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CONTRIBUTION TO THE STUDY OF AIR TEMPERATURE IN THESSALONIKI
(1946 - 1973)

By

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Abstract : *Monthly mean, daily mean, and hourly values of air temperature are studied for the city of Thessaloniki and the period between the years 1946-1973.*

Tropical days, as well as partial-and total-frost-days are examined separately and their percentage per month is established.

Finally are examined temperatures that are favorable or unfavorable for plant growth.

INTRODUCTION

Air temperature in various districts of Greece has been the subject of a number of scientists like AEGINITIS [1,2], ALEXANDROU [3,4], EREDIA [7], PH. KARAPIPERIS [10,11], MARIOLOPOULOS [17], L. KARAPIPERIS, LIVADAS [14], FLOCAS [8], ARSENI - PAPADIMITRIOU [8] and others.

In the present paper we undertake a more detailed statistical study of air temperature in the city of Thessaloniki, in view of the importance of this element for Meteorology, Argiculture, Technology, and in every-day life in general. The study is based on hourly, daily mean, and monthly mean values of air temperature between the years 1946 - 1973, because during this period the weather station of the Aristotelian University of Thessaloniki has been continuously in operation, without any interruption.

The shifting of the station by 230 m to the east of its earlier position, that took place on January 1, 1959 produced such changes on the element examined herein, as could be totally disregarded.

All the material used here, has been taken from the records of the Institute of Meteorology and Climatology and from its publications in the series «Observations Météorologiques de Thessaloniki» [19,20].

Mean and Extreme Annual Values of Air Temperature.

Athough data and details on annual mean and monthly mean values of air temperature may be found in a recent study «On the annual variation of air temperature in Thessaloniki» by A. Flocas and A. Arseni - Papadimitriou, and for an even longer interval, (1892 - 1973), it would not be without interest to examine their course during the 1946-1973 period.

Comparison between corresponding values results in differences of the order of one or two tenths.

TABLE I

Mean and extreme annual values of air-temperature.

	1892-1973	1946-1973	Δ
Max.	17.32 (1916)	17.13 (1950)	0.19
Mean	16.18 ± 0.52	16.12 ± 0.53	0.06
Min.	15.02 (1940)	15.23 (1973)	—0.21

Mean and extreme Monthly Values of Air Temperature.

Mean and extreme monthly values of air temperature of the 1946-1973 period and their standard deviation (σ) are given in Table II. These values differ from those published in the aforementioned study, as follows: differences of maximum temperatures are zero in 6 months, less than one unit in 3 months, and equal to one unit in another 3

TABLE II

Mean and Extreme monthly values of air temperature.

	Max	Mean	±σ	Min	Δ(Max-Min)
J	9.41 (1948)	5.80	1.84	3.02 (1954)	6.39
F	11.33 (1955)	7.42	2.01	3.07 (1965)	8.26
M	13.72 (1947)	9.88	1.46	6.26 (1956)	7.46
A	17.36 (1947)	14.76	1.26	12.21 (1955)	5.15
M	22.34 (1958)	19.81	1.25	17.36 (1970)	4.98
J	26.42 (1954)	23.85	0.94	22.29 (1948)	4.13
J	28.25 (1950)	26.31	0.96	24.45 (1969)	3.80
A	28.39 (1952)	26.25	1.13	24.09 (1949)	4.30
S	25.42 (1946)	22.30	1.36	20.20 (1959)	5.22
O	20.39 (1966)	16.76	1.43	13.20 (1972)	7.19
N	14.51 (1960)	12.36	1.28	9.16 (1973)	5.35
D	11.50 (1960)	7.91	1.81	2.95 (1948)	8.55

months. Minimum temperatures again have zero differences in 6 months, equal to one unit in 3 months, and equal to two units in another 3 months. Minimum values of the 1946 - 1973 period, generally appear higher than those of the longer (1892 - 1973) period. Differences between monthly mean temperatures are sometimes positive and sometimes negative, their absolute value in no case exceeding 0.6° C.

Extreme values given in Table III, are very near those already published for Thessaloniki, with two very impressive exceptions: that is the October maximum of the 1946 - 1973 period which appears smaller than the corresponding maximum of the 1892 - 1973 period by 6.5°C, and also the absolute minimum of July (for 1946 - 1973) which is by 4.9° C higher than the corresponding figure of the longer period. Nevertheless the absolute temperature range is again 54,4° C.

TABLE III

Absolute maxima and minima of air temperature in Thessaloniki.

