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The Mean and Extreme Values of Temperature at the Main Stations of Finland

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The average monthly values of temperature and, likewise, its minimum and maximum values at the main stations are regularly published in the monthly bulletins issued by the Meteorological Central Institute. Moreover, the normal value and the absolute extreme values of temperature from 1886 onwards are mentioned in the bulletins. The total climatic meaning and importance of the pictures of temperature remains, however, indistinct to most of the people studying them. Since every individual month in its turn is explained in detail, we tend to overlook the annual course of temperature. In order to get clear picture of it, a presentation of another kind is needed, either in the form of tables or graphs. Since the latter method gives both a descriptive and vivid picture of the course of temperature at the various seasons of the year and its changes at different stations, we have chiefly taken recourse to that method in this paper.

We shall begin by examining the temperature values at the stations Mariehamn (Maarianhamina), Turku, Helsinki, Kotka, Tampere, Jyväskylä, Kuopio, Kajaani, Vaasa, Oulu, Sodankylä and Inari. The monthly normal temperature N at each station during the years 1901—1930, the mean temperature of the warmest and the coldest months Mmx, Mmn, and the absolute maximum and minimum temperature values Amx, Amn which have been recorded, are represented graphically. The years during which the extreme values occurred are designated in the graphs by the last two numbers. I have earlier used a similar method and A. Ångström has recently made a graphical representation of the same kind of the temperature in Stockholm [1]).

[1] J. Keränen, Vihdin ilmasto 1929 and Anders Ångström, Sveriges klimat, Stockholm 1946, Fig. VI.

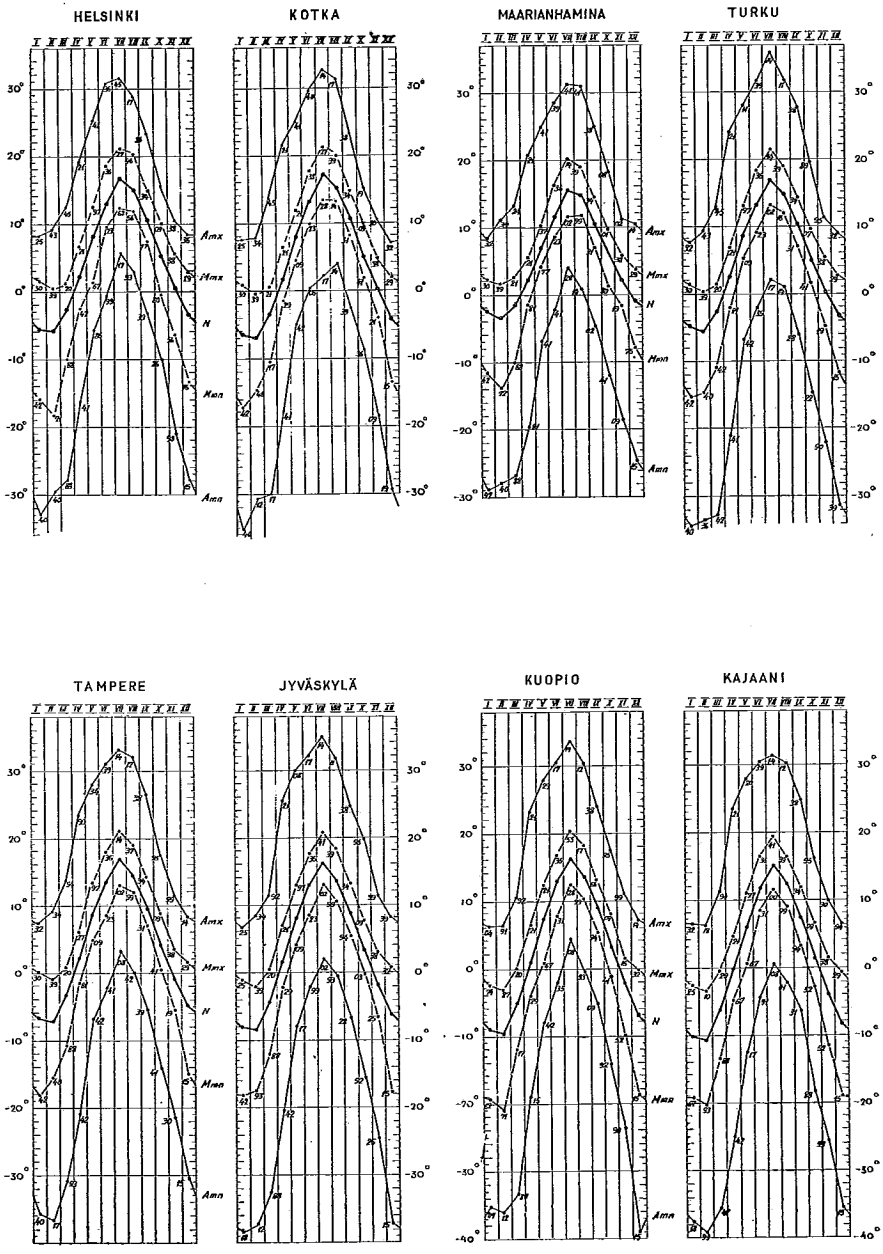
HELSINKI
KOTKA
MAARIANHAMINA
TURKU
TAMPERE
JYVÄSKYLÄ
KUOPIO
KAJAANI
Amx
Mmx
N
Mmn
Amn

Fig. 1—4.

