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SHORTER CONTRIBUTION

TEMPERATURE AND HUMIDITY ATOP HALEAKALA

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Abstract: The temperature varies about 7°F from summer to winter and the same amount from night to day. Half the observations at any hour of any season occur within about 5°F range. The highest humidity normally occurs near mid-day and is caused by thermal updrafts. Freezing occurs up to 38°F dry bulb due to low humidity, low pressure and radiation loss.

1. INTRODUCTION

The pressure variations atop this 10,020 ft high peak on the island of Maui in Hawaii have been reported upon (1957). The present discussion covers data taken during the same period July 1952 through October 1954.

2. TEMPERATURE

The thermograph charts were scaled for daily maximum and minimum. These were separately averaged on a monthly basis as shown in Fig.1 to determine the three seasons of the year. Due to the maritime climate the warm or summer season turned out to be June, July, August, September. The winter or cold season is December, January, February, March with the remaining months being transition periods.

All the charts were then scaled to the closest degree at every even hour and the data separated into the above seasons. This provided 332 summer days, 242 winter days and 262 transition days. The observations of each hour of each group were then organized on a statistical basis, to produce the graphs of Figs 2a, b, c. Using the median (50 per cent) line it may be observed that the daily variation in summer is 8°F

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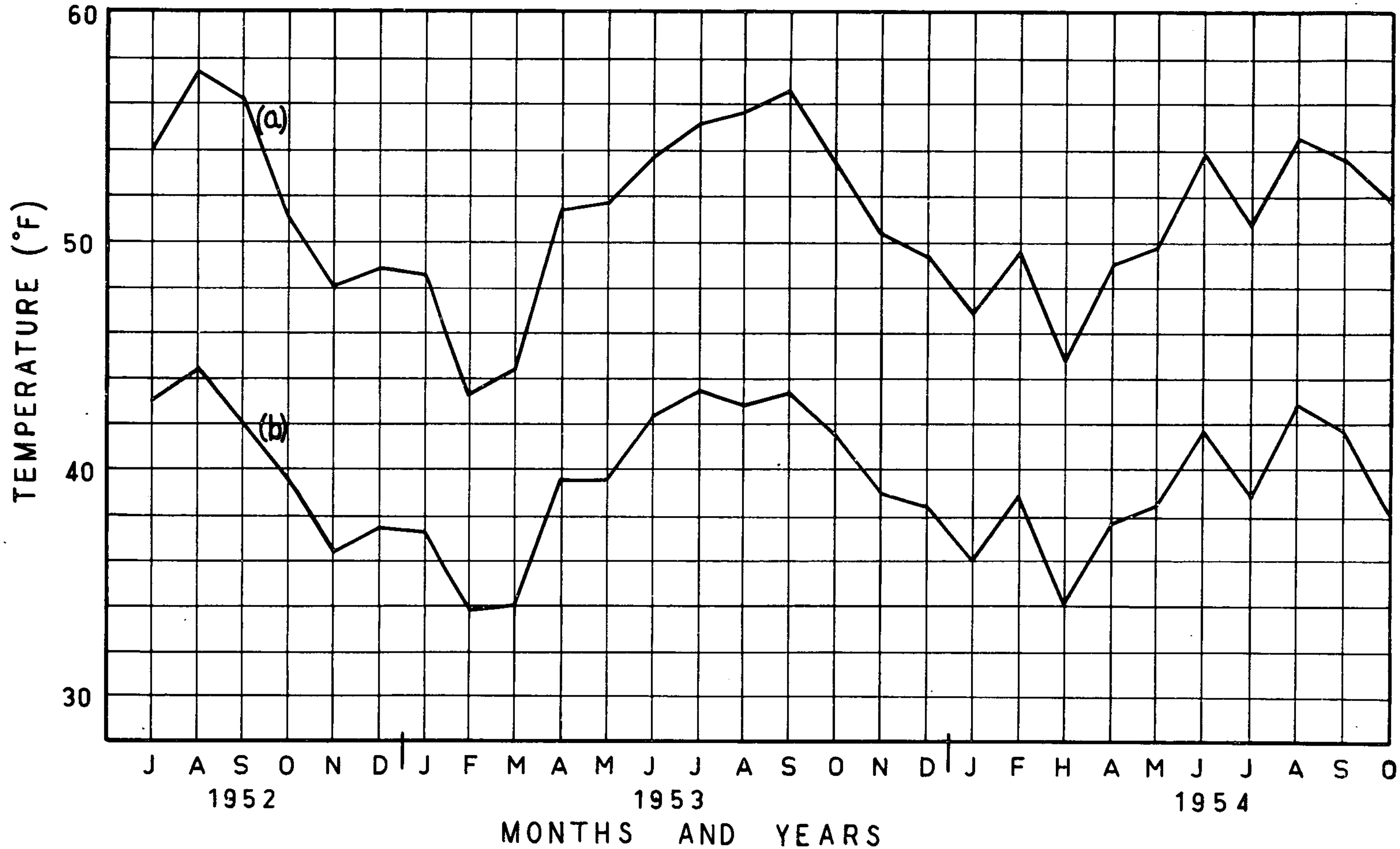

