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FREQUENCY OF OCCURRENCE OF DIFFERENT TEMPERATURES, TEMPERATURE RANGES AND RATES OF COOLING AT AUCKLAND AND ALEXANDRA AND SOME COMPARISONS.

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The following frequency tables have been prepared to give some indication of the probability of occurrence of different temperatures, to indicate what diurnal ranges of temperatures should be considered possible when forecasting convective phenomena, and what maximum rates of cooling should be allowed for in forecasting the occurrence of fog.

The first station investigated has been Auckland. The two months January and July have been chosen to give samplings of summer and winter conditions.

Figure 1 indicates the frequency of occurrence of different values of maximum (red), minimum (blue) and grass minimum (green) temperatures (taken to nearest whole degree), as recorded at Albert Park, Auckland, during ten January months. Figure 2 indicates the same data for ten July months. The graphs have been smoothed to a small extent by plotting means of the frequencies for three consecutive temperature values.

Figure 3 shows the frequency of occurrence of different values of the diurnal range of temperature (taken to the nearest whole degree) during five January and five July months at Albert Park (January red, July green). Only a small difference in frequency was noted between summer and winter, so the values for January and July are combined in Figure 4 (ten months).

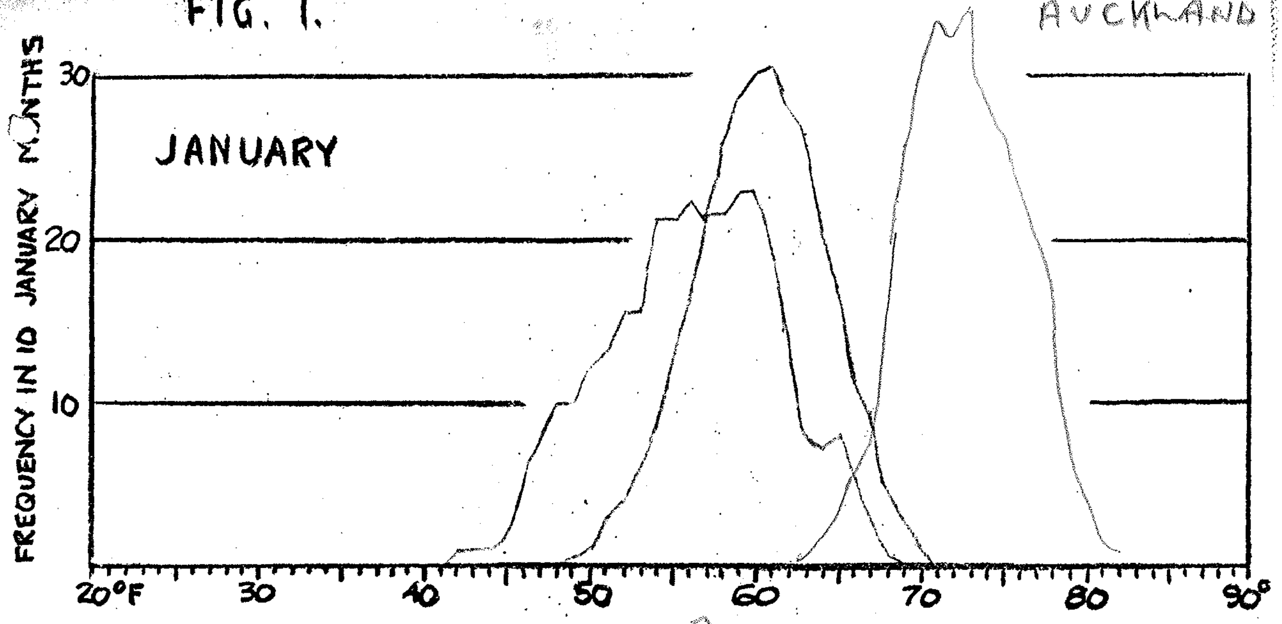
Figure 5 shows the average rate of cooling after sunset in January, taken from the hourly temperature tabulations. Figure 6 shows the corresponding data for July. The 1941 (red), 1940 (blue) and 1939 (green) graphs were prepared from Mechanics Bay tabulations, and the 1938 (~~brown~~ purple) graph from Hobsonville.

