B. Gutenberg added the following information: Records of the microbarograph at St. Louis are exhibited at the general exhibition of the I.U.G.G. These records are obtained with a galvanometer of longer period than the one used in Pasadena and consequently do not show the short period waves as clearly.

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