FIG I. AVERAGE MONTHLY TEMPERATURES ATOP HALEAKALA.
(a)– MAXIMUM (b)–MINIMUM

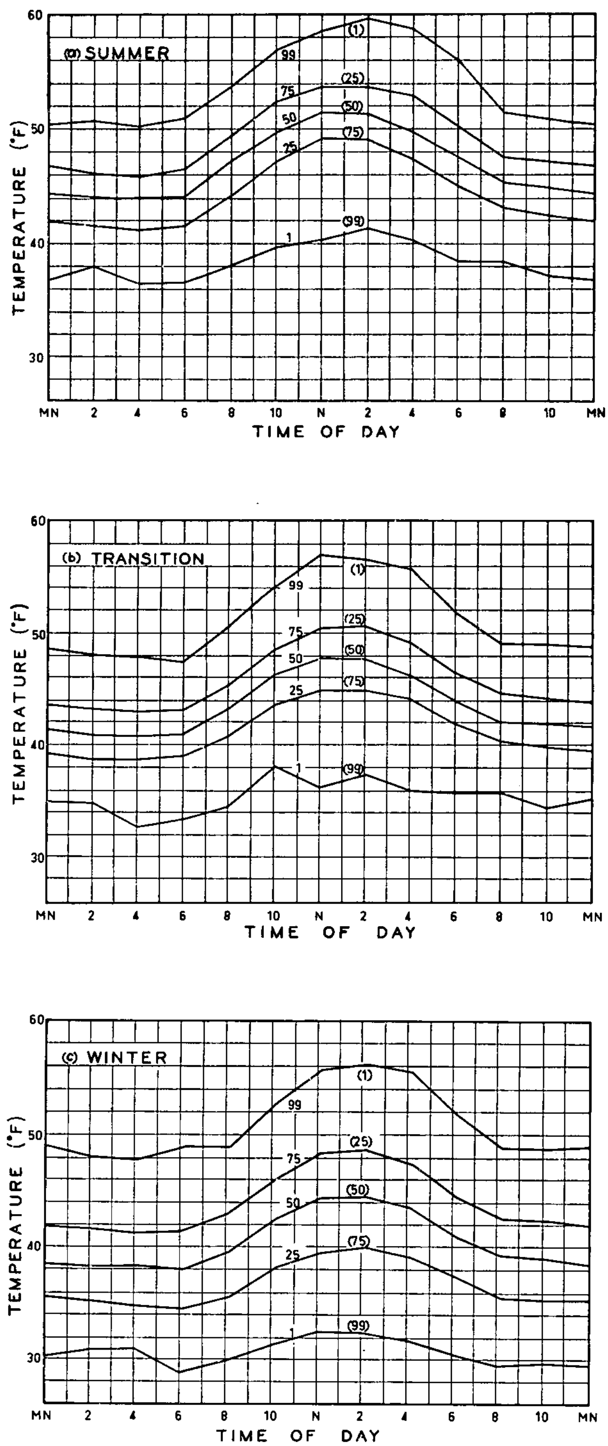

FIG. 2 DISTRIBUTION OF TEMPERATURE IN TERMS OF PERCENT DAYS IT IS LESS OR (GREATER) THAN ONE ORDINATE OF THE CURVE

and in winter 7°F. The variation from summer to winter is about 6.5°F. The interquartile range (75 per cent less 25 per cent) is greatest in winter which indicates that summer days occur from time to time in winter but not vice versa. The hourly interquartile range is commensurate with the daily variation in winter and less than the daily variation in summer and transition seasons. These results are what might be expected from a high altitude at low latitude over a large body of water.