	Max	Date	Min	Date	Δ(Max-Min)
J	19.5	(13/1952)	—12.6	(14/1968)	32.1
F	24.2	(17/1957)	— 8.2	(4/1956)	32.4
M	30.1	(31/1952)	— 4.4	(8 & 9/1952)	34.5
A	32.2	(29/1968)	0.4	(9/1956)	31.8
M	35.8	(23/1973)	7.2	(10 & 11/1957)	28.6
J	38.2	(30/1963)	9.7	(18/1952)	28.5
J	41.8	(19/1973)	12.0	(18/1970)	29.8
A	40.0	(12/1957)&(14/1958)	10.3	(21/1949)	29.7
S	37.4	(13/1950)	8.7	(14/1964)	28.7
O	29.7	(2/1950)	2.2	(31/1971)	27.5
N	25.3	(15/1961)	— 2.8	(28/1953)	28.1
D	21.2	(18/1955)	— 6.6	(1/1957)	27.8

Absolute Thermometric range 54.4°C.

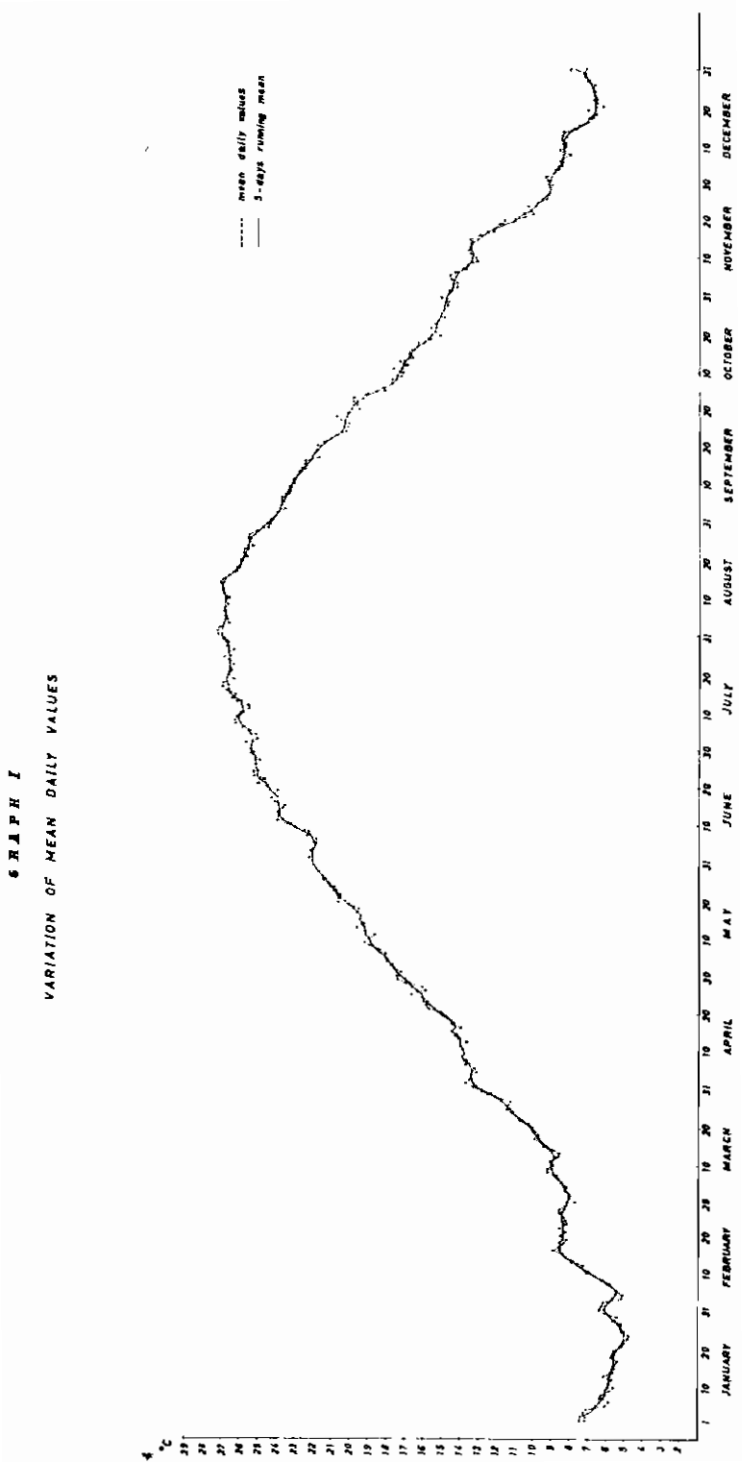
Daily Mean Temperature Values.

