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ON THE ANNUAL VARIATION OF AIR TEMPERATURE IN ATHENS

by

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Abstract: *In this poper is examined the annual course of air temperature in the eity of Athens for the period between 1858 - 1972, that is a full and consecutive 115 years. This study is effected by monthly mean temperaturc values. It is coneluded that, mean temperatures show an ascending trend, which is attributed to the expansion of the city.*

INTRODUCTION.

The study of the temperature of the air in various regions of Greece has been the subject of a number of research workers. Air temperature in Athens in particular has been studied by AEGINITIS [1,2], ALEXANDROU [4], PH. KARAPIPERIS [7,8], MARIOLOPOULOS [10,11,12], L. KARAPIPERIS [6] and others, who examined this meteorological parameter from various viewpoints.

However, in all the above mentioned works, the observational period is not longer than fifty years, while in the present paper we examine the annual variation of air temperature in Athens between the years 1858 - 1972, that is a full 115 years, for which we have a continuous series of observations. The examination is made by monthly mean values of air temperature, given in degrees Celsius (°C), and in absolute degrees (K) (see Appendix).

MATERIAL.

The material for this study, has been obtained from the following sources:

a) «Annales de l'Observatoire National d'Athènes», covering the period between 1858 - 1930.

b) «Climatological Bulletin» issued by the Meteorological Institute of the National Observatory of Athens, covering the period between 1931 - 1972.

The material thus collected had certain dissimilarities as to the

hours of observation: Weather observations were held till 1895 thrice daily, at 08 : 00, 14 : 00, and 21 :00 hours. The reduction of mean values of the three daily observations to the true mean of 24 hours, has been effected by calculating the differences of the 24 - hours' mean for the period between 1895 - 1930, from the mean values of the three above mentioned daily observations. The arithmetic mean of these differences yields the correction factor which should be added to the monthly mean values of air temperature for the 1858 - 1895 period. By this process, we have re-established a complete observational series of 115 years.

TABLE I

Correction factors for the reduction of monthly mean values $\frac{8+14+21}{3}$ *to the 24-hours' mean.*

	J	F	M	A	M	J	J	A	S	O	N	D	Y
According to Schmidt	0.61	0.73	0.93	1.12	1.20	1.23	1.21	1.15	1.02	0.80	0.60	0.57	
According to Aeginitis	0.20	0.22	0.33	0.54	0.74	0.81	0.79	0.68	0.63	0.44	0.29	0.16	
1895 - 1930 Period	0.15	0.20	0.35	0.54	0.74	0.79	0.76	0.69	0.58	0.46	0.25	0,19	0.48

These corrections slightly differ from the ones calculated by Schmidt and Aeginitis (Table I), and anyway they are valid only for that particular station, from whose observational data they have been calculated.

TABLE II

Former positions of the National Observatory of Athens and their elevations.

— 1853 - 1858 : Observatory Hill	elev.	107 m
— 1858, Dec. 2 - 1859, Aug. 13 : Paikou house (formerly Hotel Byzantion)	»	84 m
— 1859, Aug. 13 - 1861, Sept. 6 : Dedes house, in Geranion	»	77 m
— 1861, Sept. 7 - 1863, Sept. 13 : Anagnostaki house, N of the Royal palace	»	103 m
— 1863, Sept. 14 - 1871, May 15 : Skapessou House, Lykavitou Str.	»	102 m
— 1871, May 15 - 1871, Aug. 15 : Demopoulou house	»	110.9 m
— 1871, Aug. 15 - 1877, Sept. 8 : Inglessi house, N of Anagnostaki house	»	103 m
— 1877, Sept. 8 - 1886, Oct. 1 : Schmidt house, hy the Lykabettus	»	109.6 m
— 1886, Oct. 1 - 1890, Sept. 10 : Vourli house, by the Lykabettus	»	124 m
— 1890, Sept. 11 - Today : National Observatory of Athens	»	107 m

The meteorological station of the National Observatory of Athens has been functioning, without interruption, for the element of air temperature, on the same site where it still stands (φ : 37° 58.3′ N, λ : 1h 34.9′ E, H=107 m), ever since September 11, 1890.

Its former positions, as well as their corresponding elevation, as mentioned by Professor AEGINITIS [1], have as per the above Table II.

MEAN AND EXTREME ANNUAL VALUES OF AIR TEMPERATURE.

The mean and extreme annual values of air temperature in Athens for the 115 years (1858 - 1972) are given below and in Graph I:

Maximum 18.9 (year 1927)
Mean : 17.7 ± 0.52
Minimum: 16.7 (year 1884, 1949)

Distribution of Annual Mean Values of Air Temperature (°C).

	16.5	17.0	17.5	18.0	18.5	19.0	Total
No. of cases	16	31	38	24	6		115
Percentage (%)	14	27	33	21	5		100

MONTLY MEAN VALUES OF AIR TEMPERATURE.

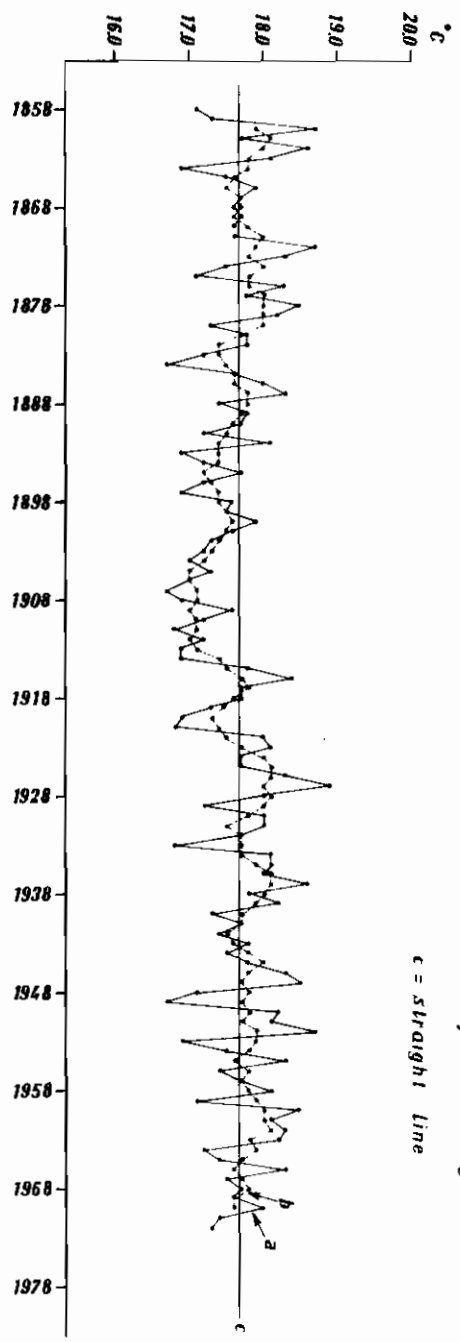
The annual conrse of the temperature of the air in the city of Athens, presents a single fluctuation (Table III, Graph II) with a maximum in

