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Summary : Evaporation in the city of Thessaloniki (Greece) is examined for the periods 1930 - 1940 and 1946 - 1970, according to readings of Wild's evaporation balance and Piché evaporimeters. Mean annual evaporation values (911.6 mm ±161.4 for Wild and 1342.3mm ±134.9 for Piché) as well as mean and extreme monthly and daily values are given.

Examination of the ratio between readings of the two types of evaporimeters, shows a clear precendence in the readings of Piché evaporimeter against those of Wild, which for mean annual values is $W/P = 0.679$.

Introduction.

Systematic evaporation measurements by evaporimeters have begun in Thessaloniki with the inauguration of the Meteorological and Climatological Institute of the University in 1930, at the meteorological station of the University (MARIOLOPOULOS [1]).

Measurements have been held ever since at the same met. station till 1957, and from 1958, when the station with its equipment was moved to a new site, some 220 m away from the previous one, near the new building of the Institute within the University campus (LIVADAS [2]) they are continued regularly.

It should be noted, however, that measurements have been inter-

rupted during World War II (KYRIAZOPOULOS [3], LIVADAS [2], LIVADAS [6], et al.).

Data from evaporation measurements have been published in the past: in 1933 by ALEXANDROU [4] who studied data of the 1930 - 1932 period, and by KYRIAZOPOULOS [5] who has extended the period examined from 1930 to 1937 using the until then published by MARIOLOPOULOS [1,7] data of the meteorological station.

It is however notable that no evaporation data are published in the two later classic climatological works by MARIOLOPOULOS [8] and PHILIPPSON [9].

Material.

Evaporation measurements have been made with the following instruments:

a. With Wild evaporimeter (evaporation balances) (manufacturer R. Fuess). This evaporimeter has been started on 1.1.1930, it has stopped on 31.10.1940 (KYRIAZOPOULOS [3]) due to wartime operations, then was started again on 10.4.1945 and has been functioning ever since. It is however obvious that within 40 years the evaporation - pan has been replaced quite a few times, by another similar, and once the balance has also been replaced.

b. *With Piché* * *evaporimeter* (manuf. R. Fuess, J. Richard). This evaporimeter has been started on 18.3.1930; it stopped also on 31.10. 1940, for the same as above reasons, and was started again on 13.10. 1950, and has been functioning ever since.

Evaportation data have been taken from the records of the Meteorological and Climatological Institute of the University of Thessaloniki. Part of these data have been published in the series «Observations Météorologiques de Thessaloniki (MARIOLOPOULOS [7], KYRIAZOPOULOS [10], LIVADAS [11]).

A. *Mean Annual, Monthly, and Daily Evaporation (Wild evaporimeter or Evaporation Balance).*

a. The mean annual evaporation in Thessaloniki, as measured (in m.m.) with a *Wild* evaporation balance, for the 1930 - 1940 and 1946 - 1970 periods, has as follows:

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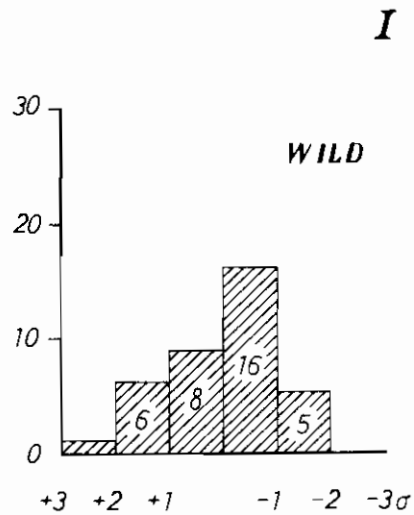
* In winter, because of extremely low temperatures, the water freezes and consequently evaporimeters are broken.

Maximum : 1240.0 mm (1962)
Mean : 911.56 mm ± 161.38
Minimum : 610.3 mm (1957)

If we should consider deviations from the mean annual values, they have as follows for the 36 years examined :

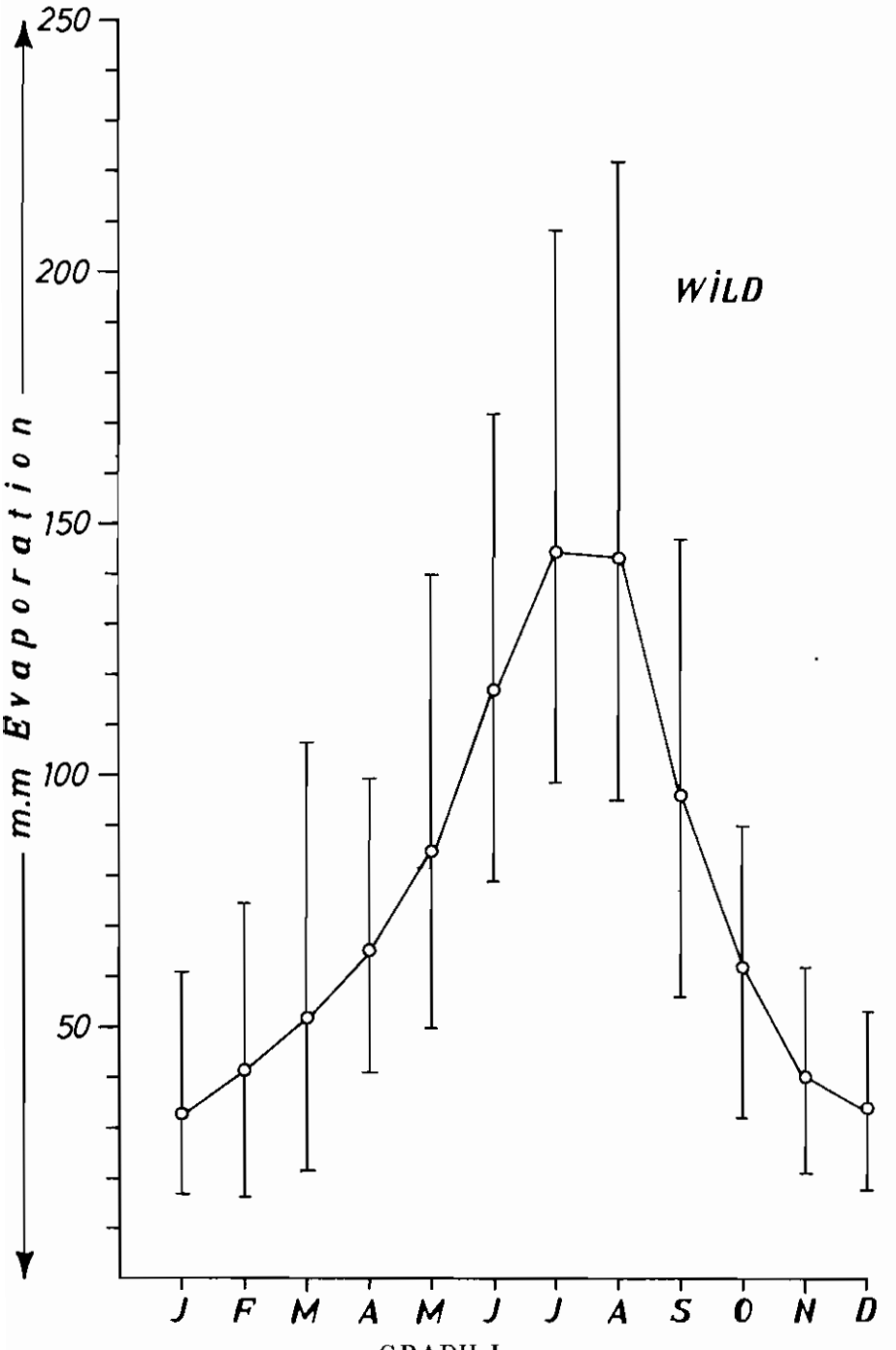
$+3\sigma$ to $+2\sigma$	1 case	2.8%	
$+2\sigma$ to $+1\sigma$	6 »	16.6%	
$+1\sigma$ to -1σ	24 »	66.6%	$8+1\sigma$
-1σ to -2σ	5 »	13.9%	$16-1\sigma$
-2σ to -3σ	0 »	0	
		99.9%	

Meaning that for a percentage of about 67% deviations stay around average values.