The fluctuation of daily mean air temperature values (Table IV, Graph I) has a primary maximum (27.03° C) recorded during the second ten-days of July and a primary minimum (4.74° C) in the last ten-days of January. A secondary minimum occurs during the first ten days of February, which is followed by an increase of temperature. This increase goes on till the first days of April, with a certain lag (delay) towards the end of February. This certain slowness in the increasing pace of temperature, observed during the first fortnight of April, is follow-

TABLE IV

Daily mean values of air temperature in Thessaloniki (1946-1973).

	J	F	M	A	M	J	J	A	S	O	N	D
1	7.15	6.26	7.98	13.71	17.23	22.23	25.43	27.26	24.18	19.78	14.82	9.44
2	7.10	6.17	7.99	13.45	17.64	22.12	25.72	27.17	24.04	19.99	14.38	9.54
3	7.23	5.16	8.22	13.41	17.76	22.15	25.09	26.71	23.71	20.00	14.40	9.13
4	7.05	5.11	8.15	13.08	18.04	21.97	25.21	26.80	23.91	19.29	14.70	8.87
5	6.03	5.39	8.40	13.18	18.16	21.87	25.46	26.82	23.91	18.27	14.80	8.73
6	5.83	5.58	8.58	13.69	18.11	21.81	25.88	26.96	23.89	18.25	14.48	8.78
7	6.36	5.79	8.71	13.64	18.46	22.36	26.33	27.04	23.54	17.81	13.93	8.69
8	6.26	6.15	9.22	13.90	18.93	22.32	26.29	26.80	23.39	17.82	13.82	8.24
9	5.82	6.57	9.21	13.77	19.29	22.91	26.19	26.86	23.45	17.36	13.29	8.80
10	5.58	7.09	8.91	13.84	19.00	23.46	26.02	26.67	23.18	17.28	13.36	8.46
11	5.88	7.24	9.06	13.99	18.69	24.01	25.55	26.99	23.25	17.86	13.65	8.49
12	5.70	7.28	8.63	13.60	19.17	23.94	25.59	27.12	23.02	17.05	13.76	8.67
13	6.16	7.92	8.55	14.11	19.68	24.03	26.22	27.10	22.85	17.50	13.60	8.64
14	5.59	8.21	8.86	14.31	19.29	23.74	26.47	27.15	22.59	16.78	13.55	8.62
15	5.52	8.35	9.38	14.13	19.51	23.61	26.34	26.96	22.57	17.00	13.72	7.89
16	5.53	8.89	9.54	13.95	19.43	24.14	26.83	26.71	22.60	16.85	13.19	7.56
17	5.33	8.57	9.94	14.43	19.60	24.25	26.99	26.28	21.88	16.53	12.42	7.35
18	5.70	8.36	9.71	14.49	19.56	24.11	27.03	26.15	22.13	16.48	12.29	7.00
19	5.63	8.16	9.92	14.73	20.06	24.01	26.43	25.96	21.95	15.83	12.08	6.79
20	5.54	8.52	10.04	15.03	20.66	24.58	26.76	26.11	21.95	15.26	11.82	7.24
21	5.14	8.19	10.23	15.74	20.66	25.17	26.66	25.74	21.59	15.57	10.76	6.41
22	5.00	8.61	10.75	15.87	20.59	24.70	26.64	25.90	21.19	15.83	10.23	6.83
23	4.81	8.13	10.85	15.78	20.92	25.26	26.38	25.88	20.88	15.60	10.35	6.89
24	4.74	8.24	11.17	16.08	20.91	25.33	26.55	25.41	20.41	15.42	10.51	6.90
25	5.13	8.34	11.43	16.70	21.14	25.14	26.90	25.56	20.26	15.07	10.00	6.93
26	5.18	8.58	11.42	15.89	21.49	25.18	26.69	25.66	20.25	15.19	9.54	6.97
27	5.16	8.55	11.26	16.13	21.51	24.95	26.44	25.58	20.68	15.13	9.42	6.96
28	5.65	8.25	11.88	17.01	21.68	25.23	26.78	25.21	20.82	14.89	9.34	7.32
29	5.41	7.67	12.44	17.45	21.92	25.46	26.69	24.57	20.27	14.86	9.24	7.38
30	6.05		12.81	17.52	22.01	25.42	26.88	24.47	19.72	15.24	9.23	7.35
31	6.40		13.23		22.07		27.25	24.46		14.90		8.14



ed by a steady increasy till air temperature acquires its maximum.

All the above confirm the view (corroborate) about tardy winter in Thessaloniki (LIVADAS [14]). Usually after the first fortnight of August air temperature starts decreasing, but with a smoother rythm than its increase during the year's first semester. This temperature goes on falling till the month of December, in the last days of which it rises again by 2° C.