TABLE III

Thermometric Data of Athens (1858 - 1972)

Month	T_{max}	Year	Mean	± σ	C.V.%	$\Delta(T_{max}-T_{min})$	T_{min}	Year
J	12.9	1936	9.0	1.74	19.37	8.6	4.3	1858
F	13.3	1955	9.5	1.70	17.83	8.1	5.2	1891
M	15.2	1947	11.6	1.48	12.76	8.0	7.2	1874
A	18.4	1862	15.3	1.28	8.37	7.1	11.3	1870
M	23.1	1945	19.9	1.31	6.57	6.9	16.2	1919
J	27.1	1916	24.3	1.14	4.68	5.9	21.2	1921
J	29.4	1888	27.2	0.88	3.23	4.3	25.1	1913
A	29.5	1946	27.1	1.01	3.73	4.9	24.6	1884
S	26.4	1952	23.5	1.30	5.53	5.7	20.7	1941
O	23.2	1932	19.0	1.37	7.21	7.7	15.5	1951
N	17.7	1923,26	14.6	1.52	10.44	8.3	9.4	1920
D	14.2	1960	10.9	1.51	13.87	7.3	6.9	1948
Year	18.9	1927	17.7	0.52	2.94	2.2	16.7	1949

July and a minimum in January, although the maximum and minimum of the year do not always occur in the same month. Out of the 115 years



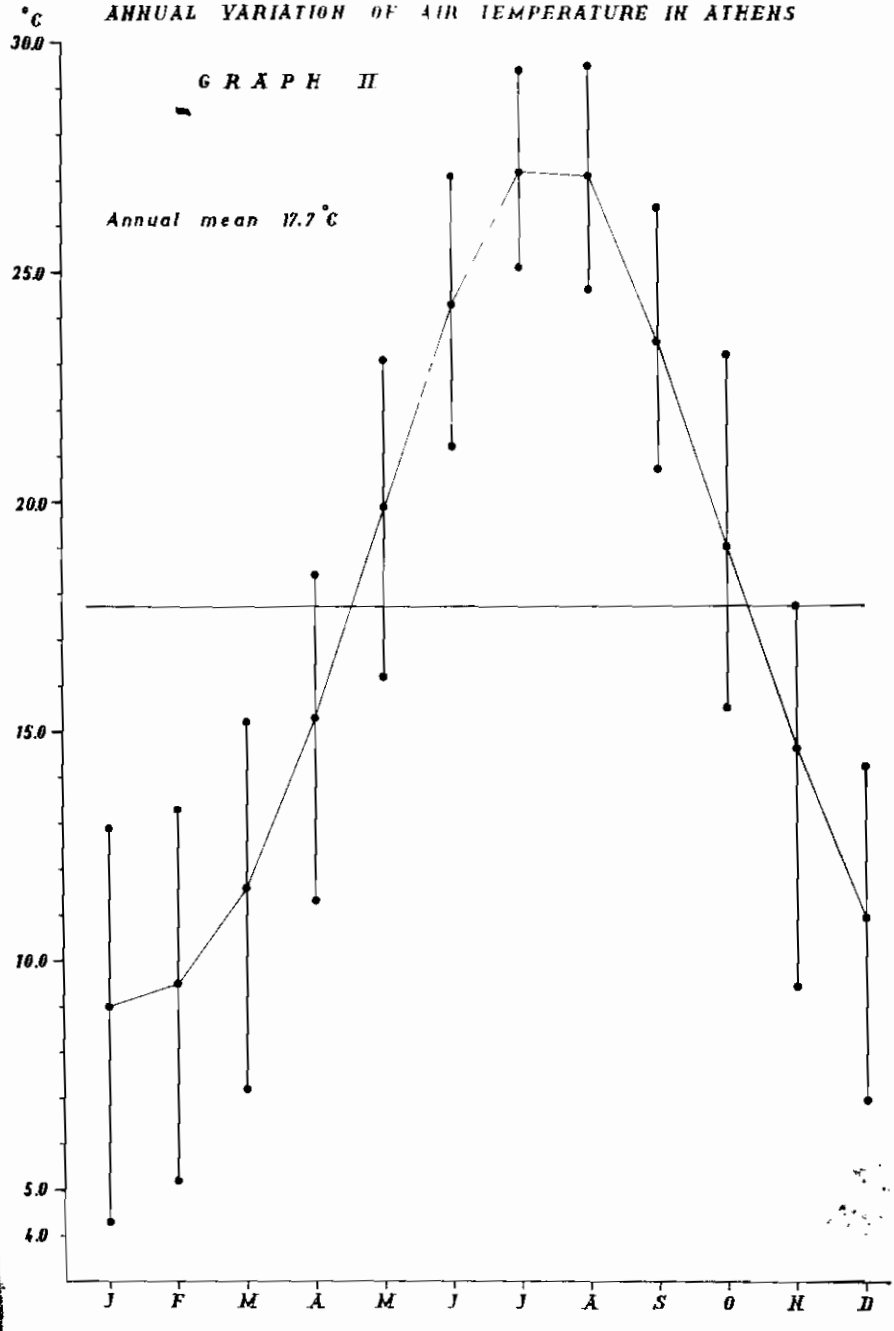
GRAPH I

VARIATION OF THE MEAN ANNUAL AIR TEMPERATURE

a = mean annual values

b = 5-year running mean

c = straight line



examined, in 58 cases (50.4 %) the maximum was recorded in July, and in 52 cases (45.2 %) it was recorded in August, while there are another 5 cases (4.3 %) in which the same maximum of the year was recorded in July and August too.

January can be considered the coldest mouth, with 55 cases (47.8 %) in 115 years, followed by February with 38 cases (33.0 %), December with 17 cases (14.8 %), and March with 2 (1.7 %). We also have two cases (1.7 %) in which the same minimum of the year was recorded in January and December, and one case (0.9 %) in which it was recorded in February and March.