3. HUMIDITY

The top of Haleakala is well above the trade wind inversion near 5000 ft. Thus the normal humidity is very low on clear windy days, However during storms the thick cirrus may settle down from above or the cumulus may blow up from over the east side of the mountain. These cause fog conditions with 100 per cent humidity. When storm conditions are not present the daily humidity cycle is found to go through a maximum near midday as shown in Fig 3. This maximum is small or absent on days when the steady wind velocity exceeds 30 mph. Under calm conditions the maximum often reaches 100 per cent for a few hours on summer days. The chart of Fig 3 was taken during about 5 to 10 mph wind. The rapid variations are due to local turbulence of the updraft.

It seems that the warm damp air from below the trade wind inversion tends to rise up the steep slopes of the mountain in a thin sheet perhaps only a couple of hundred feet thick. How much arrives at the top depends upon the prevailing wind velocity which tends to blow the sheet off the mountain. Consequently there is an inverse relation between midday rise of humidity and wind velocity. These two quantities could be calibrated against each other provided sufficient data were available.

All the humidity charts were divided into three groups. Class A days (230 days) are free from storm effects and show the midday rise to a greater or lesser extent depending on the wind velocity. Class B days (200 days) show the midday rise during part of the day but are more or less obscured by storm effects. Class C days (360 days) are storm days wherein the midday rise is not discernible due to large irregular changes caused by passing fog or steady 100% values caused by rain. The distribution of these days by months is shown in Fig 4. There is no obvious seasonal trend as the storms are an irregular phenomenon. In general, class A days are fine, class B days pleasant and class C days miserable atop the mountain.

All the humidity charts were scaled to the closest even per cent at every even hour and the data separated into the above classes. These were statistically organized in the same manner as the temperature data. The results are shown in Figs 5a, b, c. If much more data had been available it might have been worthwhile to divide each season up into the three