HISTOGRAM I

b. The following *Table I* contains extreme as well as mean evaporation values in Thessaloniki, for the 36 years (or 432 months) examined.



GRAPH I

TABLE I

Mean and extreme evaporation values for the 1930 - 1940 and 1946 - 1970 periods (36 years) with Wild evaporimeter.

	Maxima		Mean	$\pm\sigma$	Minima	
J	61.1	1964	32.89	9.32	17.1	1956
F	74.8	1934	42.20	12.29	16.1	1954
M	116.8	1961	51.91	17.63	21.9	1954
A	99.2	1933	65.46	12.67	40.3	1955
M	139.9	1962	83.73	18.30	49.6	1957
J	172.9	1932	117.03	27.62	78.6	1956
J	208.2	1960	144.92	28.40	97.3	1957
A	223.3	1960	142.86	33.27	94.8	1957
S	147.0	1962	95.30	20.09	55.8	1957
O	89.6	1958	62.00	14.12	31.9	1955
N	62.0	1960	39.80	9.48	21.1	1955
D	52.9	1962	33.50	7.57	19.1	1953
Total			911.60			

TABLE II

Distribution of S.D. of monthly evaporation values in Thessaloniki (for 432 months) with Wild evaporimeter.

	$>+3\sigma$	$+3\sigma\leqslant\geqslant+2\sigma$	$+2\sigma\leqslant\geqslant+1\sigma$	$+1\sigma\leqslant\geqslant-1\sigma$	$-1\sigma\leqslant\geqslant-2\sigma$	$-2\sigma\leqslant\geqslant-3\sigma$	$<-3\sigma$	Total
J	1(1964)	0	5	11 11	8	0	0	36
F	0	2	3	15 10	5	1	0	36
M	1(1961)	0	2	14 14	5	0	0	36
A	0	2	5	7 16	6	0	0	36
M	1(1962)	1	3	12 15	4	0	0	36
J	0	1	6	9 14.	6	0	0	36
J	0	2	4	12 10	8	0	0	36
A	0	2	3	12 12	7	0	0	36
S	0	1	4	12 14	5	0	0	36
O	0	0	6	17 6	6	1	0	36
N	0	0	6	11 15	4	0	0	36
D	0	1	6	9 14	6	0	0	36
Total	3	12	53	141 151 292	70	2	0	432

From the above *Table I* and *Graph I*, we draw the conclusion that the mean monthly evaporation in Thessaloniki has its minimum in January, that is in the coldest month of the year, and its maximum in July, which is the warmest month of the year. The hottest months of the warm season, that is July and August, not only have the highest mean monthly values, but also the highest monthly maxima and minima.

An examination of the distribution of S. D. values shows that 67,6% of the months are among $\pm\sigma$ deviations; 96,0% are between $\pm 2\sigma$, while there are 2 cases between -2σ to -3σ and 12 cases between $+2\sigma$ and $+3\sigma$ Moreover there are 3 cases out of these 432 months (0,69%) with deviations $> +3\sigma$ and these are the following :

—January 1964	Evapor. reading :	61.1	mean $+3\sigma$=	60.86 mm
—May 1962	»	»	139.9	mean $+3\sigma$=138.63 mm
—March 1961	»	»	116.8	mean $+3\sigma$=104.80 mm

The first two slightly exceed the normal (mean $+3\sigma$); but the case of March 1961 has a difference of more than 10 mm, that is why this has been a case for further investigation. An examination of weather conditions in March 1961 shows that, during this month weather types characterized by strong winds and small relative humidity have prevailed with an unusual frequency; these weather conditions account for the recording of such extremely high value of evaporation.

From the adjoined *Table III*, containing the distribution of frequencies of monthly evaporation values in Thessaloniki, we draw the following conclusions :

a. Monthly evaporation values for the October to April seven - months are <100.0 mm. Also 316 monthly values (73,1%) are below 100.0 mm.

b. Values are above 100.0 mm in the warm five - month period from May to September : May has 5 cases, and September 15, June has 26 cases, and almost all the cases of the main two warm months of July and August (35 and 34 cases respectively).

38 cases belong to the >150.0 mm degree, and only
5 cases belong to the >200.0 mm degree, (all in the above two hot months).

c. The following *Table IV* contains mean and extreme daily evaporation values for the period examined : out of 13.149 daily observations possible, 13.139 have been effected.

TABLE III

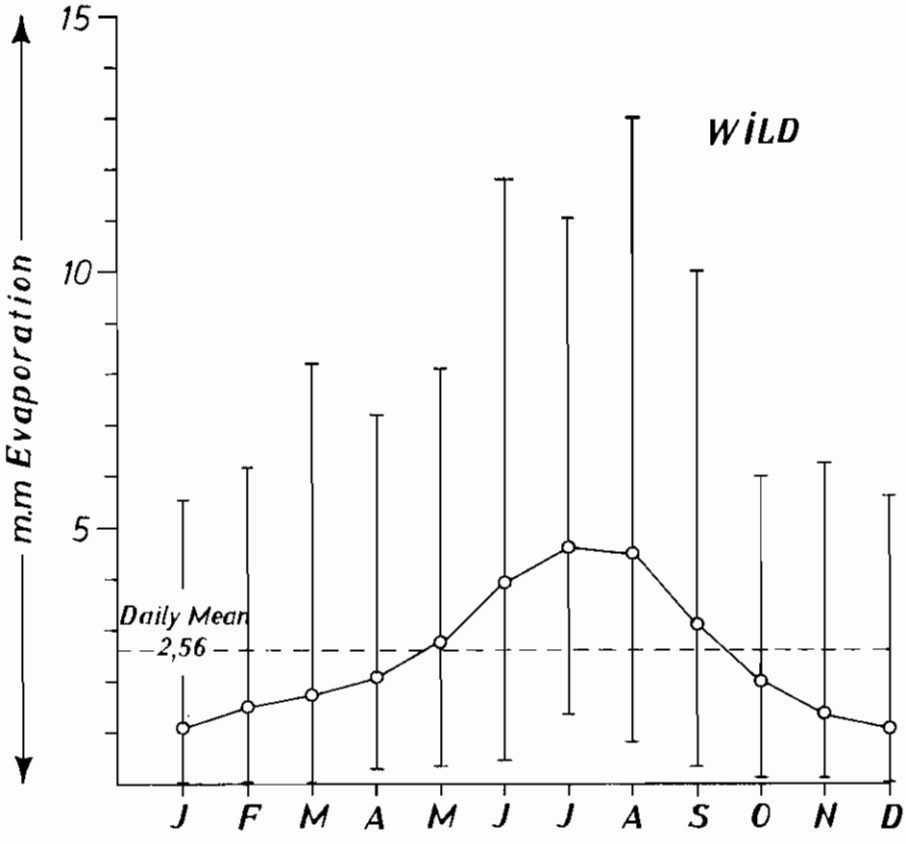
Distribution of frequencies of monthly evaporation values in Thessaloniki (36-year period - Wild evaporimeter)

