OPTICS OF ATMOSPHERIC HAZE

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(Abstract)

Experiments were carried out primarily to answer two questions concerning the optical properties of the atmosphere near the surface of the earth. The questions were: (A) What is the attenuation for white light (daylight) of the atmosphere as a function of the visual range, the visual range being the distance that one can see through the atmosphere in daylight; (B) what is the angular distribution of the light scattered by the atmosphere during various conditions ranging from clear to foggy?

The first question was answered by means of a telescopic photometer and a large approximately black body at a distance d = 3.2 km. The measured brightness b of the black body and h of the horizon sky just above the black body, and the visual range v for values from 3.2 to 15 km were found to agree with the theoretical relations

$$\beta = (1/d)\ \log_{\epsilon} [1/(1 - b/h)]$$

and

$$V = (1/\beta)\ \log_{\epsilon} (1/\eta)$$

where β is the atmospheric attenuation-coefficient, and η is the threshold of brightness contrast being 0.02 for the usual intensities of daylight illumination. It followed that the ratio of β to the attenuation of optically pure air was 277, 55.4, 27.7, 13.8, 5.54, and 2.77 for V = 1, 5, 10, 20, 50, and 100 km, respectively.

The angular distribution of light scattered by haze was determined in two ways: (1) By measuring the brightness at various angles of a searchlight-beam at night and (b) by measuring the brightness of the horizon-sky at various azimuths for a moderately low Sun and a cloudless sky. The distribution was much the same for haze ranging from thin to thick. It showed pronounced forward scattering, over three-fourths of the light being scattered in a forward direction and less than one-fourth in a backward direction. Such a scattering distribution would occur from haze-particles of various sizes, most of them being of dimensions greater than the wave-lengths of white light.

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ATMOSPHERIC-PRESSURE WAVES NEAR PASADENA

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(Contribution 312, Balch Graduate School of the Geological Sciences, California Institute of Technology)

In a previous paper [see 1 of "References" at end of paper] the authors have described results obtained from records of electromagnetic microbarographs. These experiments have been continued, and special interest has been given to the rather regular waves with periods of usually 2 to 5 seconds, which have been called "microbaroms" in the earlier paper. In January, 1940, a barograph with a larger loudspeaker-element was installed at point 2a, Figure 1, and connected with a galvanometer, constructed by F. Lehner, at the Seismological Laboratory, having a free period of about 1/2 second. This instrument has recorded regularly on a drum with a speed of one mm per second. The older two instruments were connected with Lehner galvanometers and remained at points 1 and 2a, respectively. Records were taken at irregular intervals with various speeds of recording, up to five cm per second. In December, 1940, a third instrument of this type was added. Figure 2a was taken with the three instruments side by side and shows that their characteristics were alike within small limits. From December 26, 1940, to March 31, 1941, the three instruments were located at the points 1, 2b, and 3 of Figure 1, respectively, and recorded usually twice every day for about one hour with a speed of three mm per second. Figures 2b, 2c, and 2d show examples of the records. The distances are as follows: 1 to 2a, 130 meters (426 feet); 1 to 2b, 320 meters (1,050 feet); 2b to 3, 290 meters (950 feet); 3 to 1, 264 meters (865 feet). Instruments 1 and 3 are in dense shrubs under high trees; instrument 2b is under

