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COOLING POWER DURING THE WARM SEASON AT VARIOUS ELEVATIONS IN NORTHERN GREECE

by
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Abstract: *Cooling-power during the warm quarter (July-September) at the city of Thessaloniki and on the mountain mass of Upper Olympus, is studied based on data of the years 1965-1973 (excluding 1966, and 1969) for the stations of Thessaloniki and Ayios Antonios (Olympus Scientific Center) while for the station of Olympus Skiing Center we had only data of the years 1971-73.*

Values of each station are examined separately and in context with each other, and differences between stations are explained.

Moreover, the magnitude of cooling power values at each station is accounted for; while the bioclimatic type of these stations is also defined.

Introduction

In this paper we examine cooling power during the warm quarter (July-August-September) at the following three meteorological stations, with considerable differences in their elevation.

1. Meteorological station of the Aristotelian University of Thessaloniki (A. U. T.) ($H_p = 44.65$ m, $\varphi = 40^\circ\ 37'$ N, $\lambda = 22^\circ\ 57'$ E). Observations are conducted here on the roof of the Meteorological Institute building (roof exposure) with a free horizon on all sides. From this station we take observations of the years 1965-1973 (excluding 1966 and 1969) for the above quarter.

2. Meteorological Station of Olympus Skiing Center (Sk. C.) ($H_p = 1860$ m, $\varphi = 40^\circ\ 02'30''$N, $\lambda = 22^\circ\ 20'\ 25''$ E). This stands inside a valley whose axis is oriented N to S. To the NE — SE rises the mountain mass of Kakavrakas (el. 2618 m) to W - NW the mountain mass of Dhiakoptis (el. 2349 m) and to N rises the cone of Ayios Antonios peak (el. 2817 m). Finally the horizon is completely

free to the S (Fig. 1)*. From this station we have observations of the warm quarter of the years 1971-1972-1973.

3. Olympus Scientific Center (O.S.C.) (H_p =2817 m, φ = 40° 04′ 10″ N, λ=22° 21′ 10″ E). This station stands on the cone of Ayios Antonios peak, with a completely free horizon. From this station we have observations for the same period as for the station of Thessaloniki.

Observations in all three stations were effected simultaneously thrice daily, at 08:30, 13:30 and 18:30 (Local Time = GMT+2h) with a Hill Katathermometer (red spirit)**.

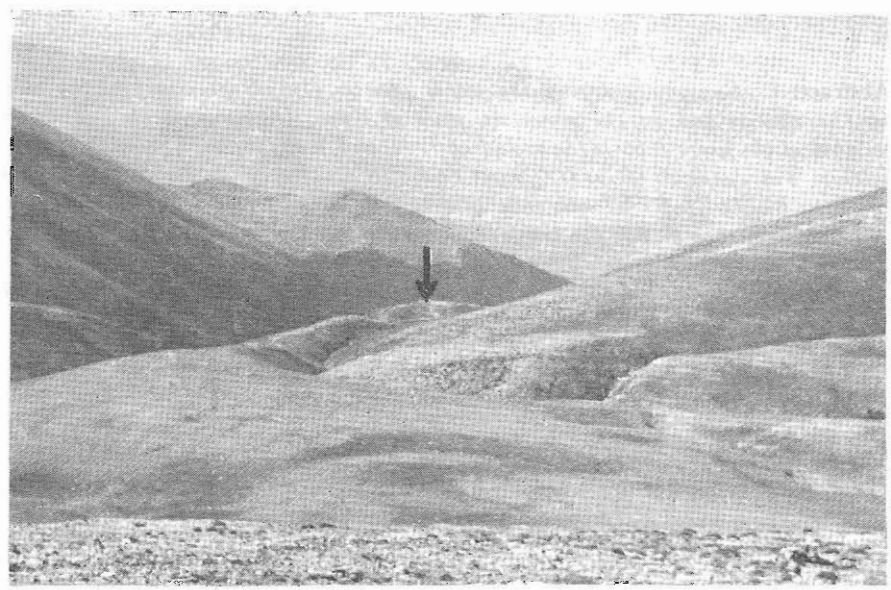


Fig. 1.

Measured Values of Cooling Power.

The total number of observations effected during the period examined are given in Table I. In this Table (as well as in those following), values inside intercalation, correspond to observations of the period of 1971-1973.

From this Table we note that cases when c. p. measurements were

* Fig. 1: The meteorological station of the Sking Center viewed from the O.S.C.
** J. J. Hicks-England and R. Fuess-W. Berlin.

TABLE I

*Amount of observations effected during the warm quarter of the period 1965-1973 (exept for those of 1966, 1969)**

	Thessaloniki			Skiing Center			Olympus Scientific Center		
	08:30	13:30	18:30	08:30	13:30	18:30	08:30	13:30	18:30
Obs. posible	644 (276)	644 (276)	644 (276)	(276)	(276)	(276)	644 (276)	644 (276)	644 (276)
Obs. effected	607 (275)	528 (250)	568 (270)	(274)	(275)	(272)	620 (270)	620 (271)	624 (272)
No Data	28 (1)	28 (4)	58 (2)	(2)	(1)	(4)	24 (6)	24 (5)	20 (4)
Overheating	9 (0)	88 (22)	18 (4)	(0)	(0)	(0)	0 (0)	0 (0)	0 (0)

* Values between parentheses represent the 1971-1973 period, common for all three stations.

impossible because of extremely high temperature values (overheating) occur only in Thessaloniki and mainly at 13^h 30′.