	J	F	M	A	M	J	J	A	S	O	N	D	S	
220.1 - 230.0								1					1	
210.1 - 220.0								1					1	
200.1 - 210.0							2	1					3	5
190.1 - 200.0													0	
180.1 - 190.0							1	1					2	
170.1 - 180.0						2	4	2					8	
160.1 - 170.0						3	4	5					12	
150.1 - 160.0						1	5	5					11	33
140.1 - 150.0						1	5	1	1				8	
130.1 - 140.0					2	3	3	2	1				11	
120.1 - 130.0						3	3	3	2				14	
110.1 - 120.0			1		1	5	3	4	4				18	
100.1 - 110.0					2	8	5	5	7				27	78
90.1 - 100.0				2	6	3	1	2	6				20	
80.1 - 90.0			2	5	7	6			6	4			30	
70.1 - 80.0		1		5	10	1			5	6			28	
60.1 - 70.0		2	3	7	7				3	14	2		38	
50.1 - 60.0	2	4	12	12					1	4	5	1	41	157
40.1 - 50.0	4	16	10	5	1					5	10	7	58	
30.1 - 40.0	16	7	6							3	15	14	61	
20.1 - 30.0	13	5	2								4	13	37	
10.1 - 20.0	1	1										1	3	159
	36	36	36	36	36	36	36	36	36	36	36	36	432	432

TABLE IV

Daily Mean and Extreme Evaporation Values in Thessaloniki (13.139 days - Wild evaporimeter)

	Daily Maximum	Daily Mean	Daily Minimum
J	5.4 (26.1.1964)	1.06	0.0 (Very often)
F	6.2 (26.2.1959)	1.49	0.0 (Very often)
M	8.2 (14.3.1961)	1.67	0.0 (Very often)
A	7.2 (13.4.1959)	2.18	0.3 (10.4.57)
M	8.1 (31.5.1932)	2.70	(20.5.33) 0.4 (23.5.52)
J	11.9 (30.6.1935)	3.90	0.5 (7.6.30)
J	11.4 (11.7.1965)	4.67	(6.7.53) 1.4 (15.7.55)
A	13.4 (27.8.1958)	4.61	0.8 (18.8.49)
S	10.1 (9.9.1962)	3.18	0.4 (28.9.55)
O	6.2 (10.10.1967)	2.00	0.1 (26.10.31)
N	6.5 (15.11.1961)	1.33	0.1 (Very often)
D	5.9 (19.12.1968)	1.08	0.0 (Very often)
		2.56	



GRAPH II

A study of the mean daily evaporation values shows that the daily mean evaporation increases from January till July, and thence it starts decreasing. The daily mean values of the two hot months of July and August (4,67 mm and 4,61 mm respectively) slightly differ from each other; the same applies for the main two winter months of December with 1,08 mm and January with 1,06 mm.

A study of absolute maxima and minima shows that :

a. From December till March (included) it is possible to have days with no evaporation (=0.0 mm). Also besides the three summer months, when the absolute minimum evaporation is $\geqslant 0.5$ mm, daily evaporation values below 0,5 mm have been recorded during the autumnal months of October and November, as well as in the two spring months of April and May.

Also from the adjoined *Table V*, containing frequencies of daily evaporation values, we find that 1.222 days out of 13.139, that is a percentage of 9.3%, have values between 0.0 and 0.5 mm.

b. All the absolute maxima of evaporation are larger than the mean daily evaporation of July. While the absolute maximum of March is the largest of absolute maxima for the eight - month period from October to May, a fact that once more proves the instability of weather in this month.

Absolute maxima of daily evaporation values above 10.0 mm may occur during the warm four - months from June to September, but they are very few : 30 days out of 13.139, as per the adjoined Table of frequencies (Table V).

The 13.139 daily evaporation values are distributed among the various degrees of the scale, as follows :

> 10.1 mm	30 days	0.2%
5.1 — 10.0 mm	1135 »	8.6%
2.6 — 5.0 mm	4146 »	31.6%
0.0 — 2.5 mm	7828 »	59.6%
Total	13139	100.0%

meaning that almost 60% have values smaller that the daily mean evaporation value (2.56 mm).

B. *Mean Annual, Monthly, and Daily Evaporation (Piché evaporimeter).*

a. The mean annual evaporation in Thessaloniki, as measured with Piché evaporimeter, for the 1931 - 1939 and 1951 - 1970 periods (that is 29 full years) has as follows :

Maximum annual	1635.9 mm (year 1961)
Mean »	1342.28 mm $\pm$134.91
Minimum »	1133.1 mm (year 1957)

If we examine values of S.D. from the mean annual during the 29 - year period examined, they have as follows :

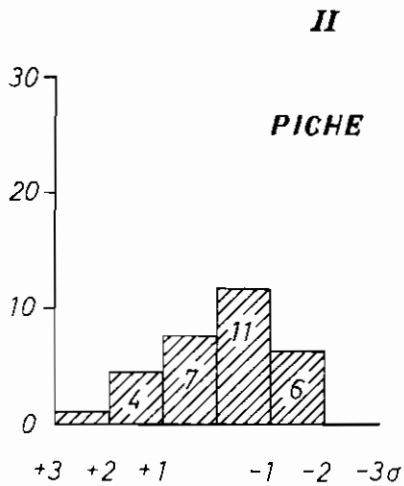
$+3\sigma$ to $+2\sigma$	1 year	3.4%
$+2\sigma$ to $+1\sigma$	4 years	13.8%
$+1\sigma$ to -1σ	18 »	62.1%
-1σ to -2σ	6 »	20.7%

TABLE V

Distribution of frequencies of daily evaporation values in Thessaloniki (13.139 days - Wild evaporimeter).