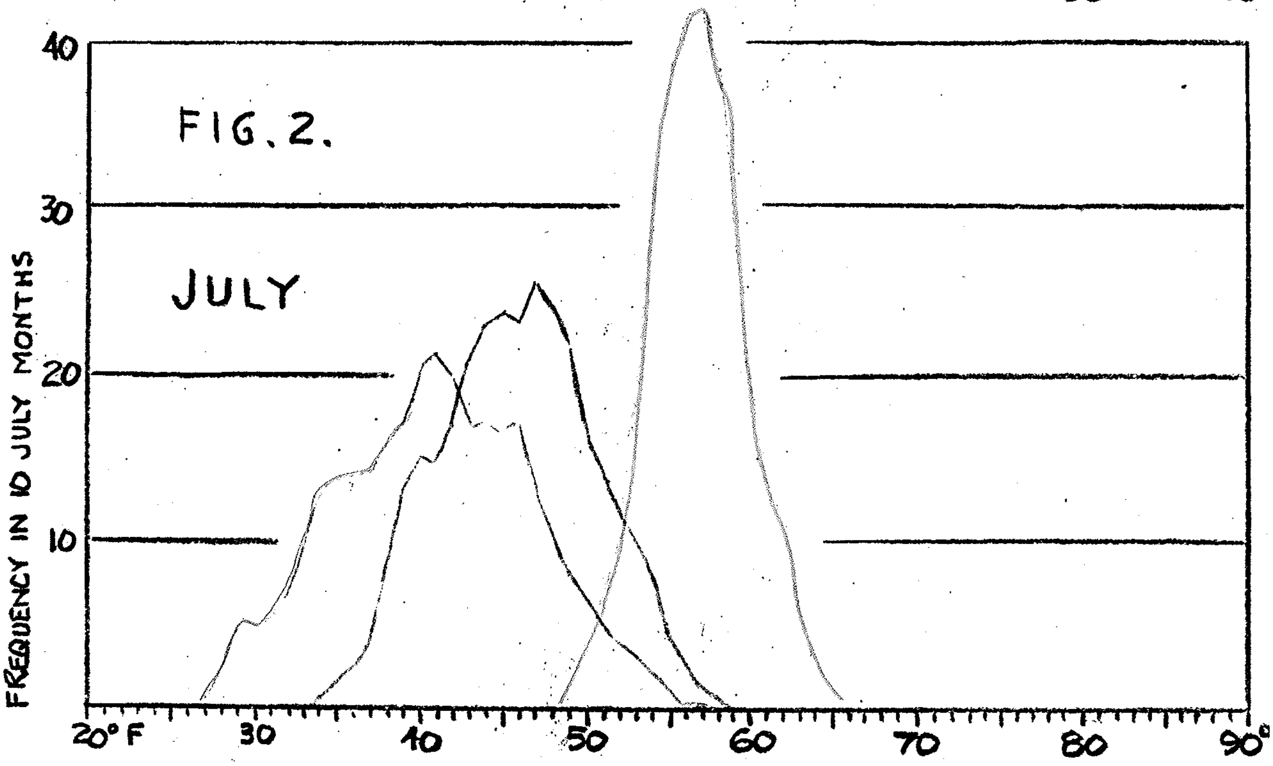
Figure 7 shows the frequency of occurrence of different amounts of cooling during the first six hours after sunset, in five January months (red) and five July months (green). The January and July frequencies are combined in Figure 8 (ten months). The frequencies are compiled for half-degree intervals, e.g., 1, 1½, 2 refer to the intervals 1·0-1·4, 1·5-1·9, 2·0-2·4 etc. The interval 0-0·4 includes also the instances of positive change in temperature.

No attempt has been made to eliminate temperature reductions due to changes of air mass.

AUCKLAND

FIG. 1.