Extreme values have been recorded (Table V) within the above mentioned intervals.

TABLE V

Extreme daily values of air temperature.

	Max	Min	Δ (Max-Min)
J	15.7 (13/1952)	—7.6 (25/1963)	23.3
F	18.1 (17/1957)	—5.1 (7/1956)	23.2
M	23.5 (31/1952)	—0.3 (4/1955) &(1/1963)	23.8
A	23.7 (29/1970)	6.0 (8/1956)	17.7
M	28.0 (28/1950)	9.6 (3/1970)	18.4
J	30.1 (24/1957)	14.9 (3/1966)	15.2
J	32.9 (10/1968)	16.3 (1/1971)	16.6
A	31.6 (14/1957)	15.9 (19/1949)	15.7
S	29.3 (14/1952)	11.0 (30/1959)	18.3
O	23.5 (5/1963)	6.4 (30/1971)	17.1
N	19.5 (22/1965)	1.0 (26/1948)	18.5
D	17.8 (14/1957) &(9/1960)	—4.7 (1/1957)	22.5

The difference between extreme daily values (Table V) is higher in March (23.8° C), with those of the winter months: January (23.3° C), February (23.2° C), and December (22.3 C) coming next.

Summer months have the smallest differences i.e. June (15.2° C). August (15.7° C), and July (16.6° C).

Tropical Days.

The study of *Tropical Days*, that is days on which the temperature maximum was $\geqq 30.0°$ C, is of paramount interest from the bioclimatological point of view.

In the following table we give the number of cases and the occurence percentage of limit dates of tropical days per month.

	First tropical day					Last tropical day		
	M	A	M	J	Total	A	S	Total
No. of cases	1	3	15	9	28	3	25	28
Percentage (%)	3.6	10.7	53.6	32.1	100.0	10.7	89.3	100.0

The earliest tropical day is the 31st of March 1952, and the latest the 29th of September 1967. The interval between the first and the last tropical day of a year is characterized as «tropical period».

The average duration of the tropical period in Thessaloniki is 117.8 days. The longest tropical period was recorded in 1952, with 182 days and the shortest in 1972, with only 72 days.

Not every day within a tropical period is necessarily a tropical day. The mean number of true tropical days in Thessaloniki is 68.8 days. The maximum number of 104 days was recorded in 1954, while the minimum of 43 days was recorded in 1965. Table VI contains the amount of true tropical days, their mean number and their percentage per month.

TABLE VI

Tropical days in Thessaloniki during the 1946-1973 Pperiod

	M	A	M	J	J	A	S	Total
No of days	1	5	72	340	668	655	184	1925
Mean	0.03	0.18	2.57	12.14	23.86	23.39	6.57	68.75
Percentage (%)	0.05	0.26	3.74	17.66	34.70	34.03	9.56	100.00

July has the highest percentage (34.70) %, with August coming next with a slight (34.03 %) difference. March has the smallest percentage (0.05 %) and April as well (0.26 %).

It is worth mentioning that during the 28 years of the period examined, only 4 days have been recorded with absolute maximum air temperature $\geqq 40.0^0$ C, two in July and two in August. These are analytically the following: 22.7.1956, 12.8.1957, 24.8.1958, and 19.7.1973.

Days of Partial and Total Frost. Partial and Total - Frost - Days.

We term «days of partial frost» those days on which the thermometer inside the screen falls below zero (0^0 C), but does not remain below this degree during the whole day; while «days of total frost», those days on which the maximum air temperature did not rise beyond 0^0 C.

In the study of frost - days we have taken into account the 28 years that elapsed between the 1st of November 1945 to 31st of October 1973,

since the winter season begins on November and ends in April of the next calendar year.

The earliest day of partial frost (partial - frost - day) has been recorded on November 9, 1956 and the latest on March 18, 1952.

Again we give below the number of cases and the occurance percentage of first and last partial - frost - days in Thessaloniki, per month.

TABLE VII

	First partial - frost - day				Last partial - frost - day			
	N	D	J	Total	J	F	M	Total
Cases	8	16	4	28	2	12	12	28
Percentage	28.6	57.1	14.3	100.0	7.1	42.9	50.0	100.0

The maximum number of partial-frost-days (46 days) has been recorded in two winter seasons, in 1948 - 49 and 1953 - 54, and the minimum (2 days) in one only, that is in 1950 - 51.

Table VIII gives the amount of partial frost days, their mean number and their percentage per month.

TABLE VIII

Days of partial frost in Thessaloniki. (Period 1946-1973).

