33. *On the Seven Day Period in the Winter Temperature of Korea and Manchuria.*

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1. "San-kan Si-on"¹⁾ or as we may literally put it "Four warm days follow three cold days" is one of the popular proverbs concerning the winter temperature in Korea and Manchuria. If this saying has much good truth in it there shall be the seven day period in the daily temperature in both districts.

In 1915 Mr. Y. Yamanouti²⁾ investigated the existence of the possible periodicity using the observations for the 10 years from 1903 to 1914 of the daily maximum and minimum temperatures of air at Jinsen, Korea. He obtained two series of the temperature curves plotting these extreme temperatures, and counted the mean length of interval between the consecutive crests of the curves of the maximum temperature as well as those between the consecutive troughs of the curve of the minimum temperature. Considering that the frequency of each period in a definite interval of the year of observations is of a different weight Mr. Yamanouti computed the weighted mean of the frequency of each periodicity, and found that the seven day period is most conspicuous one in the maximum as well as the minimum temperature at Jinsen.

2. In the present note I have made use of the daily mean temperatures at the 10 selected stations in North China, Manchuria, Korea and Japan Proper for the cold months from November, 1929 to March, 1930. In searching for periodicities in the observed data I have applied the method of periodogram analysis as simplified by Mr. A. Eagle in his Treatise on Fourier's theorem. Suppose that the given observations can be represented by a sum of several harmonic terms together with a slowly varying remainder, so that we may write

$$f(t) = a_1 \sin(n_1 t + A_1) + a_2 \sin(n_2 t + A_2) + \dots + \varphi(t).$$

If we form the sum

$$S = f(t) + f\left(t + \frac{2\pi}{n}\right) + f\left(t + \frac{4\pi}{n}\right) + \dots$$

1) 三寒四溫.

2) Y. Yamanouti: Journ. Met. Soc. of Japan. 34th year. p. 324 (in Japanese).

where $n=n_1$ taking as many terms, say m , in the sum as the extent of the observations permit, the first harmonic will become $ma_1 \sin(n_1 t + A_1)$. The other harmonics will be in different phases in different terms of this sum unless their frequency is a multiple of n , and so their resultant will in general be small compared with that of the harmonic n .

3. In the practical calculations in testing the n day period we write down in the first column the value of $f(t)$ for 0, n , $2n$, $3n$ th, days respectively, and in the successive columns for 1 day greater than each of these number successively. We take as the range the difference between the greatest and least values. We give in the following table the ranges calculated for various values of n at the 10 selected stations:—

Station n	Chanchun	Tientsin	Dairen	Jyosin	Jinsen	Gensan	Yinkow	Hukuoka	Sakai	Tokyo
3.....	8.0	23.0	37.6	9.8	20.1	5.5	14.2	8.6	20.4	19.1
4.....	51.7	17.9	30.3	27.8	26.4	26.9	19.2	17.4	12.9	20.0
5.....	41.4	21.7	39.2	16.4	15.4	6.8	6.0	11.2	21.9	32.2
6.....	15.6	26.9	27.0	22.5	17.7	12.2	25.0	21.2	17.2	23.0
7.....	47.2	36.6	78.3	30.0	38.4	28.5	22.0	20.8	20.4	11.7
8.....	34.3	13.5	19.4	21.0	12.9	28.1	12.8	19.7	13.5	14.4
9.....	24.7	38.2	27.2	18.9	17.7	9.0	27.5	28.8	17.8	24.5
10.....	47.4	30.8	28.2	21.7	22.5	13.8	18.3	30.6	29.2	49.0
11.....	37.8	25.5	47.3	33.5	23.7	33.0	23.0	23.5	21.7	22.1
12.....	29.5	28.9	42.5	21.9	19.7	18.5	15.7	17.5	12.2	27.8
13.....	43.5	16.4	23.5	19.5	40.2	30.2	33.4	31.7	22.9	33.1
14.....	54.6	37.8	65.8	33.0	54.2	38.5	39.2	27.5	26.9	33.0
15.....	56.4	31.4	41.6	39.0	30.8	31.3	35.1	24.8	37.3	33.6
16.....	46.1	25.2	37.8	31.3	41.3	35.3	38.4	19.9	28.6	36.5
17.....	42.6	21.2	30.3	31.3	49.9	39.2	43.0	23.3	36.3	33.6
18.....	37.8	34.1	40.8	26.7	27.5	22.4	30.3	25.9	24.2	27.5
19.....	23.7	23.4	36.4	27.8	26.1	24.2	24.1	31.4	22.7	19.7
20.....	49.0	28.1	37.5	23.0	19.7	22.1	17.6	21.9	18.7	28.5

A glance at the table shows us that in air temperature of Korea and South Manchuria the 7 day period predominates, and the 14 day period is also remarkable as we naturally expect. This proves the existence of the 7 day period in the daily temperatures in these districts.

It is also noticeable in the winter temperature in northern Kyusyu. From the same table we see that the 4 day period is also conspicuous in Korea and northern Kyusyu, and the 5 day period in the main island of Japan.

4. As is well known the alternation of warm and cold weathers is caused by the passage of cyclonic depressions followed by the increase

in the intensity of the Siberian high. When a cyclone is passing over Northern Manchuria, the southerly winds inflowing into the cyclonic area cause a rise of air temperature and bring a warm weather. The cyclone is usually followed by the increase in the intensity of the continental anticyclone, and a fall of temperature and a cold weather under its spell. This is clearly seen from the comparative studies of the variation of the daily temperature and pressure at various places in Korea and southern Manchuria. A comparison of the march of the daily temperature with that of the corresponding daily pressure shows that both elements present a marked correlation of opposite sense, a rise of temperature corresponding to a fall of barometric pressure and vice versa, as can be seen from the figure showing the variations of both elements at Jinsen for the winter, 1929-1930. The correlation coefficient of both elements for the cold season, ie, from October 1929 to March 1930 is -0.509 and its probable error ± 0.045 . In calculating the correlation coefficient are used the departures of the daily temperatures from the normal deduced from the daily mean temperatures for the 20 years, 1907 to 1926 in order to get free from the effect of the annual variation of it.

Daily mean Barometric pressure and Air temperature at Jinsen, Korea, for Nov. 1929-Feb. 1930.

The predominance of the 7 day period in the daily mean barometric pressure in Korea and Manchuria has been shown by applying periodogram analysis to the observed pressure at Dairen. The following table contains the result of our computations:—

n:	3	4	5	6	7	8	9	10	11	12	13	14	15
Pressure:	19.5	17.0	30.8	20.9	38.3	29.7	24.5	36.1	44.7	41.0	31.1	36.4	45.3
Temperature:	37.6	30.3	39.2	27.0	78.3	19.4	27.2	28.2	42.5	65.8	37.8	40.8	37.6