It is worth noting that the absolute maximum of the period examined, (42.6 °C) has been recorded in August (1952) (Table IV), while

TABLE IV

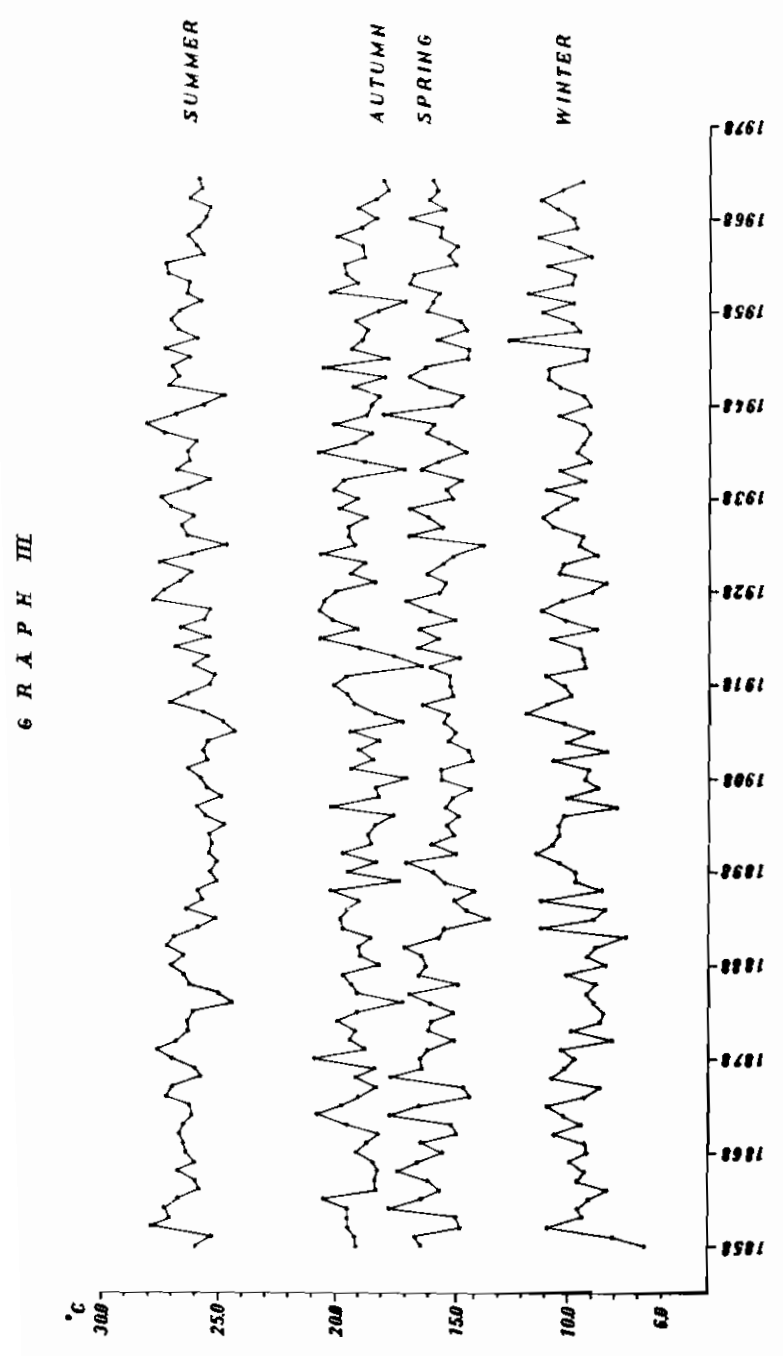
Absolute Thermometric Data of Athens (1858 - 1972)

Month	Abs. Max.	Date	Abs. Min.	Date	Abs. Temp. Range
J	21.5	3/1962	—6.5	26/1898	28.0
F	23.1	13/1861	—6.3	2/1882	29.4
M	28.4	31/1862	—6.9	15/1880	35.3
A	33.0	30/1860	—0.3	6/1943	33.3
M	38.1	18/1862	5.7	9/1886	32.4
J	43.0	21/1916	12.1	6/1858	30.9
J	42.3	24/1934	16.0	12/1949	26.3
A	42.6	22/1952	15.1	6/1860	27.5
S	38.6	1/1902	8.7	27/1875	29.9
O	36.5	3/1932	3.6	22/1866	32.9
N	30.5	1/1895	—1.1	26/1948	31.6
D	22.9	1/1930	—4.5	20/1858	26.7
Mean					30.4

the absolute minimum (—6.9 °C) was recorded in March (1880). Thus the absolute range of air temperature in the city of Athens is 49.5 °C.

The monthly range of variation (Table III) has its greatest values during the winter months, its highest values being 8.6 °C for January, with that of November (8.3°) coming next; its smallest values are recorded during the summer months, with its minimum in July (4.3 °C) and a second minimum in August (4.9 °C).

The annual temperature range in the area examined, varies between 15.3 °C (1955) to 23.6 °C (1858), its arithmetic mean being 19.3 °C. Thus, according to Gorczynski's classification, the climate of Athens may be defined as m a r i t i m e t e m p e r a t e.



The mean temperature values of the autumn, as shown by Graph III, are always higher than the corresponding values of the spring, their difference varying from 0.2 °C (1920), to 6.4 °C (1893, 1943). In most cases, it has been observed that, warm winters are followed by cool summers, and vice versa.

Standard deviation (σ) has its smallest values (0.88 and 1.01 respectively) in the main summer months of July and August (Table III). In these same months also the coefficient of variation (C.V.) has its minima, with 3.23 % and 3.73 % respectively. The maxima of σ (1.74 and 1.70) coincide with the C.V. maxima (19.37 % and 17.83 %) during the main winter months: January and February respectively.

The amount of monthly mean temperature values, that is 1377 (99.78 %) out of a total 1380, occupy the grade hetween mean $\pm 3\sigma$, and only 3 cases (0.22 %) are not included in this interval. These three exceptional cases are: April 1870, October 1932, and November 1920. The first and third case have values below -3σ and the second above $+3\sigma$. An examination of the other meteorological elements of these months, proved that:

— The small value of April 1870 is due to the great number of rain days (17 days). It is worth noting that on the 6th of that month a snow - fall occured in Athens, which is a most unusual event.

— The small value of November 1920 is also due to the same reason as above (11 rain days).

— The exceptional value of October 1932, was produced by exactly opposite reasons, that is from its dryness. As a matter of fact only 4 rain days were recorded on that month, with 1.15^h duration, and a total rainfall of 4.9 mm, while cloudiness was very small during the whole month.

From Table V containing the frequency distribution of monthly mean temperature values, and from Histogram 1, we find that the months of July and August have the smallest variation (5 - 6 °C), while all months from October to April have larger variations in their mean values (9 °C).