	N	D	J	F	M	Total
No. of cases	23	119	237	147	58	584
Mean	0.82	4.25	8.46	5.25	2.07	20.86
Percentage (%)	3.94	20.38	40.58	25.17	9.93	100.00

January has a very high number, since in this month are recorded almost half of the days. February and December come next, with little difference between them, while March and November hold only a small percentage.

In the 28-years period examined 15 cases of total-frost-days have been recorded in all, with maximum duration a 4-days spell. These cases are distributed per month as follows: 3 days in December, 11 days in January, and 1 in February, January has again the highest percentage.

Distribution of Daily Mean and Hourly Values.

The daily mean and hourly values of air temperature (for the 1946-1973 period) have been distributed in non equidistant grades (Tables IX and XI). Wherever temperature is considered important for some

TABLE IX

Distribution of Daily Mean Values of Air Temperature in Thessaloniki
(1946 - 1973)

	J	F	M	A	M	J	J	A	S	O	N	D	S	S′
≧ 35.0														
30.0-34.9						2	23	19					44	
25.0-29.9					34	286	643	636	135				1734	1778
20.0-24.9			1	22	359	488	199	202	561	117	1		1950	
18.0-19.9		1	5	93	247	46	2	9	94	208	16		721	
15.0-17.9	2	10	52	298	191	17	1	2	39	307	179	22	1120	
10.0-14.9	113	205	390	382	36	1			11	219	446	241	2044	5835
8.0-9.9	133	165	189	40	1					14	107	175	824	
6.0-7.9	182	149	127	5						3	42	168	676	
5.0-5.9	80	58	33								16	79	266	
4.0-4.9	93	57	20								13	51	234	
2.0-3.9	151	82	34								11	90	368	
0.0-1.9	68	41	15								9	25	158	2526
—2.0-(—0.1)	23	12	2									9	46	
—4.0-(—2.1)	14	6										7	27	
—6.0-(—4.1)	6	5										1	12	
—8.0-(—6.1)	3												3	88
S	868	791	868	840	868	840	868	868	840	868	840	868	10227	

TABLE X

Percentage distribution of daily mean air temperature values

	J.	F.	M.	A.	M.	J.	J.	A.	S.	O.	N.	D.	Year
25.0 - 35.0	—	—	—	—	0.0391	0.3428	0.7672	0.7546	0.1607	—	—	—	0.1739
10.0 - 24.9	0.1324	0.2730	0.5161	0.9464	0.9596	0.6571	0.2327	0.2453	0.8392	0.9804	0.7642	0.3029	0.5705
0.0 - 9.9	0.8145	0.6978	0.4815	0.0535	0.0011	—	—	—	—	0.0195	0.2357	0.6774	0.2470
—8.0 - (—0.1)	0.0529	0.0290	0.0023	—	—	—	—	—	—	—	—	0.0195	0.0086
													1.0000

TABLE XI

Distribution of Hourly of Air Temperature in Thessaloniki

(1946 - 1973)

	J	F	M	A	M	J	J	A	S	O	N	D	S	S'
≧ 40.0							2	1					3	
35.0-39.9					4	46	237	237	14				538	541
30.0-34.9				2	252	1584	3757	3669	702				9966	
25.0-29.9			26	178	2158	6069	8564	8468	4210	458			30131	40097
20.0-24.9		54	263	2052	6928	8906	7632	7798	9330	3807	417	2	47189	
18.0-19.9	9	140	456	2038	3958	2270	504	523	3436	3522	1048	98	18002	
15.0-17.9	261	746	1693	4926	5261	1159	129	111	2005	6252	4072	907	27522	
10.0-14.9	3160	4330	7440	8771	2231	126	7	25	446	6011	9402	5681	47630	140343
8.0-9.9	2924	3332	4206	1528	40				17	563	2407	3842	18859	
6.0-7.9	3736	3383	3382	566						157	1354	3582	16160	
5.0-5.9	2079	1466	1089	65						39	420	1402	6560	
4.0-4.9	1809	1320	708	19						19	360	1555	5790	
2.0-3.9	3126	2107	849	12						4	405	2177	8680	
0.0-1.9	2176	1227	502	3							205	967	5080	61129
—2.0-(—0.1)	848	564	196								69	372	2049	
—4.0-(—2.1)	391	161	22								1	160	735	
—6.0-(—4.1)	167	120										85	372	
—8.0-(—6.1)	127	33										2	162	
—10.0-(—8.1)	19	1											20	3338
S	20832	18984	20832	20160	20832	20160	20832	20832	20160	20832	20160	20832	245448	