	J	F	M	A	M	J	J	A	S	O	N	D	Toal
13.1 - 13.5								1					1
12.6 - 13.0													0
12.1 - 12.5								2					2
11.6 - 12.0						1							1
11.1 - 11.5							3	4					7
10.6 - 11.0						1		3					4
10.1 - 10.5							6	8	1				15
9.6 - 10.0						2	3	4					9
9.1 - 9.5						3	7	11	1				22
8.6 - 9.0						7	10	18	2				37
8.1 - 8.5			1		1	13	25	23	3				66
7.6 - 8.0			1		1	18	33	22	7				82
7.1 - 7.5				1	2	15	25	27	10				80
6.6 - 7.0			2	3	8	28	47	34	21				143
6.1 - 6.5		1	1	6	8	35	54	52	18	1	2		178
5.6 - 6.0		2	3	3	12	36	54	69	20	7	2	1	209
5.1 - 5.5	1	1	4	9	21	70	94	68	33	7	1		309
4.6 - 5.0	4	4	12	24	45	96	144	117	52	21	6	1	526
4.1 - 4.5	3	15	18	32	48	106	139	130	59	21	10	1	582
4.6 - 4.0	6	25	32	49	79	121	187	158	100	55	16	14	842
3.1 - 3.5	9	42	41	71	112	140	133	156	126	71	30	15	946
2.6 - 3.0	39	57	72	131	200	150	82	124	197	116	49	33	1.250
2.1 - 2.5	66	96	111	164	216	127	49	64	222	144	86	73	1.418
1.6 - 2.0	127	167	206	241	205	80	18	16	136	229	132	122	1.679
1.1 - 1.5	209	184	250	216	103	18	3	4	53	228	196	201	1.665
0.6 - 1.0	293	260	274	115	48	9	0	1	14	163	354	313	1.844
0.0 - 0.5	358	156	88	14	7	4	0	0	4	53	196	341	1.222
Total	1115	1011	1116	1079	1116	1080	1116	1116	1079	1116	1080	1115	13.139

—2σ to —3σ	0 »	—
Total	29 »	100%



HISTOGRAM II

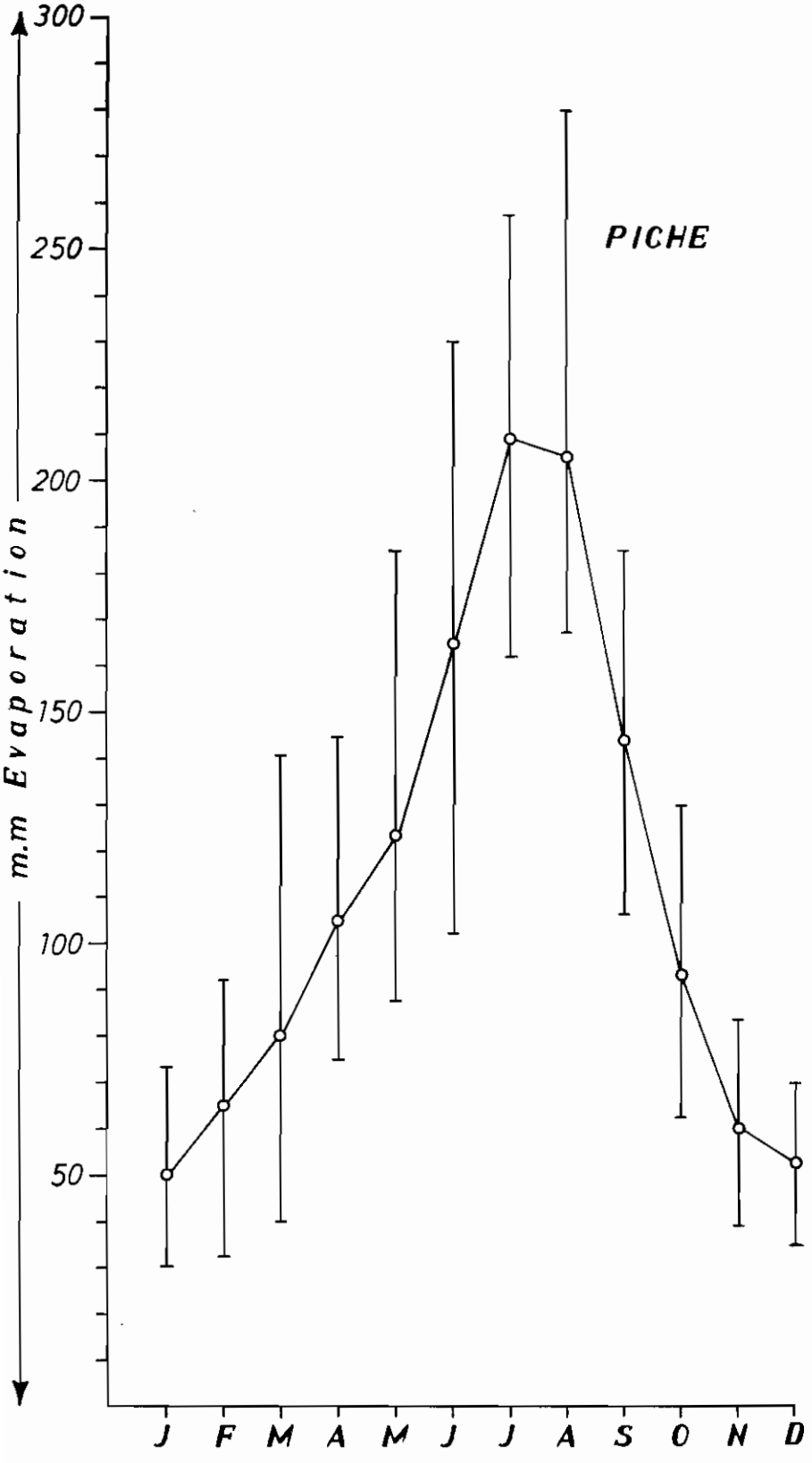
meaning that a percentage of ~ 62% is very near the average.

b. In the following *Table VI* are included extreme and mean monthly evaporation values. for the 29 - year or 348 - month period examined.

TABLE VI

Mean and extreme evaporation values in Thessaloniki for the 1931-1939 and 1951-1970 periods (Piché evaporimeter)

	Maxima		Mean	±σ	Minima	
J	73.8	1932	51.00	10.29	30.1	1956
F	92.4	1934	64.47	14.17	31.2	1954
M	141.1	1961	78.91	21.13	40.1	1954
A	144.4	1933	100.45	16.63	75.0	1955
M	185.0	1962	123.55	18.62	88.3	1957
J	230.1	1932	164.46	29.18	101.8	1970
J	257.1	1960	208.23	26.79	160.6	1970
A	279.9	1958	204.69	29.81	166.6	1970
S	184.2	1961	140.31	20.38	106.7	1957
O	129.8	1961	92.64	15.85	62.6	1955
N	83.6	1964	61.04	13.05	40.2	1955
D	70.2	1936	52.46	7.44	36.8	1953
Year			1342.21			



GRAPH III

An examination of *Table VI* as well as the adjoined *Graph III* shows that the mean monthly evaporation values in Thessaloniki, as measured with a Piché evaporimeter, have a simple variation with a minimum in January and its maximum in July. The two hottest months of the year, have the highest mean monthly values and the highest absolute maximum and minimum as well.

TABLE VII

Distribution of S.D. of monthly evaporation values in Thessaloniki (for 348 months) with Piché evaporimeter.