Cooling power values have been reduced at mean sea level, according to the relation:

$$H_{red} = H_1 f \quad (2)$$

where the factor f is given for heights of the above stations, as follows:

A.U.T.	h = 44.65 m	f = 1.001
SK.C.	h = 1860 m	f = 1.119
O.S.C.	h = 2817 m	f = 1.176

This reduction of cooling power values at mean sea level, resulted in the monthly mean c.p. values given in Table II.

In Tables IIIa and IIIb we have the extreme values of c. p., also reduced at mean sea level.

From Tables II, IIIa and IIIb we draw the following conclusions:

a) At the stations of A.U.T., and O.S.C. the smallest mean c. p. values are observed at 13^h 30′; on the contrary at the Sk. C. station at this time are recorded the highest mean c. p. values.

b) If from Table II we define the ratios between mean c. p. values of the Sk. C. and A.U.T. stations on one hand and between O.S.C. and Sk. C. on the other, we obtain

1. Sk.C./A.U.T. ($\Delta h \simeq 1800$ m)

08:30	14.95/8.95=1.67
13:30	15.77/6.65=2.37
18:30	15.65/8.85=1.77

2. O.S.C./Sk.C. ($\Delta h \simeq 1000$ m)

08:30	39.71/14.95=2.66
13:30	33.67/15.77=2.14
18:30	42.20/15.65=2.70

From the above ratios we observe that the increase rate of c. p. is quite smaller for the first 1800 m of height difference than it is for the remaining 1000 m of height difference.

c) From Table II we observe that at the O.S.C. and A.U.T. stations as well, the difference between monthly mean maximum and monthly mean minimum values is considerable, while this difference is very small at the Sk. C., proving the homogeneity of the bioclimate prevailing at this station.

TABLE II

Monthly mean cooling power values at the three stations reduced at sea level. (Values in parenthesis cover the period 1971-1973)

July

Mean Monthly Value ± σ

	Years	08 : 30	13 : 30	18 : 30
Olympus Scientific Center	1965	25.96 ± 10.77	20.80 ± 7.44	28.32 ± 9.21
	1967	37.42 ± 15.83	24.99 ± 6.70	37.46 ± 13.66
	1968	30.52 ± 11.03	25.70 ± 6.89	32.38 ± 9.31
	1970	32.56 ± 12.42	27.00 ± 10.72	33.62 ± 10.70
	1971	33.77 ± 16.17	27.80 ± 10.17	33.72 ± 9.27
	1972	30.41 ± 10.96	29.33 ± 8.03	36.05 ± 8.51
	1973	36.28 ± 14.72	35.19 ± 14.42	38.88 ± 12.33
	Mean	32.42 (33.49)	27.26 (30.77)	34.35 (36.22)
Skiing Center	1971	16.67 ± 4.19	16.33 ± 4.10	17.60 ± 4.47
	1972	14.33 ± 3.72	13.82 ± 3.49	13.38 ± 3.68
	1973	13.23 ± 3.20	14.61 ± 4.91	15.00 ± 4.54
	Mean	14.74	14.92	15.33
Thessaloniki	1965	8.42 ± 3.22	6.27 ± 3.60	7.11 ± 1.80
	1967	6.39 ± 2.21	2.94 ± 3.32	4.92 ± 3.52
	1968	11.70	5.25	9.15
	1970	7.18 ± 3.11	2.78 ± 3.15	6.37 ± 2.77
	1971	9.76 ± 3.95	7.85 ± 3.60	10.03 ± 3.19
	1972	7.63 ± 3.38	4.67 ± 3.37	7.12 ± 3.50
	1973	7.77 ± 3.60	3.52 ± 3.34	6.13 ± 4.08
	Mean	8.41 (8.39)	4.75 (5.35)	7.26 (7.76)

TABLE II (continued)