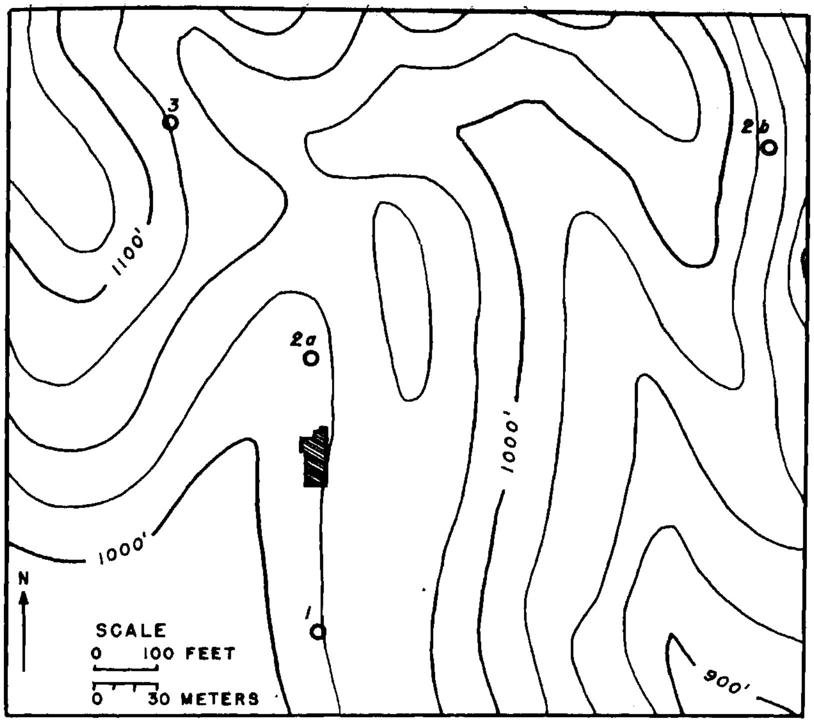

Fig. 1--Location of barographs

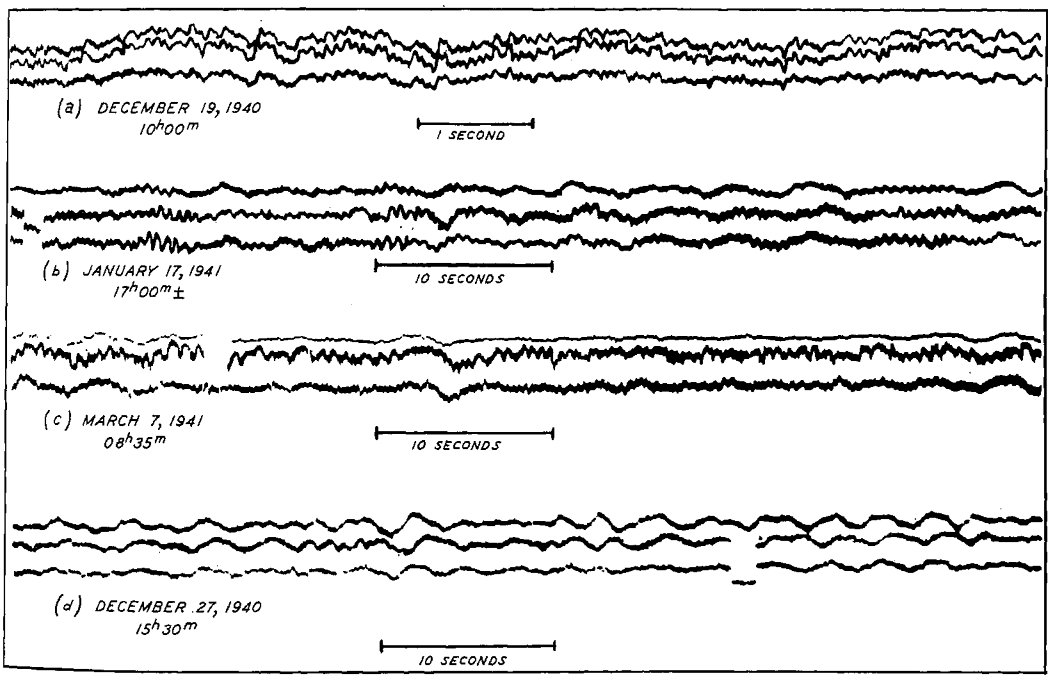

Fig. 2--Microbarograms [For (a) with all barographs in same place; for (b), (c), and (d) barographs were in locations 3 (upper line), 2b (center line), and 1, respectively]

small shrubs without trees. In general, the records of instrument 2b were much more frequently disturbed by wind than those of the other two. Besides, during the day and sometimes at night, there appear to be more or less regular air-currents up or down the slope near 2b.

The following are results found from the records: The microbaroms are very small during the summer. About the beginning of September, they begin to increase, reach their maximum during the winter and die down rather rapidly during March. During the three months when all three instruments were operating, there was never a time-difference of more than a small fraction of a second between the records of instruments 1 and 3, whereas 2 always received the waves later by almost one second (see Figs. 2b-2d). Consequently, the waves came from southwest to west (calculated azimuths between 230° and 270°. The waves arrive almost horizontally, but this is to be expected, even if the source is at some distance in the lower stratosphere, due to the curvature of the rays convex to the ground.

In all instances, where the amplitudes were unusually large, a rather pronounced low-pressure area was situated off the coast of Southern California. As soon as the low-pressure area passed the coast, the microbaroms decreased rapidly. During the months January to March, 1940, the microbaroms were much smaller than in the corresponding months in 1941, when low-pressure areas were much more frequently close to Pasadena than in 1940. No correlation was found with microseisms. On the contrary, the microseisms are a phenomenon not related to local conditions. On the other hand, both show the same type of yearly period and similar relationship to low-pressure areas, one locally, the other with distant storms; consequently, a similar type of source seems to be indicated.

Microbaroms have been found, in the interim, by Baird and Banwell [2] at Christchurch. Their findings correspond in every respect with the results obtained at Pasadena. They believe that microbaroms and microseisms are independent phenomena, possibly both related to large swells. Large ocean-waves in storms are not excluded as source of the microbaroms at Pasadena, though on relatively calm days when large swells break on the nearest coast the microbaroms remain small.

Other results presented in the previous paper [1] were confirmed. Trains of short waves were found again in a few instances. On January 17, 1941 (Fig. 2b), they came from the same direction (west-southwest) as the microbaroms. On other days, the amplitudes were too small to correlate the three records. On some days, vibrations with periods of a small fraction of a second were observed (Fig. 2a, 2c), but it could not be decided whether they are pressure-waves. Finally, the convection-currents gave practically the same records as in the preceding years.

References

[1] H. Benioff and B. Gutenberg, Waves and currents recorded by electromagnetic barographs, Bull. Amer. Met. Soc., v. 20, pp. 421-426, 1939.

[2] H. F. Baird and C. J. Banwell, Recording of air-pressure oscillations associated with microseisms at Christchurch, New Zealand J. Sci. Tech., v. 21, pp. 314B-329B, 1940.

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APPARENT RATE OF PROGRESS AS AFFECTED BY CHANGING INTENSITY OF HURRICANE SAN FELIPE (II) WHILE CROSSING PUERTO RICO

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On R. G. Stone's map [Trans. Amer. Geophys. Union 1941, p. 254, 1941] of isochrones of lowest station-pressure as the great hurricane of September 13, 1928, crossed the length of Puerto Rico there is an apparent acceleration in the advance of the storm in the east portion of the Island and a retardation in the west. In such a major storm, which must have reached great heights and been carried along, therefore, by the average of the winds through that deep portion of the atmosphere penetrated, it does not seem likely that a disturbance of its lower part by friction with a moderately mountainous island could have materially changed the general rate of progress of the storm.

If uniform progress is assumed, the times of observed minimum pressure can be compared with the times when the storm-center was nearest, and a map of the differences can be prepared. Using Stone's map, the times of lowest pressure as the storm approached the Island and after it had