	$\geqslant+3\sigma$	$+3\sigma\leqslant\geqslant+2\sigma$	$+2\sigma\leqslant\geqslant+1\sigma$		$+1\sigma\leqslant\geqslant-1\sigma$		$-1\sigma\leqslant\geqslant-2\sigma$	$-2\sigma\leqslant\geqslant-3\sigma$	$<-3\sigma$	Total
				8		10				
J	—	1	5		18		5	0	—	29
				14		8				
F	—	0	3		22		3	1	—	29
				12		10				
M	—	2	1		22		4	0	—	29
				4		15				
A	—	1	6		19		3	0	—	29
				11		12				
M	—	1	2		23		3	0	—	29
				9		12				
J	—	1	4		21		3	0	—	29
				8		7				
J	—	0	7		15		7	0	—	29
				9		9				
A	—	1	4		18		6	0	—	29
				7		12				
S	—	2	3		19		5	0	—	29
				9		11				
O	—	1	3		20		5	0	—	29
				6		11				
=	—	0	6		17		6	0	—	29
				12		10				
%	—	1	2		22		4	0	—	29
				109		127				
Total	—	11	46		236		54	1	—	348

A study of the distribution of values, proves that 67,8% are included within $\pm\sigma$ ($109+\sigma$ and 127 cases $-\sigma 0$); 55 cases (15,79%) are within $-\sigma$ to -3σ and 57 cases (16,37%) are within $+\sigma$ to $+3\sigma$, while there is no case above $\pm 3\sigma$.

We give herewith *Table VIII* containing the distribution of fre-

quencies of monthly evaporation values, from which we draw the following conclusion :

TABLE VIII

Distribution of frequencies of monthly evaporation values in Thessaloniki (29-year period - Piehé evaporimeter)

	J	F	M	A	M	J	J	A	S	O	N	D		
270.1 - 280.0								1					1	
260.1 - 270.0													—	
250.1 - 260.0							1	2					3	
240.1 - 250.0							2	2					4	
230.1 - 240.0						1	4	1					6	
220.1 - 230.0							5	1					6	
210.1 - 220.0						1	1	1					3	
200.1 - 210.0						2	5	6					13	36
190.1 - 200.0						2	2	7					11	
180.1 - 190.0					1	3	2		2				8	
170.1 - 180.0						4	5	3	1				13	
160.1 - 170.0						1	2	5	2				10	
150.1 - 160.0					2	5			4				11	
140.1 - 150.0			1	1		4			5				11	
130.1 - 140.0					4	3			5				12	
120.1 - 130.0			1	3	7	2			5	3			21	
110.1 - 120.0				4	10				3	1			18	
100.1 - 110.0			1	3	3	1			2	3			13	128
90.1 - 100.0		2	4	8	1					10			25	
80.1 - 90.0		1	8	9	1					5	4		28	
70.1 - 80.0	1	7	4	1						4	5	1	23	
60.1 - 70.0	6	9	6							3	4	2	30	
50.1 - 60.0	7	6	2								10	14	39	
40.1 - 50.0	12	2	1								6	11	32	
30.1 - 40.0	3	2	1									1	7	184
	29	29	29	29	29	29	29	29	29	29	29	29	348	348

a. During the November - February four - month the monthly evaporation values are $\leqslant$100.0 mm, while values in the first degree between 30 to 100 mm include 184 months, that is 52,9%.

b. All the remaining months, from March to October, may have values $>$100.0 mm, while the three summer months have values $>$200.0 mm : 4 cases in June, 18 cases in July, and 14 cases in August. These last two months also have values $>$250.0 mm : 3 cases in July, and 5 in August.

c. In the following *Table IX* have been included the daily mean and extreme values for the period examined. During the cold season

the water may freeze inside the glass tube of the Piché evaporimeter, and the instrument has not been working during periods with very low temperatures. During the period examined, out of 10.592 daily observations possible, observations have not been effected in 144 cases because of extremely low temperatures. These cases are distributed in the winter months as follows :

December	25 cases
January	56 cases
February	56 cases
March	7 cases

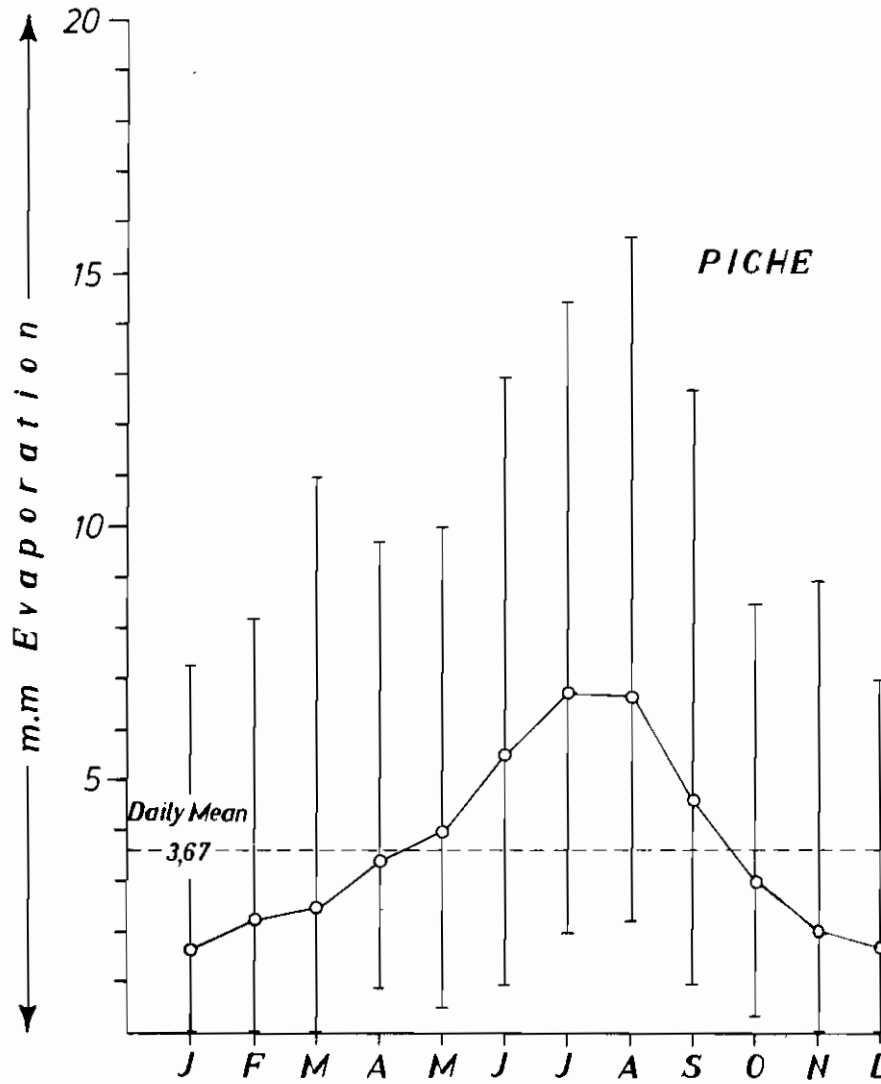
Evaporation of the 144 cases (1,4%) has been estimated by the corresponding readings of the Wild evaporation balance, which has been functioning inside the Stevenson meteorological shelter, at a distance of less than 1 meter. * Winter is the season during which water might freeze inside the Piché evaporimeter : most of these cases have occured during the two months of January and February, and especially within the 20 - days period from January 20 to February 10, which are considered the coldest of the year (LIVADAS [12]).