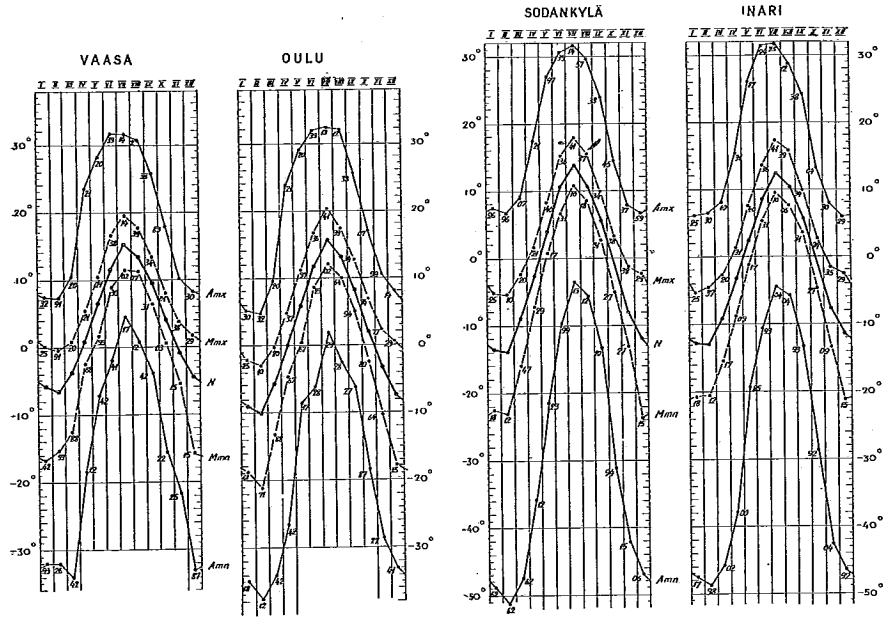

Fig. 5—6.

As we may see from the following table, the observation series are to a certain extent of varying lengths, and some of the oldest series are not continuous. The result is that all the curves representing the extreme values at different stations, both the monthly and the absolute values, are not strictly comparable with each other. Since, however, the series are of fairly considerable lengths at all stations, the graphs can give us a pretty accurate picture of the extreme values that the temperature during different months can reach in present climatic conditions. It is of course true that, when observations are continued in the future, new extreme values may sometimes be obtained, but they cannot greatly exceed the values hitherto recorded.

The warming effect of radiation due to the screen or the shelter has been put straight in the monthly values, and thus the values correspond to real average diurnal values.

The initial year of the observations series.

Mariehamn	1869 —	
Turku	1873 —	
Helsinki	1829 —	
Kotka	1908 —	
Tampere	1873 —	
Jyväskylä	1883 —	
Kuopio	1848 —	1875
	1884 —	
Kajaani	1846 —	1872
	1880 —	
Oulu	1846 —	
Sodankylä [1]	1906 —	
Inari [1]	1906 —	

Extreme values of the annual means of temperature are:

	Warmest year		Coldest year	
	Temperature, ° C	Year	Temperature, ° C	Year
Mariehamn	7.4	1934	2.9	1881
Turku	7.0	1934	2.1	1915
Helsinki	7.0	1934	1.4	1867
Kotka	6.7	1934	2.1	1941
Tampere	6.5	1934	1.0	1941
Jyväskylä	5.3	1934	0.2	1888
Kuopio	4.2	1934	—0.4	1941
Vaasa	5.7	1934	0.3	1915
Kajaani	3.8	1934	—2.0	1888
Oulu	4.5	1938	—1.4	1867
Sodankylä	1.2	1934	—3.8	1915
Inari	1.2	1934	—3.8	1915

The amplitude of the variations of the average annual values is 5° in most parts of the country but at Oulu and Kajaani it rises to nearly 6°. At Mariehamn, in the most maritime climate of the country, it is only 4.4° and, next to it, at Kuopio 4.6°.