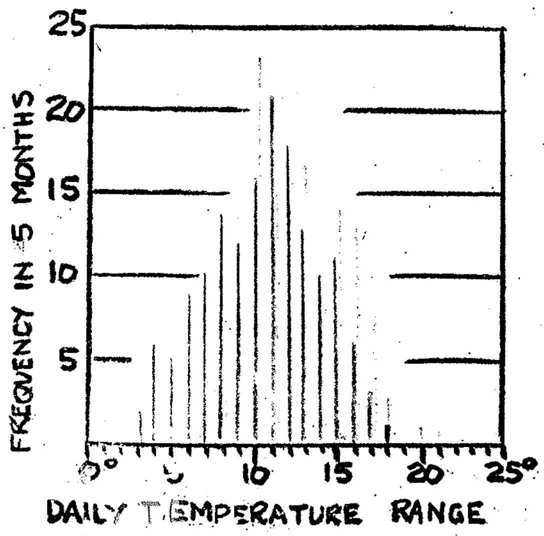


FIG 3.

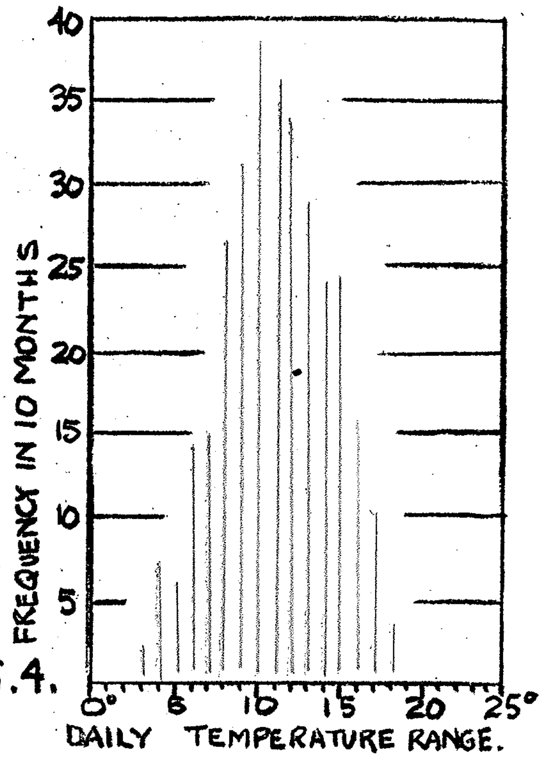


FIG.4.

FIG. 5.

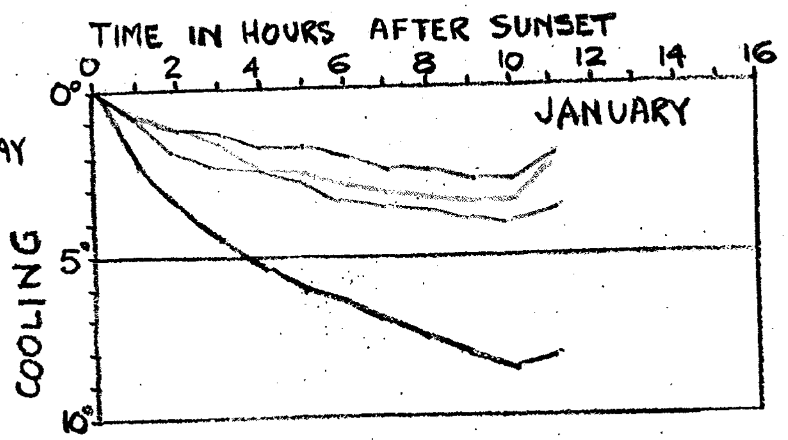


FIG. 6.

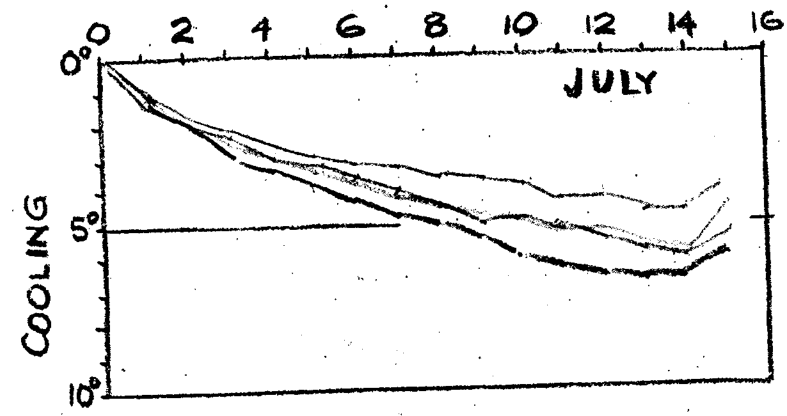


FIG. 7.