TABLE IX

Daily mean and extreme evaporation values in Thessaloniki (10.592 days - Piché evaporimeter)

	Daily Maximum	Daily Mean	Daily Minimum
J	7.3 (31.1.1962)	1.65	0.0 (Very often)
F	8.2 (26.2.1959)	2.28	0.0 (10.2.1967)
M	11.0 (14.3.1961)	2.55	0.0 (9.3.1956)
A	9.6 (6.4.1933)	3.35	0.8 (Very often)
W	9.9 (31.5.1961)	3.99	0.5 (23.5.1952)
J	12.9 (24.6.1961)	5.48	0.9 (5.6.1970)
J	14.4 (1.7.1964)	6.72	2.0 (31.7.1969)
A	15.6 (27.8.1958)	6.60	2.2 (17.8.1955)
S	12.7 (16.9.1961)	4.68	1.0 (Very often)
O	8.5 (15.10.1961)	2.99	0.3 (26.10.1931)
N	8.9 (15.11.1961)	2.03	0.0 (24.11.1933)
D	7.0 (19.12.1968)	1.69	0.0 (30.12.1962)
Annual		3.67	

* On July 31, 1965 the Piché evaporimeter recorded 18.0 mm of evaporation; since this reading has been considered as exaggerated, it was compared with the readings of the Wild evaporation balance and the Wild evaporation balance recorder (R. Fuess).which read 4,2 mm and 4,0 mm respectively. Moreover on that day relative humiditiy varied between 80-90% and there was calm. Because of all the



GRAPH IV

above reasons, this reading has been excluded, and has been attributed either to a faulty position of the brass: spring clip or to the quality of the filter paper. This last is extremely rare, but it is howerer possible, for the filter disc to have some defect.

From the above *Table IX* and *Graph IV* we draw the following conclusions :

—The daily mean evaporation value increases from January till July, and thence it begins decreasing. The daily mean values of the two hot months slightly differ from each other (July 6,72 mm, August 6,60 mm); the same applies for the main two winter months (December 1,69 mm, January 1,65 mm).

—An examination of absolute maxima and minima shows that :

a. It is possible to have days with no evaporation (=0,0 mm) from November till March included. Moreover, excepting the main two summer months of July and August, whose absolute minimum of daily evaporation is >2.0 mm, in all the remaining months (spring, summer, and autumn) the absolute minima are ≤1,0 mm.

Also from the adjoined *Table X*, containing frequencies of daily mean values, we find that 350 days out of 10.592, that is a percentage of 3,2%, have evaporation values from 0,0 to 0,5 mm, while 1.147 case, that is a percentage of 10,8%, have values from 0,0 to 1,0 mm.

b. All the absolute maxima of daily evaporation are higher than the mean daily evaporation of July.

The absolute maxima that have been recorded in March, are the highest for the eight - month period from October to May.

An examination of the data of the above Table X shows that it is possible to have dailt values 10,0 mm in March (1 case) as well as during the warm four - month period from June to September.

The 10.592 daily readings are distributed in the various degrees of the scale as lollows :

>10,1 mm	175 days	1,7%
5,1 to 10,0 mm	2.562 »	24,2%
3,6 to 5,0 mm	1.990 »	18,8%
0,0 to 3,5 mm	5.865 »	55,4%
Total	10.592 »	100,1%

This means that almost 55% of these values are below the mean daily of 3,67%.

Conclusions.

From the study of results of evaporation measurements in Thessaloniki, done with various types of evaporimeters during the period from 1930 to 1970, we have come to the following conclusion :

TABLE X

Distribution of frequencies of daily evaporation values in Thessaloniki piché evaporimeter.

Ev. mm	J	F	M	A	M	J	J	A	S	O	N	D	Total
16.1 - 16.5													
15.6 - 16.0								1					1
15.1 - 15.1													0
14.6 - 15.0													0
14.1 - 14.5							1	1					2
13.6 - 14.0							1	2					3
13.1 - 13.5							2	4					6
12.6 - 13.0						2	4	5	1				12
12.1 - 13.5						2	4	8					14
11.6 - 12.0						1	5	8	1				15
11.1 - 11.5						5	8	11	1				25
10.6 - 11.0			1			3	11	19	3				37
10.1 - 10.5						8	26	19	7				60
9.6 - 10.0				1	3	10	30	24	11				79
9.1 - 9.5					1	14	33	23	7				78
8.6 - 9.0				4	4	22	32	22	10		1		95
8.1 - 8.5		1	1	4	5	37	47	44	10	1			150
7.6 - 8.0			3	5	10	25	58	43	24	6			174
7.1 - 7.5	1		4	10	25	46	68	74	20	6			244
6.6 - 7.0		1	4	11	23	51	92	70	24	8	4	2	290
6.1 - 6.5	2	8	11	19	24	64	104	97	44	15	7		395
5.6 - 6.0	3	17	21	24	50	102	93	83	64	22	6	2	488
5.1 - 5.5	5	13	11	38	54	95	105	133	73	29	8	5	569
4.6 - 5.0	5	22	31	43	93	88	76	91	84	48	19	19	610
4.1 - 4.5	14	37	34	79	102	94	44	49	112	59	38	16	678
3.6 - 4.0	20	53	59	76	127	62	23	36	119	66	34	27	702
3.1 - 3.5	39	46	81	128	125	64	16	19	111	105	56	61	851
2.6 - 3.0	75	80	113	128	117	29	9	8	71	134	72	58	894
2.1 - 2.5	98	90	130	132	83	16	6	5	38	137	81	95	911
1.6 - 2.0	169	165	155	88	30	12	1		27	133	138	130	1.048
1.1 - 1.5	159	132	139	63	24	11			6	86	211	183	1.014
0.6 - 1.0	198	114	83	16	8	7			2	37	150	192	807
0.0 - 0.5	111	40	18	1	1					7	45	117	340
Total	899	819	899	870	899	870	899	899	870	899	870	899	10.592

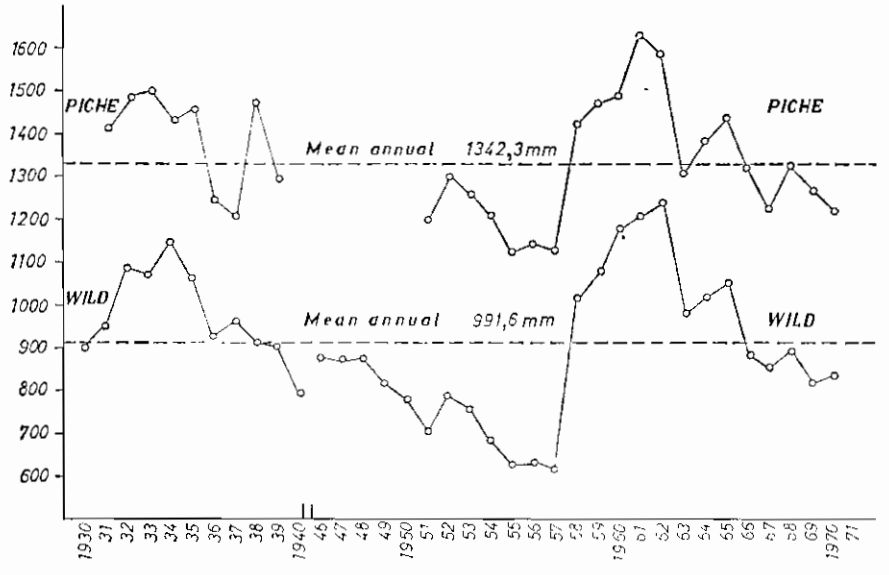
A. The amount of evaporation as measured with a Wild evaporation balance is smaller than that measured with a Piché evaporimeter.