The range of average monthly temperature values shows some features characterizing the climate of Finland. The amplitude of the fluctuations

[1] At these stations also records from the last century are extant. Their absolute extreme values are taken into consideration in this study.

is greatest during winter months and smallest in July—September and, regionally, in spring. The greatest amplitude is reached in the south of the country in January or February, elsewhere in December, and its value is in most parts of the country 18—19°, but smaller on the western coast, where it is 14.5—17.6°, and greatest at Sodankylä, 21.4°. The smallest amplitude generally occurs in August or September but it is sometimes reached already in July in the center of the country and in Lapland. It is for the most part 7—8°, but in the Åland Islands and Northern Lapland only about 6°. In spring there exists a secondary minimum which becomes the main minimum in the Åland Islands.

The variations of the average monthly values at the periods when they are greatest and smallest will now be looked upon on a wider basis. If we take three-monthly mean values at the period of both the greatest and the smallest changes, the result is the following:

	Period of the greatest changes		Period of the smallest changes	
	Months	Value, ° C	Months	Value, ° C
Mariehamn	I—III	13.9	VIII—X	7.4
Turku	XII—II	15.4	VIII—X	7.3
Helsinki	XII—II	17.5	VII—IX	8.3
Kotka	XII—II	16.0	VII—IX	7.1
Tampere	XII—II	16.5	VII—IX	7.5
Jyväskylä	XII—II	17.0	VII—IX	7.8
Kuopio	XII—II	17.8	VII—IX	7.9
Vaasa	XII—II	16.4	VIII—X	7.0
Kajaani	XII—II	17.3	VII—IX	7.5
Oulu	XII—II	17.8	VII—IX	7.8
Sodankylä	XII—II	19.2	VII—IX	7.1
Inari	XII—II	16.8	VIII—X	7.3

The 3-monthly maximum value of the amplitude is generally 16—18°, but on the south-western coast smaller and in southern Lapland greater, whereas the 3-monthly minimum value of the amplitude is about the same, 7—8°, all over the country. When we calculate the ratio of these 3-monthly amplitudes, its value becomes 1.9—2.3, at Sodankylä, however, exceptionally 2.7°. Thus we see that the average monthly value at the period of middle winter varies somewhat more than twice as much as in late summer and early spring.

These great variations of the average monthly values in winter give evidence of that weather types of various kinds are prevalent in Northern Europe. The mildest winter months are due to the continuous transport hereto of warm and moist maritime air masses. Cyclone activity then is ordinarily prevalent. Polar and sometimes also arctic air masses which usually originate either in the eastern continent or Greenland or even in the Arctic ocean, again, are responsible for the coldest months. During that period Northern Europe belongs to the areas of anticyclones.

The monthly average values change least in summer, early autumn, and spring, when temperature variations — in autumn the cooling-down and in spring the warming-up — are moderated by the effect of the Baltic, its bays, and the abundant inland lakes. On the western coast and Northern Lapland, where the effect of the seas is most pronounced, October still belongs to this group. The coldest months in the summer season result from abundant cyclone activity, when the insolation is relatively weak, which is due to cloudy weather.

These facts will be treated more carefully in another paper.

All the foregoing directly implies that the differences of the absolute extreme values of temperature are greatest in winter and in spring when the ground is covered with snow. The greatest difference of the extreme monthly temperatures occurs in the greater part of the country in February—April but, regionally, already earlier. It is 55—58° in Lapland, but else-

	The maximum differences between the absolute extreme values		The minimum differences between the absolute extreme values	
	Months	Value, ° C	Months	Value, ° C
Mariehamn	I—III	39.8	VII—IX	29.7
Turku	II—IV	44.7	VII—IX	32.7
Helsinki	I—III	40.0	VIII—X	26.0
Kotka	I—III	41.7	VIII—X	25.6
Tampere	II—IV	45.0	VII—IX	31.3
Jyväskylä	XII—II	45.4	VII—IX	32.1
Kuopio	XII—II	43.3	VII—IX	29.7
Vaasa	II—IV	42.0	VII—IX	28.9
Kajaani	II—IV	47.0	VII—IX	31.7
Oulu	II—IV	45.6	VII—IX	32.3
Sodankylä	I—III	57.0	VII—IX	35.9
Inari	I—III	54.3	VII—IX	36.1

where 40—50°. The smallest difference generally occurs in July or in August, but here and there in the lake district of Finland in September, and, on the coast of the Gulf of Finland, as late as October. Its value is 24—25° on the coast of the Gulf of Finland, elsewhere 27—35°, greatest in Lapland. The maximum difference between extreme temperatures during a year is 60° in the Åland Islands, 80—82° in Lapland, and 65—73° elsewhere.

The differences of the absolute extreme temperatures of the months have also been calculated at three-monthly periods, and the dates of their occurrence recorded. The figures are given in the preceding table.

The ratio of the absolute differences of these periods is 1.3.—1.6, evenly all over the country.

It is the writer's intention to continue this study and extend it to cover different climates.