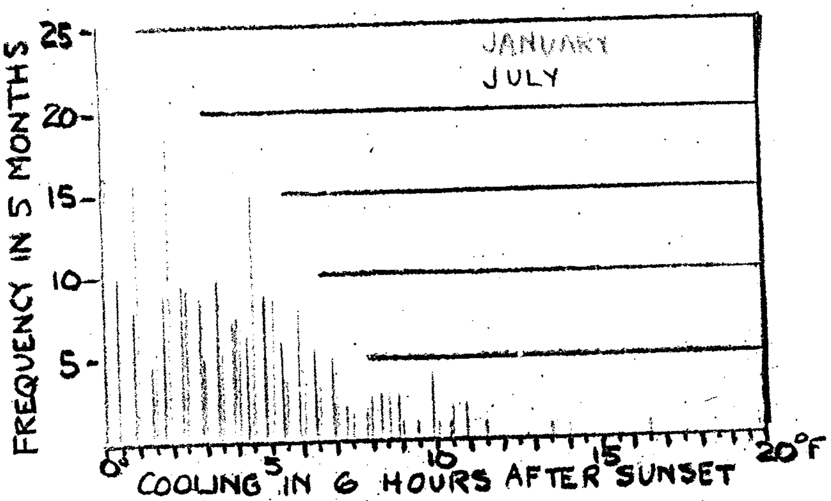
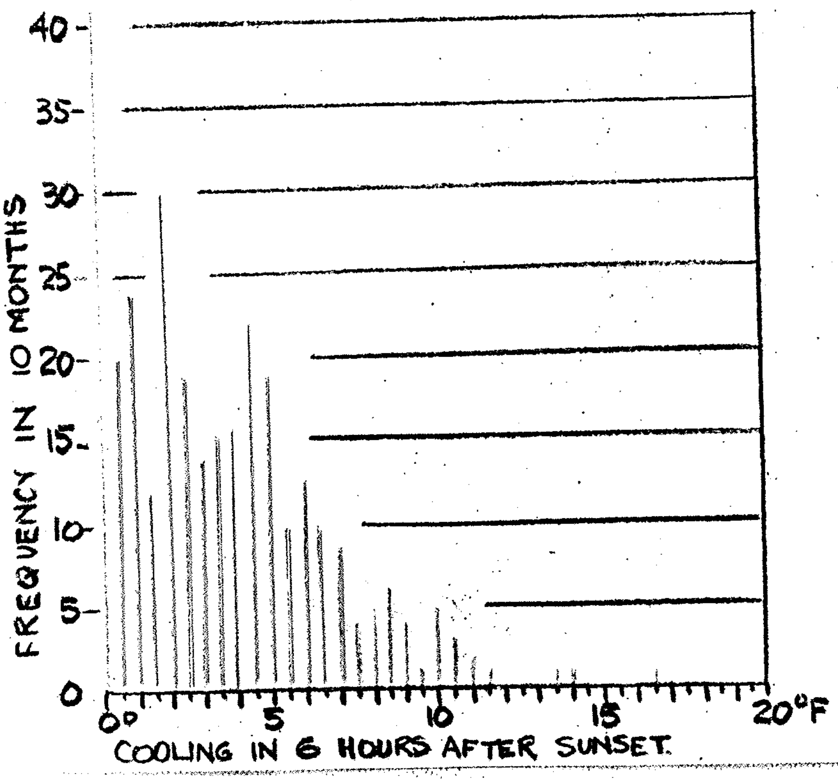


FIG. 8.