TABLE XI

Comparison between the readings of Wild and Piché evaporimeters of mean and extreme annual evaporation values in Thessaloniki

	Wild	Piché	W/P
Abs. Max.	1.240,0 mm(1962)	1.635,9 mm(1961)	0.758
Mean Ann.	911,56 ±161,38	1.342,28 ±134,91	0.679
Abs. Min.	610,3 mm(1957)	1.133,1 (1957)	0.539

The absolute minimum in both (observational) series of measurements has occured in 1957, while the absolute maxima have been recorded during the two years 1961 - 1962 as follows: The absolute maximum of the Piché evaporimeter was recorded in 1961, and in this same year was recorded also the secondary maximum of the Wild evaporation balance. The absolute maximum of this latter occured within the next year 1962, and in this same year also the secondary maximum of the Piché evaporimeter has been recorded.



GRAPH V

In the above *Graph V* we notice a shifting of curves between the years 1957 and 1958; this we attribute to the fact that in 1958 the Me-

teorological Station was moved to its new site. This new site holds a much more open space within the campus, and should be «ventilated» much better than the former.

It should be noted herewith that previous studies prove that this removal of the met. station to a new location has influenced the readings of various mateorological elements, such as sunshine duration (LIVADAS [6]), and cooling - power (LIVADAS - BALAFOUTIS [13]).

The latter downward trend of the curves, which occurs since 1966, might also be attributed to general factors, such as lesser «ventilation» (ventilation plus renewal of surrounding air masses), due to the rising of new buildings around the meteorological station, i.e. the building of the Faculty of Law to SW, and the Veterinary Faculty to NE.

B. The monthly mean values also show, as should be expected, different readings between the two types of evaporimeters.

TABLE XII

Comparison of monthly mean evaporation readings between Wild and Piché evaporimeters.

	Wild	Richè	P/W	W/P
J	32.89	51.00	1.551	0.645
F	42.20	64.47	1.528	0.655
M	51.91	78.91	1.520	0.657
A	65.46	100.45	1.535	0.652
M	83.73	123.55	1.476	0.678
J	117.03	164.46	1.405	0.712
J	144.92	208.23	1.437	0.696
A	142.86	204.69	1.433	0.698
S	95.30	140.31	1.472	0.679
O	62.00	92.64	1.494	0.669
N	39.80	61.04	1.534	0.652
D	33.50	52.46	1.566	0.639
Year	911.60	1342.21	1.472	0.679

From the above *Table XII* we find that the P/W ratio is $>1,5$ for the November - April semester, that is in the cold season, while for the warm semester from May to October this P/W ratio is $<1,5$. Also mean monthly values show that :

1. Evaporation is comparatively small during the winter season : l.e. for the five - months period from November to March it amounts to 21,96% of the annual evaporation according to the readings of Wild's evaporation balance, and to 22,94% of the per annum total of Piché

evaporimeter. The main two winter months hold 3.67% and 3,60% of the annual evaporation respectively.

TABLE XIII

Percentage of eaeh month in the annual amount of evaporation in Thessaloniki, as maesured with Wild and Piché evaporimeters.

	Wild		Piché	
J	0.0360		0.0380	
F	0.0463		0.0480	
M	0.0569	0.1392	0.0588	0.1448
A	0.0718		0.0748	
M	0.0918		0.0920	
J	0.1284		0.1225	
J	0.1590		0.1551	
A	0.1568	0.4442	0.1525	0.4301
S	0.1045	0.5487	0.1045	0.5346
O	0.0680		0.0690	
N	0.0437		0.0455	
D	0.0367		0.0391	
Total	0.9999		0.9998	

2. On the other hand evaporation increases excessively during the summer: the two hot months of July and August, hold respectively for the two evaporimeters 31,58% and 30,76% of the annual amount. This is characteristic of the area examined, that is the are of Thessaloniki in particular, but also the whole area of Greece and Eastern Mediterranean in general. The climate of this area, according to *Köppen's* classification is of the Csa type, meaning that etesians blow during the warm season, that is northerly off - shore winds, whose source region is the sub - tropical Azores high. The influence of the etesians is such, that the summer climate of Greece is also called «etesian climate».

C. A study od daily evaporation values shows that, the frequency of higher daily values belongs, as it would be expected, to readings of the Piché evaporimeter, while *Wild's* readings rank first in values $<$5,0 mm per day as well as in readings of zero evaporation.

TABLE XIV

Distribution of frequencies of daily evaporation values in Thessaloniki with Wild and Piché evaporimeters.

Daily evap. in mm.	Wild days	Wild %	Piché days	Piché %	P — W	
>10.1	175	1.7	30	0.2	+ 1.5	17.1
5.1 - 10.0	2562	24.2	1135	8.6	+15.6	
0.6 - 5.0	7515	70.9	10752	81.8	—10.9	17.0
0.0 - 0.5	340	3.2	1222	9.3	— 6.1	
Total	10592	100.0	13139	99.9		

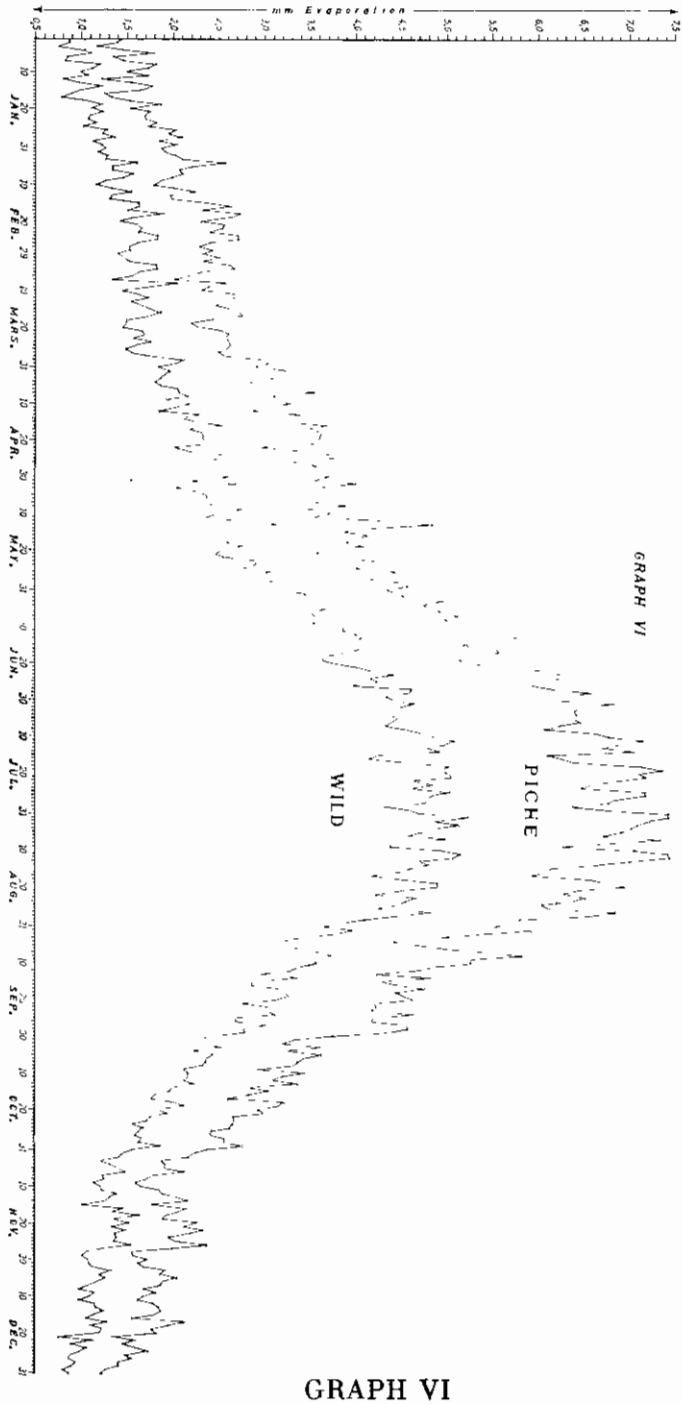
The adjoined *Graphs VI and VII* show that daily values of the two evaporimeters differ even as an average, with those of Piché always surpassing Wild's. Also the absolute maxima of evaporation are always higher with Piché evaporimeters.