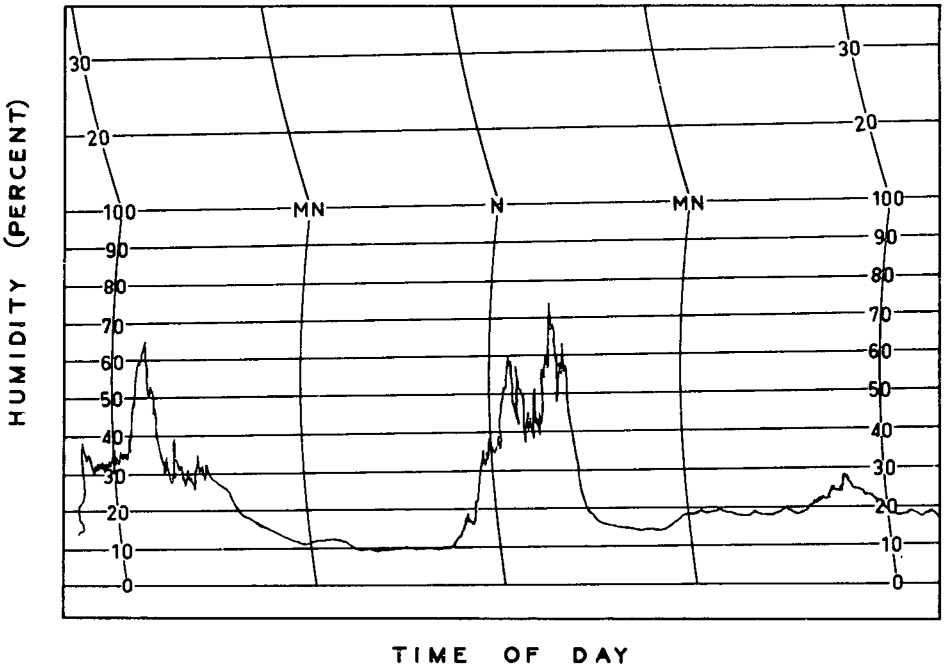

FIG. 3. TYPICAL DIURNAL HUMIDITY - CHART ON A CLASS A DAY ATOP HALEAKALA

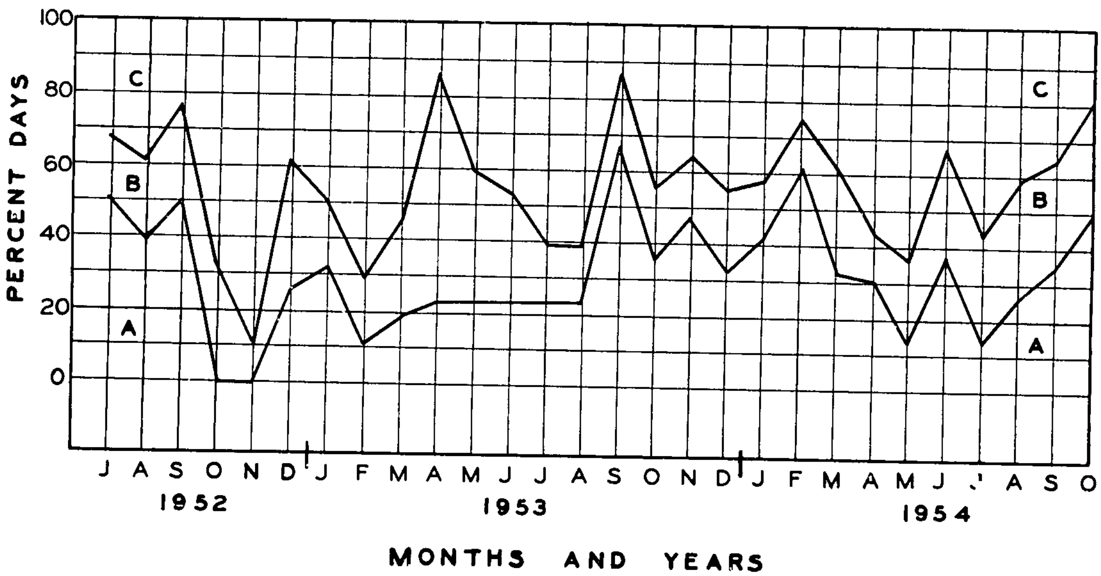

FIG. 4. DISTRIBUTION OF CLASS A B C DAYS VERSUS MONTHS

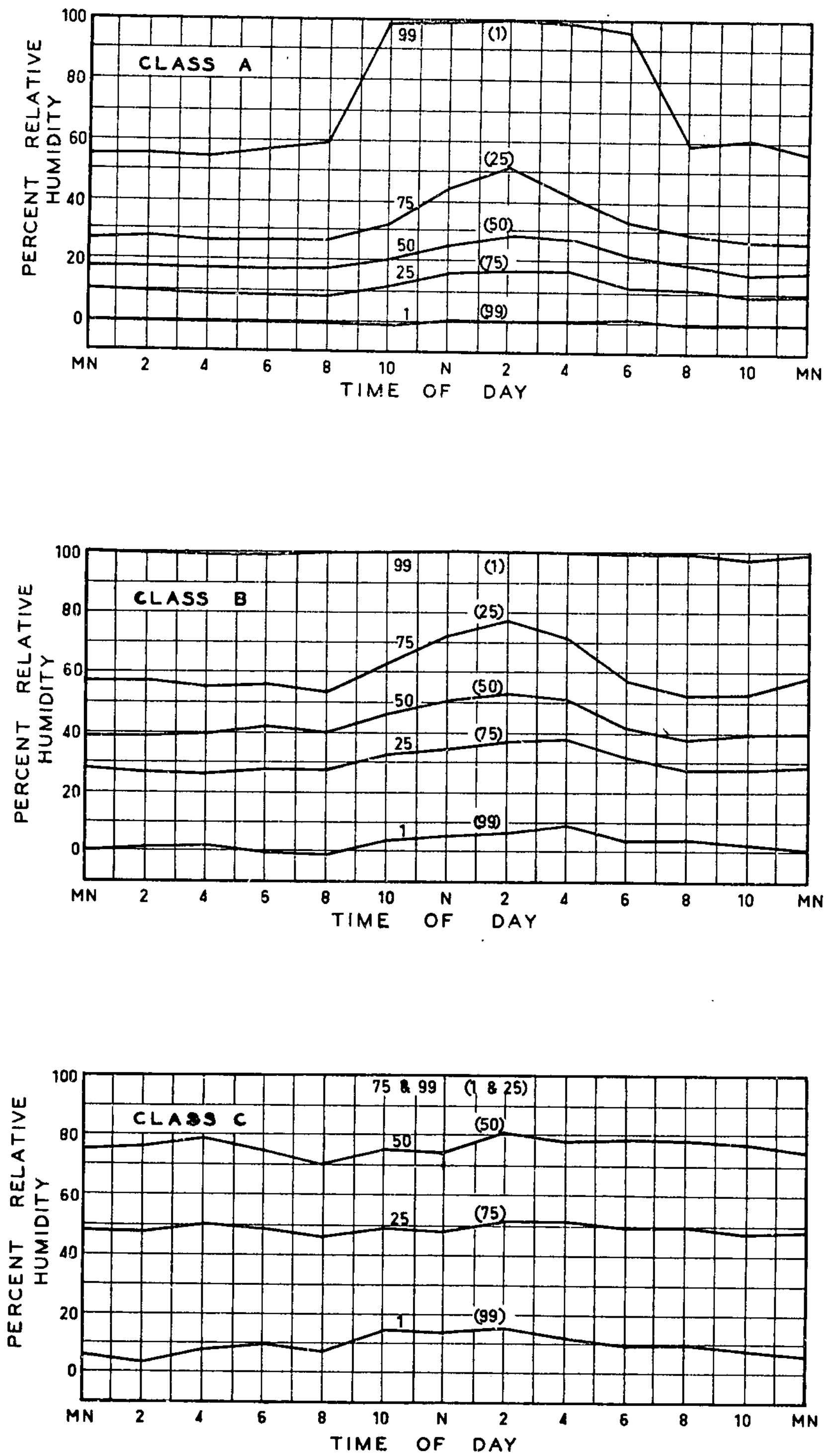

FIG 5 DISTRIBUTION OF RELATIVE HUMIDITY IN TERMS OF PERCENT DAYS IF IS LESS OR (GREATER) THAN THE ORDINATE OF CURVE

classes but this did not seem warranted on the limited collection available. It may be observed that the average relative humidity is only about 25 per cent on class A days, 45 per cent on class B days and 75 per cent on class C days. Thus the top of the mountain is quite dry, as testified to by the rapid cracking of wood and very slow rusting of steel. Black iron strap allowed to stand out remains black after four years. In part this is due to absence of salt particles above the trade wind inversion.

4. FREEZING

While the temperature seldom drops to 32°F, freezing of water frequently occurs during nights when the temperature is in range 32°F to 38°F dry bulb. Two phenomena are acting. In part, the low pressure, low humidity and considerable wind cause the wet bulb to drop to 32°. However freezing also occurs on calm damp nights when the sky is free of cirrus. Under such conditions, if two pails of water are allowed to stand out and one pail is covered, then only the open pail will freeze to a depth of a half inch or so. Apparently considerable heat leaks out toward the open sky and causes just enough radiation loss to bring about freezing. The same phenomenon causes ice stalagmites about one to three inches high to grow out of the ground at night. They come up bearing bits of cinder on top like a roof. These perish by an hour after sunrise. Aside from a few days in winter, the top of Haleakala is a pleasant place to work.

Reference:

Grote Reber 1957 Aust. Met. Mag. No.18, P.50.