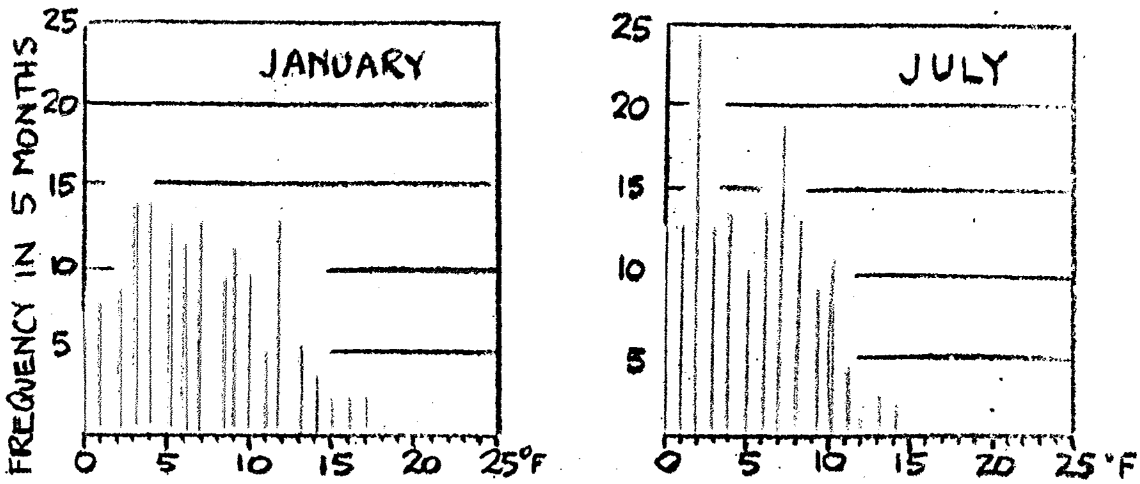


The following frequency data for Alexandra have been extracted in furtherance of the investigation which commenced with the Auckland data. These two stations have been chosen for being the most extreme in climatic type for which adequate information is available.

Figure 1 shows the frequency of occurrence of different values of maximum, minimum and grass minimum temperatures (red, blue and green respectively) during the ten January months, recorded to nearest whole degree. Figure 2 shows the corresponding frequencies for July. Figure 3 shows the frequency of occurrence of different values of the diurnal range of temperatures (taken to the nearest whole degree) during five January months (red) and five July months (green). There is a substantial predominance of large values in summer, but the five January and five July months have been combined in Figure 4 for comparison with the Auckland figures.

Figures 5 and 6 show the frequency of occurrence of different amounts of cooling, in the first six hours after sunset for five January and five July months respectively. The frequencies have been compiled for whole degree intervals 0·0-0·9, 1·0-1·9, etc.

FIG. 5. FIG. 6.



COOLING IN 6 HOURS AFTER SUNSET.

ALEXANDRA

FIG. 1.