TABLE XV

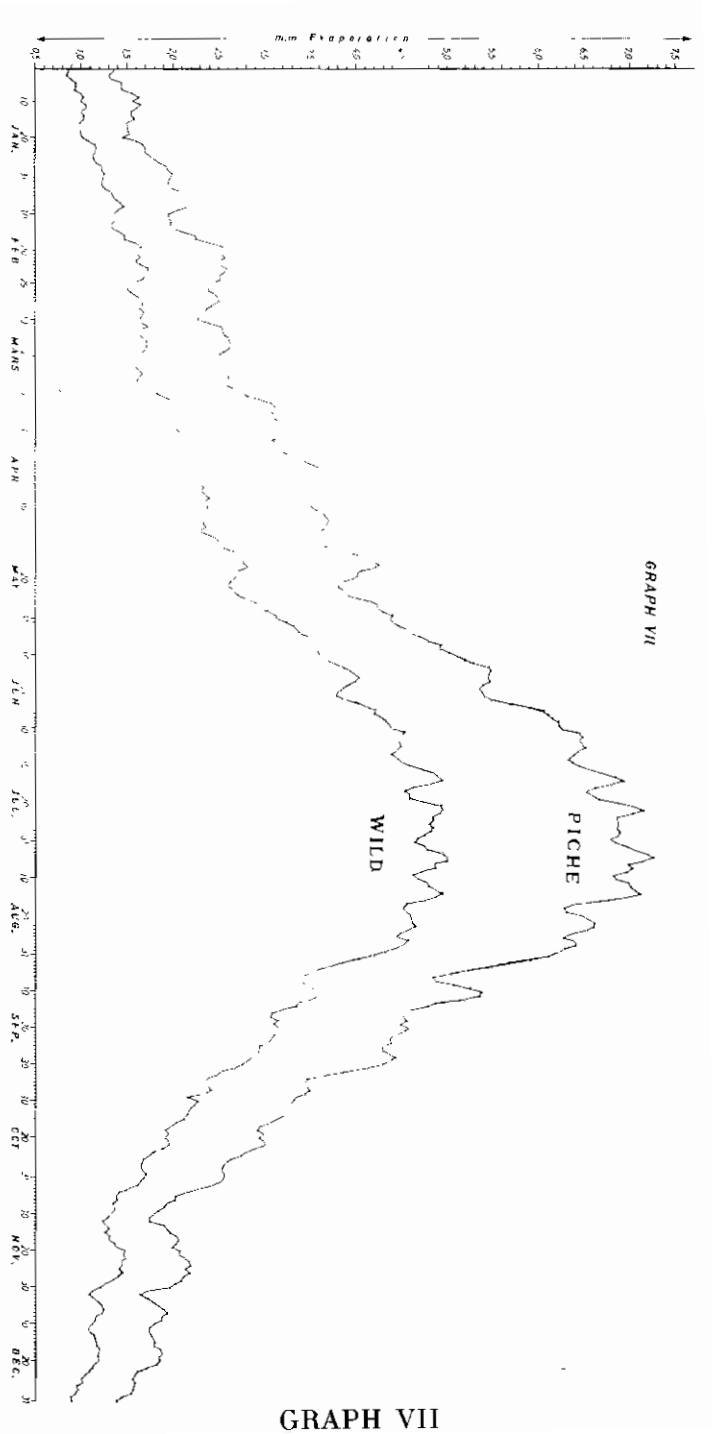
Comparative of absolute daily evaporation maxima between Wild and Piché evaporimeters

	Wild		*Piché*	
	evap. in mm.	date	evap. in mm.	date
J	5.4	16.1.1964	7.3	31.1.1962
F	6.2	16.2.1964	8.2	26.2.1959
M	8.2	14.3.1961	11.0	14.3.1961
A	7.2	13.4.1959	9.6	6.4.1933
M	8.1	31.5.1932	9.9	31.5.1961
J	11.9	30.6.1935	12.9	24.6.1961
J	11.4	11.7.1965	14.4	1.7.1964
A	13.4	27.8.1958	15.6	27.8.1958
S	10.1	9.9.1962	12.7	16.9.1961
O	6.2	10.10.1967	8.5	15.10.1961
N	6.5	15.11.1961	8.9	15.11.1961
D	5.9	19.12.1968	7.0	19.12.1968

The coincidence of having the absolute maximum of the two evaporimeters on the same day, is an extremely interesting item, which should be the subject of a separate study.



GRAPH VI



GRAPH VII

EVAPORATION IN THESSALONIKI - GREECE

by

GEORGÈ C. LIVADAS and PANAGHIOTI CHR. MACHAIRAS
Institute of Meteorology and Climatology

ΠΕΡΙΛΗΨΙΣ

Μελετᾶται ἡ ἐξάτμισις εἰς τὴν πόλιν τῆς Θεσσαλονίκης κατὰ τὰς χρονικὰς περιόδους 1930 - 1940 καὶ 1946 - 1970, τόσον ἐκ τῶν ἐνδείξεων ἐξατμισημέτρου Wild, ὅσον καὶ ἐξ ἐξατμισιμέτρου Piché. Δίδονται τὰ μέσα ἐτήσια ὕψη ἐξατμίσεως (911,6mm $\pm$ 161.4 Wild καὶ 1342.3mm $\pm$ 134.9 Piché) ὡς καὶ αἱ μέσαι καὶ ἄκραι μηνιαῖαι καὶ ἡμερήσιαι τιμαὶ αὐτῆς.

Μελετᾶται ἐπίσης ἡ σχέσις μεταξὺ τῶν ἐνδείξεων τῶν δύο τύπων ἐξατμισημέτρου, καὶ προκύπτει ὅτι ὑπάρχει μία σαφῆς ὑπεροχὴ τῶν ἐνδείξεων τοῦ ἐξατμισημέτρου Piché ἔναντι τῶν ἐνδείξεων τοῦ ἐξατμισημέτρου Wild, ἥτις εἰς τὰ μέσα ἐτήσια δίδει : W)P = 0.679.

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