If we consider the absolute difference of each month from its previous, that is:

D - J	J - F	F - M	M - A	A - M	M - J	J - J	J - A	A - S	S - O	O - N	N - D
1.9	0.5	1.9	3.7	4.6	5.4	2.9	0.1	3.6	4.5	4.4	3.7

we observe that months that have great thermometric similarities are the main winter months of Jannary and February, and the main summer

TABLE V

Frequency distribution of monthly mean values of air temperature in Athens (°C) (1858 - 1972)

	J	F	M	A	M	J	J	A	S	O	N	D		%
29.0 - 29.9							1	4					5	0.4
28.0 - 28.9							24	18					42	3.0
27.0 - 27.9						2	48	42					92	6.7
26.0 - 26.9						8	30	36	3				77	5.6
25.0 - 25.9						24	12	12	11				59	4.3
24.0 - 24.9						37		3	31				71	5.1
23.0 - 23.9					2	31			29	1			64	4.6
22.0 - 22.9					5	11			24	1			41	3.0
21.0 - 21.9					20	1			15	8			44	3.2
20.0 - 20.9					30				2	19			51	3.7
19.0 - 19.9					27					33			60	4.3
18.0 - 18.9				1	26					28			55	4.0
17.0 - 17.9				10	4					17	6		37	2.7
16.0 - 16.9				29	1					6	13		49	3.6
15.0 - 15.9			1	29						2	26		58	4.2
14.0 - 14.9			6	31							35	1	73	5.3
13.0 - 13.9		3	16	11							19	8	57	4.1
12.0 - 12.9	5	3	26	3							9	21	67	4.9
11.0 - 11.9	12	21	30	1							5	27	96	7.0
10.0 - 10.9	19	25	21								1	23	89	6.4
9.0 - 9.9	23	21	9								1	25	79	5.7
8.0 - 8.9	25	19	4									7	55	4.0
7.0 - 7.9	18	17	2									2	39	2.8
6.0 - 6.9	7	3										1	11	0.8
5.0 - 5.9	4	3											7	0.5
4.0 - 4.9	2												2	0.1
	115	115	115	115	115	115	115	115	115	115	115	115	1380	

months of July and August. The greatest differences are observed between the transitory months of April and May, and also September and October.

The examination of mean maxima and mean minima of air temperature, yield the following straight lines (resulting from the method of least squares):

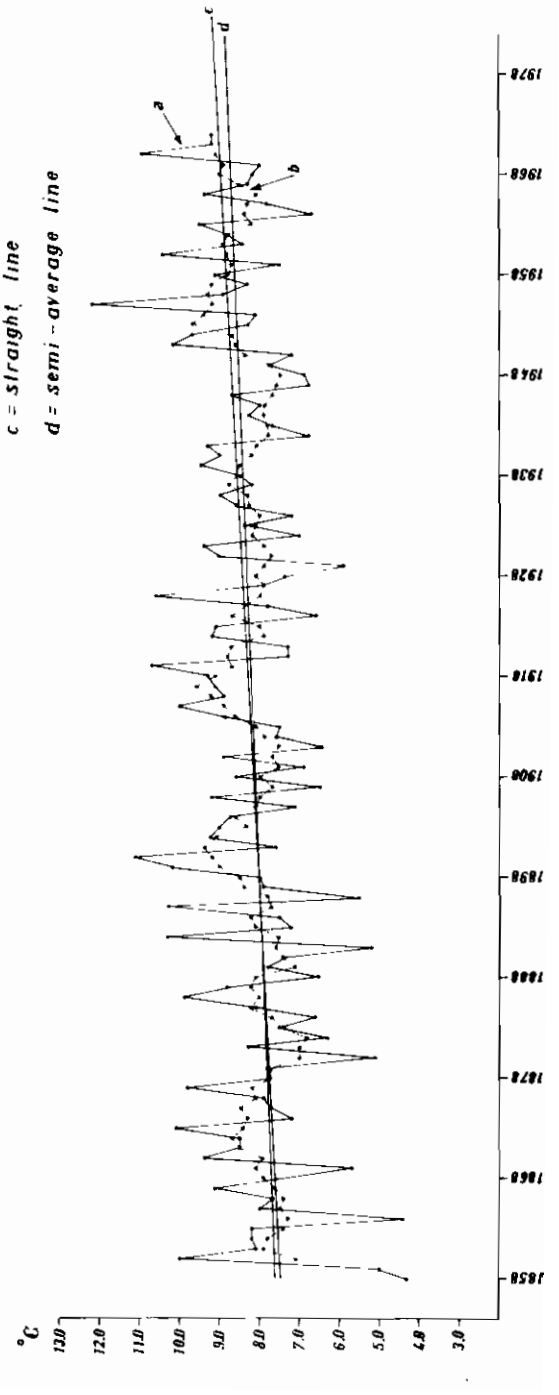
$$x_{max} = 27.421 + 0.002t$$
$$x_{min} = 7.552 + 0.011t$$

where t the order of each value. The straight lines resulting from these two equations illustrate the ascending trend of maximum as well as minimum values (Graph IVa and IVb). Comparison of these two Graphs shows that their lines are almost parallel, meaning that there must exist

GRAPH IV_a

VARIATION OF MEAN MINIMUM VALUES OF AIR TEMPERATURE

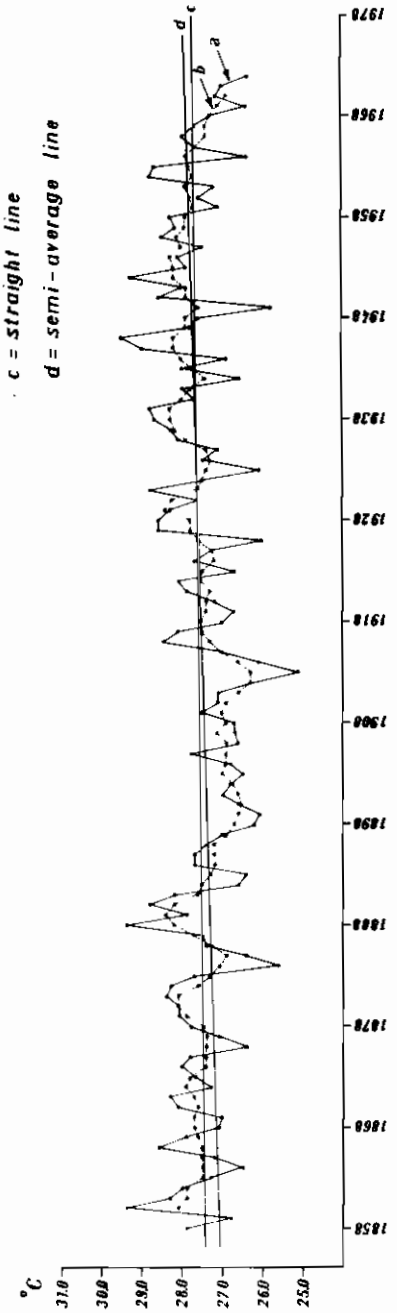
a = mean monthly values
b = 5 - year running mean
c = straight line
d = semi - average line



GRAPH IV$_b$

VARIATION OF MEAN MAXIMUM VALUES OF AIR TEMPERATURE

a = mean monthly values
b = 5 - year running mean
c = straight line
d = semi-average line



a certain simultaneous increase of air temperature, which could be attributed mainly to the expansion of the city (urbanization). To the same conclusion, about the increase of temperature, leads the study of straight lines, calculated according to the semiaverage method.