TABLE XII

Percentage Distribution of hourly air temperature values

	J	F	M	A	M	J	J	A	S	O	N	D	Year
≧ 35.0	—	—	—	—	0.0002	0.0023	0.0115	0.0114	0.0007	—	—	—	0.0022
25.0 - 34.9	—	—	0.0012	0.0089	0.1157	0.3796	0.5914	0.5826	0.2437	0.0220	—	—	0.1634
10.0 - 24.9	0.1647	0.2776	0.4729	0.8823	0.8822	0.6181	0.3971	0.4060	0.7548	0.9405	0.7410	0.3210	0.5718
0.0 - 9.9	0.7608	0.6761	0.5154	0.1088	0.0019	—	—	—	0.0008	0.0375	0.2555	0.6492	0.2491
< 0	0.0745	0.0463	0.0105	—	—	—	—	—	—	—	0.0035	0.0297	0.0136
													1.0000

section of human activity (Agriculture, Technology, Industry) they have been examined in detail. Thus, in the above mentioned Tables, one can see grade - divisions of 1° C, 2° C, but also of 5° C. Winter months have characteristically higher fluctuation than the summer months.

The percentages of these temperature (daily mean and hourly ones) are gathered within the interval between 10.0° - 24.9° C (Tables X and XII).

Plants and Temperature.

Plants in general need certain temperatures for their satisfactory growth, each plant having its own temperature optimum. One can however formulate certain general rules as to harmful and favorable temperatures for vegetation.

Extreme temperatures damage plants in two ways, either by freezing or by scorching.

Early and late frosts may destroy more sensitive plants, or withhold the growth of more sturdy ones. Such catastrophes may however be avoided if one knows the frostless season, the number and dates of early or late frosts. These data may be found for the city of Thessaloniki in Tables VII and VIII.

The harmful effects of excessively high temperatures on plants depends not only from their height but also from how long they last. However temperatures $> 35^{0}$ C are generally harmful for vegetation [18]. Such (daily mean) temperatures have not been recorded in the area of Thessaloniki during the 28 years examined herein (Table IX).

On the other hand, temperatures $< 6^{0}$ C do not favor the growth of plants, even though humidity conditions may be otherwise favorable.

Temperatures that affect favorably the life processes of plants are those included between the interval of 10.0° - 30.0° C. Table IX contains the distribution of daily mean values of air temperature in Thessaloniki for these 28 years, per month. Temperatures between 30.0° - 35.0° C do not affect the growth of plants either favorably or unfavorably, consequently one can without risk of error, count them as temperatures favorable for plants.

Table X contains the percentage distribution of such temperatures per month. It is worth noting that every month participates in these favorable for plants temperatures.

CONCLUSIONS

The study of air temperature for the 1946 - 1973 period led us to the following conclusions.

The annual mean, and the monthly mean and extreme temperatures in the city of Thessaloniki, slightly differ from those recently published in a previous paper. The same applies for extreme values, except for the October maximum and the July minimum.

The fluctuation of daily mean temperatures has a primary maximum in July and a primary minimum in January. The variation curve does not appear symmetrical in both semesters, being smoother in the second semester than in the first.

The «tropical period» in Thessaloniki begins as a rule in May and ends in September its average duration being 117.8 days. July has the highest percentage of tropical days.

Partial - frost - days may occur during the five month period from November to March. The highest percentage of partial and/or total-frost - days belongs to January, since almost half of the partial - frost - days and 70% of the total - frost - days are recorded in this month.

A percentage of 57 % of daily mean as well as hourly temperature values are gathered between the interval of 10.0° -24.9° C.

Excessively high air temperatures, harmful to plants, have not been recorded in Thessaloniki. On the other hand, excessively low temperatures, dangerous for plant growth, holding 0.86 % of daily mean values, have been studied separately, because of the great interest they present.

All the months participate with considerable percentage in the favorable for plant growth interval of 10.0° - 35.0° C.

REFERENCES

1. Aeginitis, D. : Τὸ κλῖμα τῆς Ἑλλάδος. Μέρος Α'. Τὸ κλῖμα τῶν Ἀθηνῶν.
The climate of Greece, Part A, The climate of Athens, (1907).
2. Aeginitis, D. : Μέρος Β'. Τὸ κλῖμα τῆς Ἀττικῆς.
The climate of Attica, (1908).
3. Alexandrou, L. : Τὸ κλῖμα τῆς Θεσσαλονίκης. Ἐπιστ. Ἐπετ. Φ.Μ. Σχολῆς Πανεπιστημίου Θεσσαλονίκης, Τόμ. Ι. (1933).
The climate of Thessaloniki. Sci. Annals, Fac. Phys. & Mathem., Univ. of Thessaloniki, Vol. 1, (1933).
4. Alexandrou, L.: Ἐπὶ τῆς ἡμερησίας πορείας τῆς θερμοκρασίας ἐν Ἀθήναις. Ἐπιστ. Ἐπετ. Φ.Μ. Σχολῆς Πανεπιστημίου Θεσσαλονίκης.

