

## ATMOSPHERIC PRESSURE ATOP HALEAKALA

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Abstract: Pressure data taken for 28 months atop a 10,000 feet high volcano in Hawaii, are analysed for daily cycles. Periods with 24, 12 and 8 hours are established. The amplitude and phase of these variations oscillate with the seasons in a characteristic manner; except the phase of the 8 hour variation which rotates backwards in time a full 360 degrees in one year. No significant variation with a 6 hour period could be detected.

## 1. INSTALLATION AND PROCEDURE

A microbarograph was operated from July 1952 to October 1954 at an altitude of 10,020 feet upon the summit of Mount Haleakala, on the island of Maui, in the Hawaiian archipelago. The microbarograph was kept in a concrete block house which provided a nearly uniform temperature and protected the instrument from wind surges. The clock rarely departed more than a quarter of an hour from the correct time over a week's observations. Nearly all the traces obtained are sharp and clear. Storm variations are gradual rises and falls over ten days or two weeks and seldom exceed 0.1 inches of mercury pressure.

The smallest chart division is .020 inches of mercury pressure corresponding to twenty units of the following discussion. A fine pointed pen made a line three to five units wide. The charts are scaled at each hour to the closest quarter of a division. Thus the maximum scaling error on a clear chart is about an eighth of a division or three units. The average scaling error is probably less than two units. Over ninety-five percent of the readings could be determined to this accuracy.

The observations are grouped by calendar months for convenience. Averages for each hour are computed which provide the diurnal pressure variation characteristic of the month. When plotted on an open scale and all detectable errors are removed, the resultant curve in all cases is

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sufficiently smooth to provide data with a probable error of less than one unit.

Using the methods of Conrad (1946) each month's data has been harmonically analysed for cycles having periods of 24, 12, 8 and 6 hours. The arithmetic was carried to the nearest tenth unit of pressure. The phase shown on the following figures is time of positive maximum of the cycle. Midnight is MN and noon is N.

## 2. MONTHLY MEAN PRESSURE

All twenty four hourly values of the diurnal pressure variation are averaged to give the mean pressure for the month. Fig. 1 shows the mean monthly pressure versus time. The annual variation is about 4 millibars; the pressure being high in summer and low in winter. This is the reverse of the situation at sea level and is in accordance with the accepted theory of atmospheric hydrostatics. The gradual decrease may be due to creep in the metal of the bellows of the microbarograph, or to long term storm effects. It is too small and slow to affect the results.

## 3. PRESSURE VARIATION WITH A 24 HOUR PERIOD

The amplitude and phase versus time are shown in Fig. 2. The amplitude varies from zero to eight units; being large in spring to summer and small in autumn to winter with considerable scatter.

The phase oscillates on a yearly basis with rapid changes and long periods of near stationary.

This pressure variation is probably of local character, associated with the very steep volcanic peak surrounded by an immense body of water.

## 4. PRESSURE VARIATION WITH A 12 HOUR PERIOD

The amplitude and phase versus time are shown in Fig. 3. The amplitude in winter is about twice that in summer with rather small scatter. The source of the variation may be thermally induced oscillations in the entire atmosphere of the earth.

The phase advances about two hours of time from winter to summer and probably represents the change in time

of sunrise corresponding to the driving force of the oscillation.

#### 5. PRESSURE VARIATION WITH AN 8 HOUR PERIOD

The amplitude and phase versus time are shown in Fig. 4. The amplitude varies over a five to one range with considerable scatter; being largest in winter.

The phase rotates by retrogression over one year through 360 degrees. The curve is much more smooth than the similar results for 24 and 12 hour variations. Probably this variation is of world wide nature and little influenced by local events.

#### 6. PRESSURE VARIATION WITH A 6 HOUR PERIOD

The amplitude and phase versus time are shown in Fig. 5. In all cases the amplitude is less than two units and does not show a seasonal variation. The phase varies rapidly in a random manner over large ranges. Thus it appears that these results are merely residual errors of observation and do not represent any physical phenomenon. If a pressure variation with a six hour period exists; it is of much smaller amplitude than the variations with periods of 24, 12 and 8 hours. The present data are inadequate to detect a 6 hour component. The pressure variations atop Haleakala may be adequately described by combining three daily components having periods of 24, 12 and 8 hours.

No attempt has been made to derive any generalized theory from these results. They are presented merely as a set of data from an unusual location. It is hoped that the results may be of interest to others and perhaps fitted into a world wide picture.

#### 7. ACKNOWLEDGEMENT

The charts were scaled by several people. However, the quality of the results shown is directly due to the meticulous care and great patience of Mr. P.T. Miller, who examined all the data and plotted the monthly means, removed all obvious errors, performed the many and tedious harmonic analyses and plotted the figures.