Also the annual mean values of air temperature show the same ascending trend, as we conclude from its straight equation line:

$$\bar{x} = 17.593 + 0.001\,t$$

CONCLUSIONS.

The study of air temperature in Athens, for the period between 1858 - 1972, has led us to the following conclusions:

The annual course of air temperature has a single fluctuation, with a maximum in July and a minimum in January, although the absolute maximum and the absolute minimum of the period examined have been recorded in August and March respectively.

Almost the whole amount of monthly mean values stand in the grade between mean $\pm 3\sigma$. The three in all exceptional cases, had mean values outside this interval, because of the particular rainfall conditions that prevailed during the months they were recorded.

Mean maximum and minimum, as well as mean annual values of air temperature show a small ascending trend, that could be attributed mainly to the expansion of the city; of all these, the mean minimum values have the greatest increase.

According to Gorczynski's climate classification, the climate of Athens may be defined as maritime temperate (annual temperature range: 19.3° C).

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APPENDIX NO 1

Monthly mean air temperature values in Athens, in degrees Celsius (1858 - 1972)

	J	F	M	A	M	J	J	A	S	O	N	D	Year
1858	4.3	5.3	12.2	15.7	21.0	23.6	27.0	26.6	21.6	20.0	15.6	10.4	17.1
1859	5.0	8.0	11.7	16.4	21.5	23.5	25.8	26.7	22.4	21.1	14.2	11.3	17.3
1860	10.4	10.0	11.8	17.7	20.3	26.8	27.5	29.4	26.1	19.7	12.6	12.3	18.7
1861	8.1	11.9	11.6	14.9	18.0	25.5	28.3	27.5	24.5	17.5	16.4	8.1	17.7
1862	9.5	11.2	13.0	18.4	21.7	26.2	28.0	27.7	24.7	18.8	15.1	8.2	18.6
1863	10.1	8.2	12.5	14.2	22.1	25.4	27.3	27.3	25.7	20.2	15.6	9.0	18.1
1864	4.4	10.6	14.8	12.9	18.7	24.8	26.5	26.1	22.2	17.8	14.7	9.8	16.9
1865	11.3	9.5	12.6	15.0	20.3	23.8	27.0	27.2	21.1	20.2	13.7	8.0	17.5
1866	7.7	11.0	14.7	17.0	20.1	24.7	28.6	26.9	24.3	17.0	13.4	9.1	17.9
1867	10.5	10.2	12.1	16.6	20.7	23.9	27.9	26.2	24.1	19.2	11.8	9.1	17.7
1868	9.5	7.6	10.3	14.6	21.3	25.3	26.8	27.1	24.1	20.5	12.8	10.5	17.6
1869	5.7	10.7	12.1	14.1	22.7	26.0	26.6	27.0	23.1	18.4	14.5	11.4	17.7
1870	9.8	9.4	11.2	11.3	21.9	25.0	28.1	27.1	21.1	17.2	16.3	12.6	17.6
1871	10.7	8.9	10.3	15.3	19.3	23.8	28.3	27.5	24.2	18.7	15.6	8.5	17.6
1872	9.6	8.5	13.4	16.7	22.6	24.2	26.9	27.3	25.6	21.1	15.8	12.6	18.7
1873	12.1	10.6	13.4	16.6	19.3	23.4	27.7	27.6	23.8	20.3	15.1	10.1	18.3
1874	7.9	7.2	7.2	17.1	18.3	26.3	28.0	27.4	24.2	19.1	13.6	12.7	17.5
1875	7.7	8.6	8.8	14.3	20.3	26.7	27.8	26.5	21.0	19.1	14.6	9.5	17.1
1876	7.9	11.0	14.1	16.8	21.9	24.5	26.3	26.4	24.5	19.9	13.0	13.2	18.3
1877	9.8	10.0	11.7	17.2	19.9	24.3	27.1	26.7	24.8	17.3	12.8	10.5	17.8
1878	7.7	8.3	11.1	16.3	21.5	25.4	27.8	27.8	25.0	20.6	17.0	13.1	18.5
1879	10.0	13.2	12.1	16.6	19.3	27.0	28.1	27.7	24.8	18.0	13.4	7.8	18.2
1880	5.1	8.5	8.7	15.7	20.2	25.9	28.1	26.5	22.7	20.0	15.5	10.7	17.3
1881	11.6	8.3	12.5	16.4	19.1	23.5	26.9	28.4	24.6	19.1	13.7	9.7	17.8
1882	7.7	6.3	13.5	14.0	20.2	23.8	28.3	26.7	25.0	18.9	15.9	11.9	17.8
1883	8.8	7.5	10.6	14.3	19.8	24.7	27.7	25.9	23.7	19.0	14.4	9.2	17.2
1884	6.6	8.1	11.2	16.5	20.1	23.0	25.6	24.6	21.5	18.4	11.5	12.1	16.7
1885	8.1	10.0	12.9	16.4	21.1	22.8	25.8	26.4	23.2	19.5	14.7	9.5	17.6
1886	11.4	9.9	10.4	15.1	18.7	24.3	26.9	27.4	24.0	19.4	14.5	14.1	18.0
1887	8.8	9.5	13.1	14.1	22.0	24.6	27.5	27.5	24.5	20.1	14.6	12.1	18.3
1888	6.5	9.0	12.7	16.6	19.1	24.9	29.4	26.6	23.6	18.2	12.4	9.4	17.4
1889	7.8	11.4	12.5	15.9	20.4	24.2	27.9	27.5	22.7	20.8	13.2	8.4	17.8
1890	8.7	7.4	13.2	16.2	21.5	24.3	28.5	28.8	24.0	18.6	14.5	10.2	17.7
1891	7.5	5.2	12.4	14.6	19.8	25.1	27.3	28.2	22.7	18.5	14.2	9.8	17.2
1892	10.6	10.3	12.1	14.4	19.5	25.0	26.2	26.6	25.0	21.0	13.2	12.8	18.1
1893	7.2	9.1	9.6	12.0	18.5	23.2	26.4	25.8	23.4	19.8	16.3	10.5	16.9
1894	7.5	7.7	10.6	13.5	19.1	24.4	27.7	27.1	23.8	22.0	12.8	10.0	17.2
1895	11.9	10.3	10.9	15.0	18.7	23.2	27.7	26.1	22.0	19.6	15.4	11.3	17.7
1896	5.5	7.9	12.1	12.0	17.9	23.7	26.7	27.4	23.6	21.0	16.1	12.0	17.2
1897	10.4	10.8	12.6	15.2	18.1	22.3	27.0	26.0	24.9	16.8	10.2	7.9	16.9
1898	8.0	9.9	11.4	16.1	19.8	24.6	26.2	25.4	22.7	20.4	15.4	11.1	17.6
1899	10.4	10.2	12.1	15.1	20.8	23.0	26.1	26.1	23.5	17.8	13.6	10.7	17.5
1900	11.1	11.6	10.7	15.0	18.8	23.2	26.6	26.4	21.9	21.4	15.7	11.4	17.9