On the diurnal course of air temperature in Athens. Sci. Annals, Fac. Phys. & Mathem., Univ. Thessaloniki, (1940).

5. Conrad V. and Pollak, L. W.: Methods in climatology. Harvard University Press, Cambridge Mass., (1950).
6. Duckham, A. N.: Meteorological forecasting and agricultural management (in «Weather forecasting for Agriculture and Industry» edited by J. A. Taylor, David & Charles/Newton Abbot). (1972).
7. Eredia, F.: Sul clima di Salonicco. Bollet. della R. St. Geografica italiana, Fasc. 1916, (1916).
8. Flocas and Arseni-Papadimitriou, : «Περὶ τῆς ἐτησίας πορείας τῆς θερμοκρασίας ἀέρος ἐν Θεσσαλονίκῃ». Ὑπὸ ἔκδοσιν.
   On the annual variation of air temperature in Thessaloniki, (in press).
9. Hudson, J. P.: «Agronomic Implications of Long-term weather forecasting (in «Weather forecasting for Agriculture and Industry», edited by J. A. Taylor, David and Charles-Newton Abbot) (1972).
10. Karapiperis, Ph.: Συμβολὴ εἰς τὴν μελέτην τῶν τροπικῶν ἡμερῶν ἐν Ἀθήναις. Δελτίον Γ. Υ. Σ. I, II/1959.
    Contribution to the study of tropical days in Athens. G.Y.S. Bulletin I, II/1959, (1959).
11. Karapiperis, Ph.: Συμβολὴ εἰς τὴν μελέτην τῆς ἐτησίας πορείας τῆς θερμοκρασίας ἐν Ἑλλάδι. Δελτίον Γ. Υ. Σ. I/1962.
    Contribution to the study of the annual variation of air temperature in Greece. G.Y.S. I/1962, (1962).
12. Kyriazopoulos, S. : Τὸ κλῖμα τῆς Ἑλληνικῆς Κεντρικῆς Μακεδονίας.
    The climate of Central Greek Macedonia - Athens, (1939).
13. Livadas, G. C.: Ὁ καιρὸς τῆς πάχνης ἐν Ἑλλάδι. Ἐπιστ. Ἐπετ. Φ. Μ. Σχολῆς Παν. Θεσσαλονίκης. Παράρτημα 12, (1962).
    Hoar-frost weather in Greece.Sci. Annals, Fac. Phys. & Mathem., Univ. Thessaloniki, App. No 12, (1962).
14. Livadas, G. C.: Annuaire No 27 - Special I. Annuaire de l'Institut Met. et Climat. de l'Univ. de Thessaloniki, (1973).
15. Mariolopoulos, B.: Τὸ κλῖμα τῆς Ἑλλάδος. Ἀθῆναι, (1938).
    The climate of Greece - Athens, (1938).
16. Theshow, M.: Environment and plant response. Mac Graw-Hill. U.S.A.(1970).
17. Wiesner, C. J.: Climate, irrigation and agriculture. Halstesd Press-Sydney. Australia, (1970).
18. Winslow, C. E. A. and Herrington, : «Temperature and Human life». Princeton University Press - Princeton - New Jersey, (1949).

MATERIAL

19. Kyriazopoulos, B.: Observations Météorologiques de Thessaloniki (1946-1958). Annuaire de l'Institut Met. et Climat. de l'Univ. de Thessaloniki, (1953-64).
20. Livadas, G. C.: Observations Météorologiques de Thessaloniki (1959-1973). Annuaire de l'Institut Met. et Climat. de l'Univ. de Thessaloniki. (1970-73).

ΠΕΡΙΛΗΨΙΣ

ΣΥΜΒΟΛΗ ΕΙΣ ΤΗΝ ΜΕΛΕΤΗΝ ΤΗΣ ΘΕΡΜΟΚΡΑΣΙΑΣ ΤΟΥ ΑΕΡΟΣ ΕΝ ΘΕΣΣΑΛΟΝΙΚΗ

Ὑπὸ

ΑΓΓΕΛΙΚΗΣ ΑΡΣΕΝΗ - ΠΑΠΑΔΗΜΗΤΡΙΟΥ

Εἰς τὴν παροῦσαν ἐργασίαν ἐπιχειρεῖται διεξοδικώτερη μελέτη τῆς θερμοκρασίας ἀέρος τῆς Θεσσαλονίκης καὶ διὰ τὴν χρονικὴν περίοδον 1946-73, περίοδον καθ' ἣν ἐλειτούργησεν ἄνευ διακοπῆς ὁ μετεωρολογικὸς σταθμὸς τοῦ Α.Π.Θ. Μελετῶνται αἱ μέσαι μηνιαῖαι, μέσαι ἡμερήσιαι, καθὼς καὶ αἱ ὡριαῖαι τιμαὶ αὐτῆς.