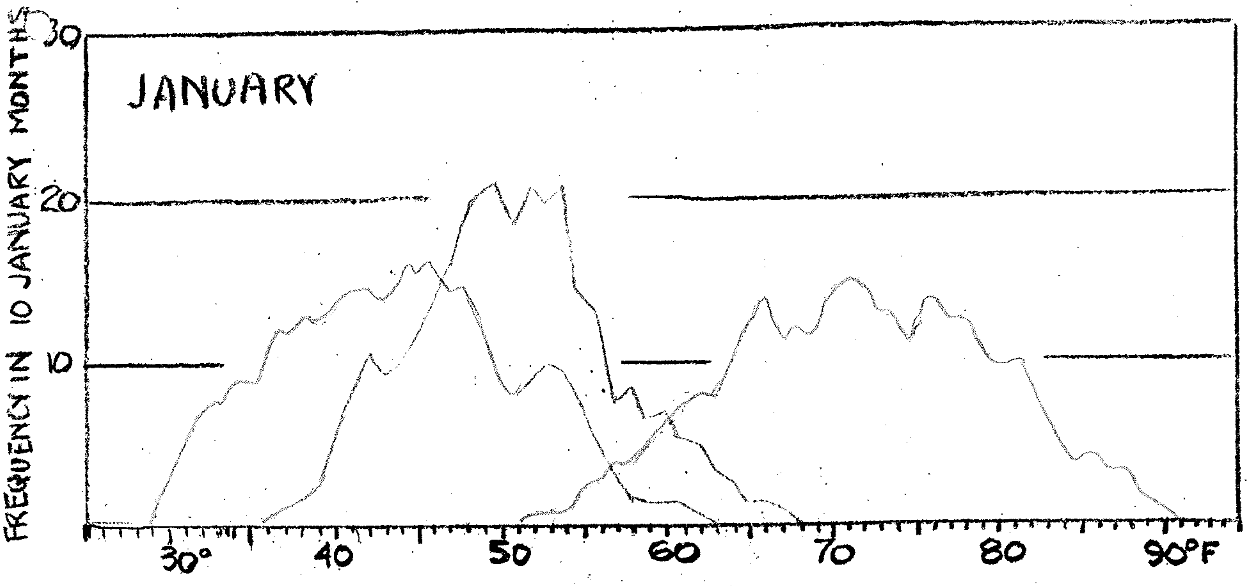
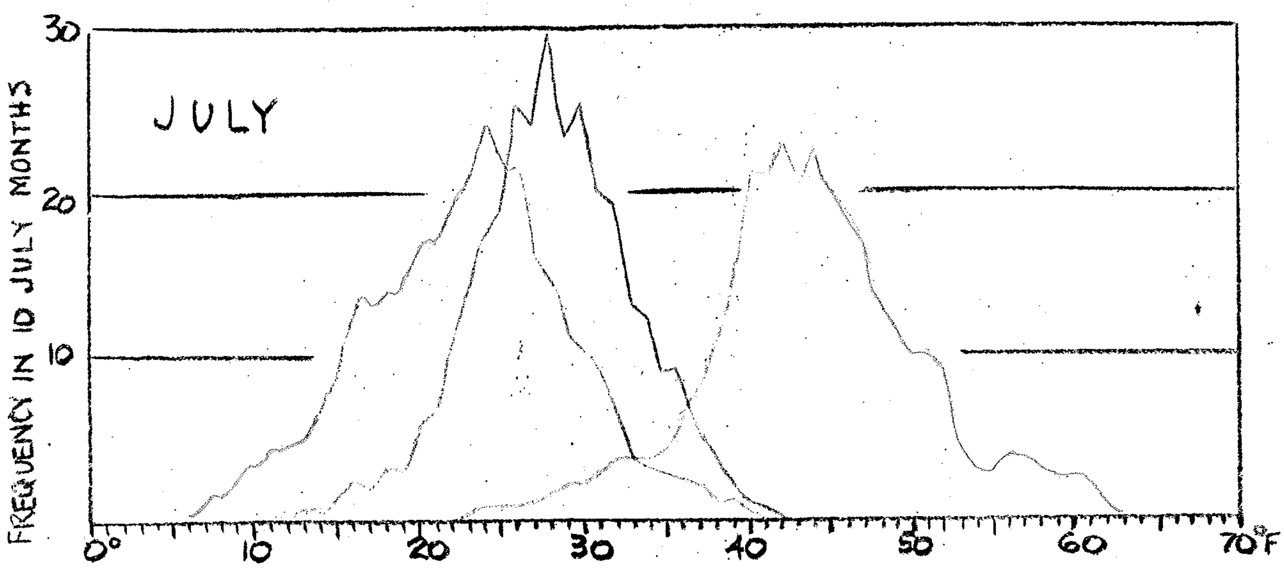


FIG. 2.