1901	7.6	11.5	14.0	15.3	18.5	22.5	27.0	26.3	23.1	18.9	13.5	12.7	17.6
1902	10.0	11.9	11.1	14.9	18.7	23.2	26.3	26.8	24.0	20.2	11.7	9.2	17.3
1903	9.0	9.9	11.5	14.5	19.5	22.2	25.6	26.5	22.2	18.7	13.9	12.2	17.2
1904	8.7	12.4	10.3	14.5	19.2	23.6	26.8	26.4	21.9	19.0	11.6	9.6	17.0
1905	7.1	7.2	10.5	15.1	20.2	22.7	27.3	27.8	24.6	19.2	16.7	9.4	17.3
1906	9.2	10.2	13.0	14.3	17.7	22.7	26.6	25.5	22.6	17.4	14.4	10.8	17.0
1907	6.5	8.3	7.7	13.5	21.3	23.6	26.7	26.2	21.5	20.0	13.4	11.4	16.7
1908	8.6	9.6	10.8	13.8	21.9	24.4	26.2	26.7	21.7	16.8	12.3	9.6	16.9
1909	7.3	6.9	12.3	15.2	19.1	24.6	27.5	26.9	24.6	18.5	15.2	13.0	17.6
1910	8.9	11.2	9.4	14.8	18.2	23.0	26.4	27.1	22.9	18.1	14.3	11.9	17.2
1911	8.0	6.4	10.3	14.0	18.5	24.1	25.9	27.1	22.9	19.0	15.2	10.6	16.8
1912	7.6	11.2	13.0	13.9	18.8	24.4	25.9	26.3	22.3	17.5	14.4	11.5	17.2
1913	9.2	7.5	11.7	15.0	18.0	23.0	25.1	24.9	25.1	18.8	14.1	10.1	16.9
1914	8.9	10.1	12.7	15.1	18.5	22.5	25.8	26.1	21.8	16.8	12.6	11.6	16.9
1915	12.2	10.0	12.0	14.7	18.8	23.9	27.0	26.3	21.4	19.1	14.5	13.4	17.8
1916	8.9	10.2	13.4	15.1	20.3	27.1	28.5	25.7	22.1	19.6	15.9	13.7	18.4
1917	11.2	9.3	12.3	14.8	17.8	23.7	27.3	28.1	23.7	19.5	15.3	9.1	17.7
1918	9.9	9.3	10.0	15.4	19.9	22.9	27.0	26.3	25.4	20.7	14.2	11.5	17.7
1919	11.2	11.1	13.2	16.0	16.2	23.2	26.7	25.8	23.3	19.7	15.7	10.7	17.3
1920	10.2	7.3	12.0	16.4	19.6	24.0	27.2	27.1	22.9	16.3	9.4	10.4	16.9
1921	10.5	7.3	9.9	13.6	20.5	21.2	27.5	27.9	22.0	17.1	13.3	10.5	16.8
1922	9.2	9.7	14.1	16.0	19.5	24.9	27.8	28.1	24.1	20.5	12.3	9.6	18.0
1923	9.1	10.7	11.8	14.7	20.4	23.0	26.6	26.7	24.5	19.9	17.7	12.6	18.1
1924	6.6	9.8	11.1	17.1	20.9	25.1	27.7	27.3	25.7	18.5	13.1	9.9	17.7
1925	7.8	11.3	11.6	14.3	18.8	22.5	26.9	27.3	24.5	19.4	16.6	11.6	17.7
1926	10.6	11.4	11.9	16.1	19.9	24.6	26.0	25.5	23.9	20.5	17.7	11.6	18.3
1927	10.7	7.8	13.8	16.0	21.3	26.4	28.5	28.6	25.6	19.5	16.5	12.3	18.9
1928	10.0	7.4	9.5	17.2	20.1	25.3	28.4	28.6	25.1	18.7	16.3	9.5	18.0
1929	7.8	5.9	9.3	14.5	22.0	24.9	27.0	28.3	20.8	18.3	15.8	11.6	17.2
1930	9.5	9.0	13.0	16.3	19.0	23.7	27.6	27.3	24.1	18.9	15.3	12.7	18.0
1931	11.3	9.9	12.5	13.9	19.9	25.7	28.8	28.4	24.0	18.8	13.5	9.4	18.0
1932	8.0	7.0	10.3	15.1	19.6	24.3	27.5	26.8	25.1	23.2	13.8	11.5	17.7
1933	8.4	10.3	9.8	13.4	17.8	22.4	25.7	26.1	21.4	19.3	17.0	10.2	16.8
1934	9.1	7.2	13.3	16.8	20.6	24.4	27.4	27.5	23.4	19.2	15.9	11.8	18.1
1935	8.6	10.4	10.2	15.8	20.2	25.7	27.1	27.1	23.5	20.9	14.1	13.1	18.1
1936	12.9	11.3	13.0	16.9	18.5	23.1	28.1	27.1	22.8	19.1	14.2	9.0	18.0
1937	8.2	11.6	14.5	15.9	20.2	25.3	28.3	27.6	24.9	19.0	15.7	11.7	18.6
1938	9.2	8.5	11.2	13.9	19.8	25.6	28.7	28.2	22.8	19.9	14.5	11.5	17.8
1939	11.4	9.5	10.2	16.2	19.5	22.9	28.8	27.1	24.0	21.5	14.7	12.0	18.2
1940	8.0	10.3	11.1	14.7	18.0	23.1	27.7	25.3	23.2	20.1	15.9	9.7	17.3
1941	11.0	12.2	12.2	16.6	20.1	24.6	28.0	27.7	20.7	17.8	12.9	8.3	17.7
1942	6.8	10.0	10.7	14.9	21.2	25.9	26.6	26.3	24.5	18.3	13.5	10.6	17.4
1943	7.7	9.5	9.0	15.0	19.1	23.9	27.4	28.0	24.9	20.1	17.5	12.0	17.8
1944	8.3	10.1	10.8	15.9	19.0	25.1	26.9	25.9	23.6	19.5	14.6	9.9	17.5
1945	8.3	8.0	10.5	14.7	23.1	25.2	28.1	29.0	23.9	17.7	14.0	11.1	17.8
1946	8.7	9.3	11.2	15.6	20.6	26.2	28.5	29.5	26.0	18.0	16.4	10.1	18.3
1947	6.8	11.6	15.2	17.7	21.0	25.2	27.8	27.7	23.6	17.6	14.9	12.8	18.5
1948	12.2	8.2	9.9	15.0	20.5	23.1	26.4	27.6	22.9	19.4	13.2	6.9	17.1