Αἱ μέσαι ἡμερήσιαι τιμαὶ παρουσιάζουν ἐν πρωτεῦον μέγιστον, τὸ ὁποῖον λαμβάνει χώραν κατὰ τὸ δεύτερον δεκαήμερον τοῦ Ἰουλίου καὶ ἓν πρωτεῦον ἐλάχιστον, ἐμφανιζόμενον κατὰ τὸ τελευταῖον δεκαήμερον τοῦ Ἰανουαρίου. Ἡ καμπύλη μεταβολῆς των παρουσιάζεται περισσότερον ὁμαλὴ κατὰ τὸ β΄ ἑξάμηνον, ἀπὸ ὅτι τὸ α΄.

Ἡ μελέτη τῶν τροπικῶν ἡμερῶν, μᾶς ἔδωσε μέσην διάρκειαν τροπικῆς περιόδου 117,8 ἡμερῶν, μὲ μέσον ἀριθμὸν ἀληθῶς τροπικῶν ἡμερῶν 68,8 ἡμερῶν. Ἡ ἐνωρίτερον σημειωθεῖσα τροπικὴ ἡμέρα ὑπῆρξεν ἡ 31η Μαρτίου 1952 καὶ ἡ βραδύτερον ἡ 29η Σεπτεμβρίου 1967.

Εἰς ὅλην τὴν 28ετίαν ἐνεφανίσθησαν 4 ἡμέραι μὲ μεγίστην θερμοκρασίαν $\geq 40^{o}$ C. Ἐξ ὅλων τῶν μηνῶν εἰς τοὺς ὁποίους ἐμφανίζονται συνήθως αἱ τροπικαὶ ἡμέραι, τὴν μεγαλυτέραν συχνότητα παρουσιάζει ὁ Ἰούλιος καὶ τὴν μικροτέραν ὁ Μάρτιος.

Αἱ ἡμέραι μερικοῦ καὶ ὁλικοῦ παγετοῦ ἐμφανίζονται κατὰ τὸ 5μηνον Νοεμβρίου-Μαρτίου. Ἐξ αὐτῶν τὴν μεγαλυτέραν συχνότητα ἡμερῶν μερικοῦ ἀλλὰ καὶ ὁλικοῦ παγετοῦ παρουσιάζει ὁ Ἰανουάριος, ὁ ὁποῖος ἔχει τὸ ἥμισυ τῶν ἡμερῶν μερικοῦ καὶ τὸ 70% ὁλικοῦ παγετοῦ. Εἰς τὴν μελετωμένην περίοδον, ἐνεφανίσθησαν μόνον 15 περιπτώσεις ὁλικοῦ παγετοῦ.

Τόσον αἱ μέσαι ἡμερήσιαι, ὅσον καὶ αἱ ὡριαῖαι τιμαί, παρουσιάζουν μεγαλυτέραν συχνότητα (57%) εἰς τὸ διάστημα 10.0^{o} C - 24.9^{o} C.

Ἐγένετο διαχωρισμὸς τῶν εὐνοϊκῶν καὶ τῶν δυσμενῶν διὰ τὰ φυτὰ θερ-

μοκρασιῶν. Ὑψηλαὶ δυσμενεῖς δι' αὐτὰ θερμοκρασίαι δὲν ἐσημειώθησαν εἰς τὴν πόλιν τῆς Θεσσαλονίκης, καὶ κατὰ τὴν χρονικὴν περίοδον 1946-73. Αἱ δυσμενεῖς χαμηλαί, ἀνερχόμεναι μόλις εἰς τὸ 0.86% τοῦ συνόλου τῶν μέσων ἡμερησίων θερμοκρασιῶν, παρέχονται εἰς τὸν πίνακα IX ἀναλυτικῶς κατὰ μῆνα. Σημαντικὴ εἶναι ἡ συμμετοχὴ ὅλων τῶν μηνῶν (Πίναξ IX), εἰς τὰς εὐνοϊκὰς διὰ τὰ φυτὰ θερμοκρασίας, ἤτοι τὰς περιλαμβανομένας εἰς τὸ διάστημα 10.0° C - 35.0° C.