

As all investigations on climate must be preceded by a knowledge of the normals, their computation must be a matter of the first concern.

It is not intended to enter needlessly upon technicalities, but as the principles concerned in computing normals are intimately connected with the question of the external appliances that should be brought into action, it will be necessary to devote some space to this subject.

The value of an element, (such as temperature, for example,) as given by an isolated observation, is affected by various circumstances, of which some, such as the time of the day or of the year, are periodic; while others are in a certain sense accidental, sometimes increasing and sometimes diminishing the temperature, and causing it to deviate above or below the value due in strictness to periodic causes.

Now, if the temperatures observed at the same hour on every day in a month and for several years be averaged, the average will be free to a great extent from the irregularities of single days, as well as from those which affect single years, and may be regarded as the normal or most probable temperature (derivable from the materials employed) for that particular hour and for a day near the middle of the month. From the twelve monthly normal means found separately and for each of the twenty-four hours (if the observations are made at every hour), the normals proper to each hour and for each day in the year may be computed. (a)

From hourly observations of temperature at Toronto continued for six years, were computed the normals for each hour and for every fifth day throughout the year.

The following is a portion of the table of normal temperatures, given for brevity at alternate hours only:—

TABLE I.

	Noon	2	4	6	8	10	Mid't	2	4	6	8	10	Mean
January 30th.....	27.1	28.1	27.7	25.4	24.1	23.3	22.4	21.9	21.4	21.3	21.6	21.7	21.1
July 30th.....	73.9	75.6	75.7	73.4	65.8	62.7	60.5	59.1	57.9	60.4	66.8	71.2	66.9

By subtracting the mean normal of the day (on the extreme right) from the normals for each hour, the diurnal variations for that day are obtained.

A portion of a table thus formed for every fifth day through the year is here given. (b)

TABLE II.

Part of a table of the Diurnal Variations of Temperature at Toronto:—

	Noon	2	4	6	8	10	Mid't	2	4	6	8	10
January 30th ...	+3.0	+4.0	+3.6	+1.3	0.0	-0.8	-1.7	-2.2	-2.7	-2.8	-2.5	+0.6
July 30th.....	+7.0	+8.7	+8.8	+6.5	-1.1	-4.2	-6.4	-7.8	-9.0	-6.5	-0.1	+4.3

The monthly and annual means of the diurnal variations are similarly derived by subtracting the *general* (c) monthly and annual means of temperature (for all hours collectively) from the *particular* monthly and annual means for the several hours.

(a) If the monthly means at any hour be considered as the temperatures (for that hour) proper to the middle day of the month, and if the months are supposed to be of equal length, the temperature for that hour on any other day will be given by the formula—

$$T_n = T_0 + T_1 \sin(n \times 30 + C_1) + T_2 \sin(2n \times 30 + C_2) + T_3 \sin(3n \times 30 + C_3) + \&c.$$

The January mean being the temperature corresponding to the 15th of the month, regarded as the zero of time, T_n the required temperature at time (n) (the unit of time being the twelfth part of the year) and $T_1, T_2, T_3, \dots, C_1, C_2, C_3, \&c. \&c.$, constants determined from the twelve monthly means. The assumption that the means of the months are the temperatures proper to their middle days is evidently not necessarily correct. The error occasioned by this assumption will necessitate a correction to the constants $T_1, T_2, \&c.$

(b) See a paper read by Colonel Sabine before the Royal Society Feb. 10, 1853 and published in the Phil. Transactions. In Colonel Sabine's paper the table gives the *corrections* to be applied to the temperature observed at any hour in order to give the mean temperature of the day. The corrections are the diurnal variations with their *signs changed*.

(c) The term *general* annual or monthly mean, is used to express the mean derived from the twenty-four hours *collectively*, as distinguished from the annual or monthly mean relative to any single hour.