1949	8.6	7.8	9.0	14.0	20.7	23.7	25.8	24.8	21.5	17.5	15.4	11.7	16.7
1950	7.2	10.5	11.2	16.8	20.0	25.3	28.6	27.6	24.8	18.3	14.7	13.4	18.2
1951	10.8	11.6	13.2	16.4	21.0	24.9	27.4	28.0	23.6	15.5	14.6	10.2	18.1
1952	10.0	9.7	11.2	17.3	20.1	24.8	27.0	29.3	26.4	20.1	15.4	12.9	18.7
1953	9.1	10.5	8.7	15.8	18.6	24.3	27.9	26.8	23.5	18.2	11.6	8.3	16.9
1954	8.1	8.5	11.7	13.0	18.1	26.1	28.1	27.6	24.8	19.1	14.4	11.0	17.5
1955	12.2	13.3	12.6	13.3	21.1	24.8	27.5	25.8	23.0	19.5	14.1	12.0	18.3
1956	10.3	8.9	8.1	15.5	19.6	24.3	27.7	28.5	23.1	18.4	14.7	9.7	17.4
1957	8.3	11.4	11.0	14.9	18.3	25.8	27.4	28.2	23.6	19.6	14.4	9.9	17.7
1958	9.1	12.1	11.8	14.7	21.8	24.4	27.6	28.3	21.8	18.4	14.3	12.4	18.1
1959	9.1	7.5	12.5	15.0	20.1	23.5	26.8	27.1	21.6	15.6	13.7	12.8	17.1
1960	10.4	10.8	10.9	15.1	20.7	24.4	27.2	27.6	22.5	21.1	17.2	14.2	18.5
1961	9.6	8.4	12.8	17.5	20.5	24.8	27.0	27.2	22.5	18.1	16.6	11.6	18.1
1962	10.5	8.8	13.0	16.0	21.2	25.1	27.6	28.8	23.9	18.3	16.5	10.2	18.3
1963	9.5	11.2	10.8	15.1	18.9	25.1	28.0	28.7	24.7	18.2	16.2	11.9	18.2
1964	6.7	8.4	11.5	14.9	19.1	24.6	26.4	26.0	22.0	19.4	15.0	11.8	17.2
1965	9.6	7.8	11.5	14.1	18.7	25.0	27.7	25.3	24.0	17.3	15.4	12.6	17.4
1966	9.4	13.0	11.5	16.5	18.7	23.8	27.5	28.0	22.6	21.4	16.1	11.5	18.3
1967	9.0	8.3	11.4	14.8	20.3	23.3	26.6	27.7	23.3	19.0	14.4	11.9	17.5
1968	8.2	10.7	11.0	16.7	23.0	24.0	27.4	25.5	23.2	17.4	14.3	10.5	17.7
1969	8.0	11.5	10.8	13.5	21.6	24.5	25.3	26.4	23.9	17.4	15.9	11.9	17.6
1970	11.2	11.6	12.3	17.0	18.6	24.6	27.0	27.2	22.9	17.4	14.7	10.9	18.0
1971	11.1	9.2	11.3	14.5	21.3	24.9	25.6	27.0	22.2	16.8	14.4	10.5	17.4
1972	9.2	9.4	11.5	16.0	20.3	25.2	26.0	26.4	23.2	16.4	14.4	9.6	17.3

APPENDIX NO 2

Monthly mean air temperature values in Athens, in absolute degrees (K)
(1858 - 1972)

	J	F	M	A	M	J	J	A	S	O	N	D	Year
1858	277	278	285	289	294	297	301	300	295	293	289	283	290
1859	278	281	285	289	295	297	299	300	295	294	287	284	290
1860	283	283	285	291	293	300	301	302	299	293	286	285	292
1861	281	285	285	288	291	299	301	301	298	291	289	281	291
1862	283	284	286	291	295	299	301	301	298	292	288	281	292
1863	283	281	286	287	295	298	300	300	299	293	289	282	291
1864	277	284	288	286	292	298	300	299	295	291	288	283	290
1865	284	283	286	288	293	297	300	300	294	293	287	281	291
1866	281	284	288	290	293	298	302	300	297	290	287	282	291
1867	284	283	285	290	294	297	301	299	297	292	285	282	291
1868	283	281	283	288	294	298	300	300	297	294	286	284	291
1869	279	284	285	287	296	299	300	300	296	291	288	284	291
1870	283	282	284	284	295	298	301	300	294	290	289	286	291
1871	284	282	283	288	292	297	301	301	297	292	289	282	291
1872	283	282	286	290	296	297	300	300	299	294	289	286	292
1873	285	284	286	290	292	296	301	301	297	293	288	283	291
1874	281	280	280	290	291	299	301	300	297	292	287	286	291
1975	281	282	281	287	293	300	301	300	294	292	288	283	290
1876	281	284	287	290	295	298	299	299	298	293	286	286	291
1877	283	283	285	290	293	297	300	300	298	290	286	284	291
1878	281	281	284	289	295	298	301	301	298	294	290	286	292
1879	283	286	285	290	292	300	301	301	298	291	286	281	291
1880	278	282	282	289	293	299	301	300	296	293	289	284	290
1881	285	281	286	289	292	297	300	301	298	292	287	283	291
1882	281	279	287	287	293	297	301	300	298	292	289	285	291
1883	282	281	284	287	293	298	301	299	297	292	287	281	290
1884	280	281	284	290	293	296	299	298	295	291	285	285	290
1885	281	282	286	289	294	296	299	299	296	293	288	283	291
1886	284	283	283	288	292	297	300	300	297	292	288	286	291
1887	282	283	286	287	295	298	301	301	298	293	288	285	291
1888	280	282	286	290	292	298	302	300	297	291	285	282	290
1889	281	284	286	289	293	297	301	301	296	294	286	281	291
1890	282	280	286	289	295	297	302	302	297	292	288	283	291
1891	281	278	285	288	293	298	300	301	296	292	287	283	290
1892	284	283	285	287	293	298	299	300	298	294	286	286	291
1893	280	282	283	285	292	296	299	299	296	293	289	284	290
1894	281	281	284	287	292	297	301	300	297	295	286	283	290
1895	285	283	284	288	292	296	301	299	295	293	288	284	291
1896	279	281	285	285	291	297	300	300	297	294	289	285	290
1897	283	284	286	288	291	295	300	299	298	290	283	281	290
1898	281	283	284	289	293	298	299	298	296	293	288	284	291
1899	283	283	285	288	294	296	299	299	297	291	287	284	291
1900	284	285	284	288	292	296	300	299	295	294	289	284	291