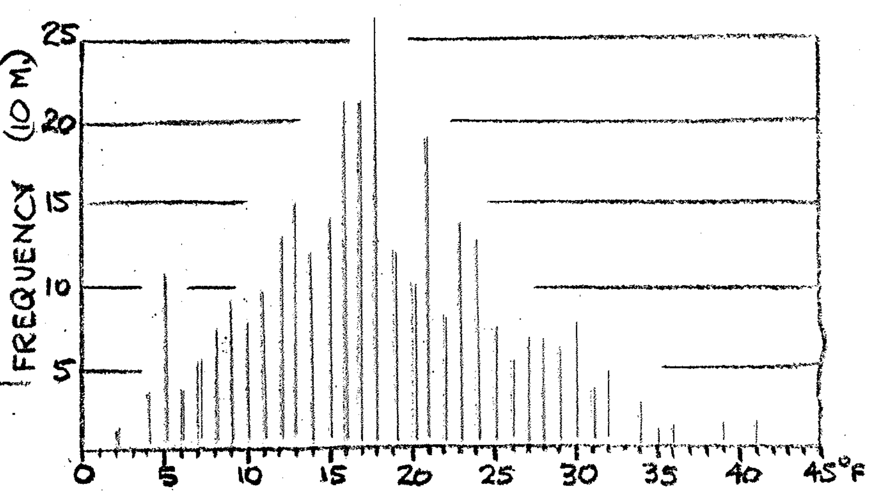
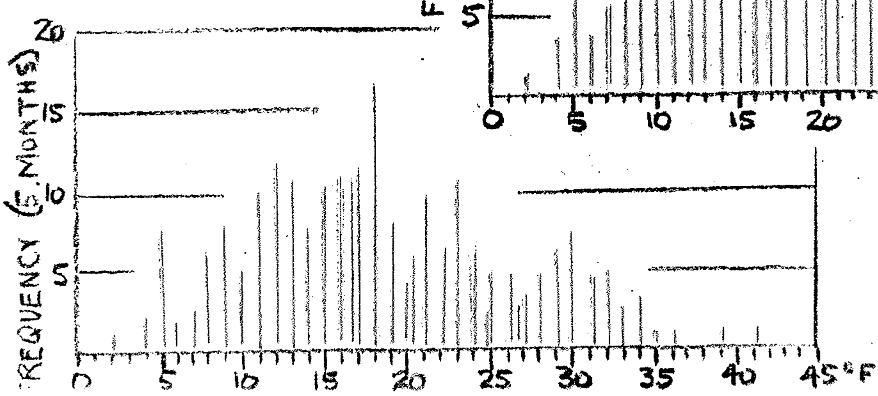


FIG. 4.

FIG. 3.



DAILY TEMPERATURE RANGE

SOME COMPARISONS.

The greater variability of the temperature of Alexandra, away from the stabilising influence of the ocean, compared with the variability at Auckland, is quite apparent from the broader, flatter distribution curves. Doubtless, too, many of the extremes of temperature and of daily range at Alexandra are due to the occurrence of Föhn conditions.

Not only are the normal values of daily temperature range much greater at Alexandra, but the seasonal differences also are significant for forecasting purposes. These features are shown in the following table of percentages of days with ranges exceeding certain values:-

Daily Range:		>15	>20	>25	>30	>35°F
Auckland -	January	17%	1%	-	-	-
	July	6%	-	-	-	-
Alexandra	January	86%	54%	29%	12%	2%
	July	43%	18%	3%	-	-

At Alexandra the maximum rates of cooling are appreciably higher in summer than in winter, although at Auckland the seasonal difference appears unimportant.

The following table shows the proportions of nights with large values of cooling (in six hours following sunset):-

6-hour cooling:		10°F or over	15°F or over
Auckland	January	4%	1%
	July	5%	-
Alexandra	January	28%	5%
	July	12%	-

A preliminary comparison between these figures and the cooling curves calculated from Brunt's formula for El Centro, California, by Woodrow C. Jacobs ("A Convenient Minimum Temperature Diagram" B.A.M.S. Vol. 21, No.7, Sept. 1940) suggests that results of the right magnitude could be predicted by taking Jacobs' factor "D" as approximately 0·7 for Auckland and 0·7 or 0·8 for Alexandra, i.e., the soil factor S ($= \sqrt{\pi}\, \rho \sqrt{\kappa}\, c$) should be 0·12 to 0·10 compared with 0·082 for which the curves were calculated.

In view of the vital necessity for accurate fog prediction this coming winter it seems desirable that local studies should be made for all the main aerodromes. Local studies along the lines of the series in B. Amer. Met. Soc. initiated in April 1940 by J.J. George appear likely to yield the most valuable results owing to the large influence of local factors such as air drainage. Simple diagrams based on Jacobs' cooling curves or on G.I. Taylor's Wet Bulb Depression Curves may however prove of value in permitting an airman meteorologist attending night flying operations to say that fog is unlikely for at lease one hour, two hours, etc.

8/4/42