The instrument and charts were provided by the Pineapple Research Institute of Hawaii and all observational

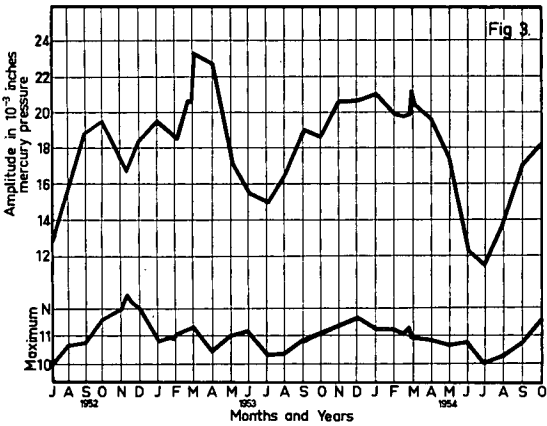
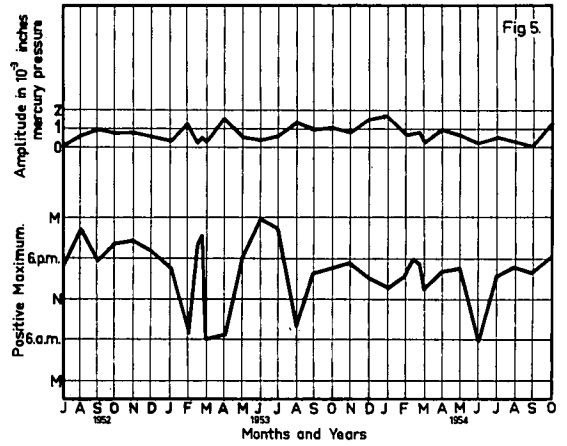
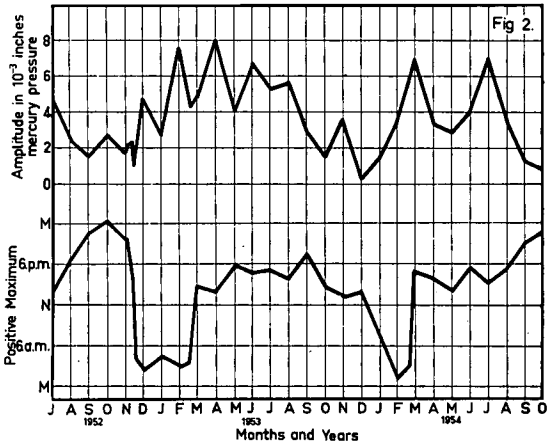
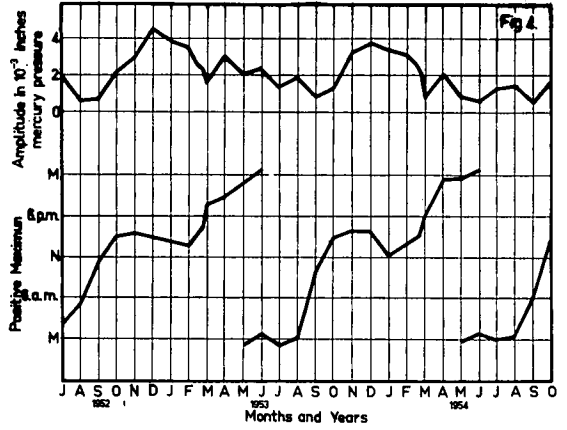
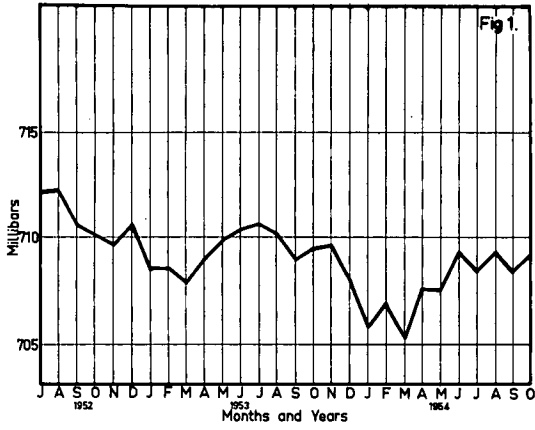


Fig 1. Monthly mean pressure atop Haleakala, July 1952 to October 1954.

Fig 2. The 24 hourly variation of pressure atop Haleakala, July 1952 to October 1954.

Fig 3. The 12 hourly variation of pressure atop Haleakala, July 1952 to October 1954.

Fig 4. The 8 hourly variation of pressure atop Haleakala, July 1952 to October 1954.

Fig 5. The 6 hourly variation of pressure atop Haleakala, July 1952 to October 1954.

material remains in their custody.

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REFERENCE

Conrad, V.A. 1946 Methods in Climatology, p. 70.