1901	281	285	287	288	292	296	300	299	296	292	287	286	291
1902	283	285	284	288	292	296	299	300	297	293	285	282	290
1903	282	283	285	288	293	295	299	300	295	292	287	285	290
1904	282	285	283	288	292	297	300	299	295	292	285	283	290
1905	280	280	284	288	293	296	300	301	298	292	290	282	290
1906	282	283	286	287	291	296	300	299	296	290	287	284	290
1907	280	281	281	287	294	297	300	299	295	293	286	284	290
1908	282	283	284	287	295	297	299	300	295	290	285	283	290
1909	280	280	285	288	292	298	301	300	298	292	288	286	291
1910	282	284	283	288	291	296	299	300	296	291	287	285	290
1911	281	279	283	287	292	297	299	300	296	292	288	284	290
1912	281	284	286	287	292	297	299	299	295	291	287	285	290
1913	282	281	285	288	291	296	298	298	298	292	287	283	290
1914	282	283	286	288	292	296	299	299	295	299	286	285	290
1915	285	283	285	288	292	297	300	299	294	292	288	286	291
1916	282	283	286	288	293	300	302	299	295	293	289	287	291
1917	284	282	285	288	291	297	300	301	297	293	288	281	291
1918	284	282	283	288	293	296	300	299	298	294	287	285	291
1919	284	284	286	289	289	296	300	299	296	293	289	284	290
1920	283	280	285	289	293	297	300	300	296	289	282	283	290
1921	284	280	283	287	294	294	301	301	295	290	286	284	290
1922	282	283	287	289	293	298	301	301	297	294	285	283	291
1923	282	284	285	288	293	296	300	300	298	293	291	286	291
1924	280	283	284	290	294	298	301	300	299	292	286	283	291
1925	281	284	285	287	292	296	300	300	298	292	290	285	291
1926	284	284	285	289	293	298	299	299	297	294	291	285	291
1927	284	281	287	289	294	299	302	302	299	293	290	285	292
1928	283	280	283	290	293	298	301	302	298	292	289	283	291
1929	281	279	282	288	295	298	300	301	294	291	289	285	290
1930	283	282	286	289	292	297	301	300	297	292	288	286	291
1931	284	283	286	287	293	299	302	301	297	292	287	282	291
1932	281	280	283	288	293	297	301	300	298	296	287	285	291
1933	281	283	283	286	291	295	299	299	294	292	290	283	290
1934	282	280	286	290	294	297	300	301	296	292	289	285	291
1935	282	283	283	289	293	299	300	300	297	294	287	286	291
1936	286	284	286	290	292	296	301	300	296	292	287	282	291
1937	281	285	288	289	293	298	301	301	298	292	289	285	292
1938	282	282	284	287	293	299	302	301	296	293	288	285	291
1939	284	283	283	289	293	296	302	300	297	295	288	295	291
1940	281	283	284	288	291	296	301	298	296	293	289	283	290
1941	284	285	285	290	293	298	301	301	294	291	286	281	291
1942	280	283	284	288	294	299	300	299	298	291	287	284	290
1943	281	283	282	288	292	297	300	301	298	293	291	285	291
1944	281	283	284	289	292	298	300	299	297	293	288	283	291
1945	281	281	284	288	296	298	301	302	297	291	287	284	291
1946	282	282	284	289	294	299	302	303	299	291	289	283	291
1947	280	285	288	291	294	298	301	301	297	291	288	286	292
1948	285	281	283	288	294	296	299	301	296	292	286	280	290

1949	282	281	282	287	294	297	299	298	295	291	288	285	290
1950	280	284	284	290	293	298	302	301	298	291	288	286	291
1951	284	285	286	289	294	298	300	301	297	289	288	283	291
1952	283	283	284	290	293	298	300	302	299	293	288	286	292
1953	282	284	282	289	292	297	301	300	297	291	285	281	290
1954	281	282	285	286	291	299	301	301	298	292	287	284	291
1955	285	286	286	286	294	298	301	299	296	293	287	285	291
1956	283	282	281	289	293	297	301	302	296	291	288	283	290
1957	281	284	284	288	291	299	300	301	297	293	287	283	291
1958	282	285	285	288	295	297	301	301	295	291	287	285	291
1959	282	281	286	288	293	297	300	300	295	289	287	286	290
1960	283	284	284	288	294	297	300	301	296	294	290	287	292
1961	283	281	286	291	294	298	300	300	296	291	290	285	291
1962	284	282	286	289	294	298	301	302	297	291	290	283	291
1963	283	284	284	288	292	298	301	302	298	291	289	285	291
1964	280	281	285	288	292	298	299	299	295	292	288	285	290
1965	283	281	285	287	292	298	301	298	297	290	288	286	290
1966	282	286	285	290	292	297	301	301	296	294	289	285	291
1967	282	281	284	288	293	296	300	301	296	292	287	285	291
1968	281	284	284	290	296	297	300	299	296	290	287	284	291
1969	281	285	284	287	295	298	298	299	297	290	289	285	291
1970	284	285	285	290	292	298	300	300	296	290	288	284	291
1971	284	282	284	288	294	298	299	300	295	290	287	284	290
1972	282	282	285	289	293	298	299	299	296	289	287	283	290

ΠΕΡΙ ΤΗΣ ΕΤΗΣΙΑΣ ΠΟΡΕΙΑΣ ΤΗΣ ΘΕΡΜΟΚΡΑΣΙΑΣ ΤΟΥ ΑΕΡΟΣ ΕΝ ΑΘΗΝΑΙΣ

Ὑπὸ

ΑΓΓΕΛΙΚΗΣ ΑΡΣΕΝΗ - ΠΑΠΑΔΗΜΗΤΡΙΟΥ

(Ἐργαστήριον Μετεωρολογίας-Κλιματολογίας, Πανεπιστημίου Θεσσαλονίκης)

ΠΕΡΙΛΗΨΙΣ

Εἰς τὴν παροῦσαν ἐργασίαν μελετᾶται ἡ ἐτησία πορεία τῆς θερμοκρασίας τοῦ ἀέρος εἰς τὴν πόλιν τῶν Ἀθηνῶν, καὶ διὰ τὸ χρονικὸν διάστημα 1858 - 1972, ἤτοι περίοδον 115 πλήρων καὶ συνεχῶν ἐτῶν.

Ἡ μελέτη γίνεται διὰ τῶν μέσων μηνιαίων τιμῶν τῆς θερμοκρασίας.

Ὡς προκύπτει, αἱ μέσαι θερμοκρασίαι παρουσιάζουν τάσιν ἀνόδου, ἀποδιδομένην εἰς τὴν ἐξάπλωσιν τῆς πόλεως.