August

Mean Monthly Value ± σ

		0.8:30	13:30	18:30
Olympus Scientific Center	1965	30.65 ± 9.84	26.25 ± 11.56	34.44 ± 11.03
	1967	25.25 ± 8.25	20.21 ± 5.54	29.90 ± 7.34
	1968	33.36 ± 12.53	31.31 ± 10.26	37.43 ± 11.41
	1970	36.03 ± 11.14	28.04 ± 8.23	40.46 ± 11.71
	1971	38.34 ± 11.35	24.74 ± 8.21	34.59 ± 9.37
	1972	39.49 ± 14.04	35.81 ± 18.23	43.62 ± 12.41
	1973	37.80 ± 11.99	29.47 ± 10.17	43.06 ± 9.46
	Mean	34.42 (38.54)	27.98 (30.01)	37.64 (40.42)
Skiing Center	1971	14.48 ± 2.78	15.24 ± 3.94	15.28 ± 5.86
	1972	13.70 ± 3.15	14.28 ± 4.76	13.62 ± 4.04
	1973	15.19 ± 2.90	15.55 ± 2.39	15.57 ± 4.00
	Mean	14.46	15.02	14.82
Thessaloniki	1965	10.24 ± 5.10	7.28 ± 3.32	8.69 ± 2.12
	1967	5.70 ± 3.77	1.39 ± 2.37	5.04 ± 2.32
	1968	9.18 ± 4.04	4.44 ± 3.21	9.82 ± 3.96
	1970	7.76 ± 3.66	3.60 ± 2.03	6.84 ± 2.42
	1971	8.87 ± 3.61	6.61 ± 3.12	9.00 ± 3.50
	1972	8.40 ± 5.08	5.17 ± 4.43	7.39 ± 3.76
	1973	7.20 ± 3.13	4.67 ± 1.72	7.12 ± 1.73
	Mean	8.19 (8.16)	4.74 (5.48)	7.70 (7.84)

TABLE II (Continued)

September

Mean Monthly Value ± σ

		08:30	13:30	18:30
Olympus Scientific Center	1965	30.22 ± 13.59	25.00 ± 7.21	31.84 ± 9.70
	1967	32.61 ± 12.63	28.22 ± 10.66	38.03 ± 11.09
	1968	31.75 ± 11.39	31.70 ± 12.05	39.85 ± 12.65
	1970	34.42 ± 13.85	25.64 ± 8.29	39.29 ± 9.62
	1971	46.89 ± 17.68	40.97 ± 21.13	46.99 ± 16.41
	1972	50.74 ± 25.49	46.16 ± 21.41	56.66 ± 23.54
	1973	43.65 ± 16.31	33.56 ± 10.26	45.19 ± 13.34
	Mean	38.61 (47.09)	33.04 (40.23)	42.69 (49.95)
Skiing Center	1971	17.34 ± 5.35	18.89 ± 4.53	18.77 ± 6.67
	1972	14.91 ± 3.19	17.54 ± 3.60	16.00 ± 3.49
	1973	14.68 ± 4.37	15.65 ± 3.70	15.62 ± 3.50
	Mean	15.64	17.36	16.80
Thessaloniki	1965	8.95 ± 2.23	6.60 ± 1.51	7.95 ± 1.07
	1967	7.84 ± 2.22	5.44 ± 2.19	7.42 ± 2.62
	1968	11.92 ± 5.01	7.51 ± 3.99	11.82 ± 5.15
	1970	10.73 ± 4.97	6.50 ± 3.37	9.39 ± 4.00
	1971	11.08 ± 5.76	9.41 ± 4.44	12.18 ± 5.32
	1972	11.27 ± 6.36	10.16 ± 4.57	11.48 ± 5.62
	1973	8.56 ± 4.28	7.79 ± 3.83	9.15 ± 2.48
	Mean	10.05 ± (10.30)	7.63 (9.12)	9.91 (10.94)

TABLE IIIa

Absolute Maximum cooling power values at the three stations reduced at sea-level.
(indexes denote dates)

		July			August			September		
		08:30	13:30	18:30	08:30	13:30	18:30	08:30	13:30	18:30
Olympus Scientific Center	1965	58.37[13]	41.80 [9]	51.55 [5]	47.40[28],[27]	58.90[27]	58.90[27]	65.00 [7]	43.58 [7]	53.40[13]
	1967	88.95 [9]	39.49[20]	75.16[11]	42.90[22]	32.86 [2]	43.48[23],[22]	62.75 [7]	65.29[16]	66.87[12]
	1968	57.67[19]	42.66[20]	61.47 [2]	61.26[20]	54.14[12]	66.31[12]	56.56[19]	70.54 [7]	68.36 [7]
	1970	54.39[31]	61.04[17]	58.11[18]	59.54[26]	50.20[11]	66.54[12]	64.03[22]	47.00[23]	58.51[30]
	1971	81.92[26]	51.17[20]	49.97[23]	59.58[11]	41.56[11]	51.48[12]	86.06[16]	90.63[17]	99.07[11]
	1972	56.80 [6]	45.07[16]	52.27[31]	85.20[20]	87.83 [4]	76.41[30]	106.50[28]	118.33[28]	121.71 [9]
	1973	90.77[25]	86.01[25]	85.20[31]	63.24[19]	59.61 [1]	61.43[10]	75.55 [9]	55.08[19]	78.68[19]
	max	90.77/25,73	86.01/25,73	85.20/31,73	85.20/20,72	87.83/4,72	76.41/30,72	106.50/28,72	118.33/28,72	121.71/9,72
Skiing Center	1971	31.32[26]	26.66[22]	27.21[31]	22.39[20]	27.11[18]	30.31[28]	34.51[18]	32.41[19]	40.88 [7]
	1972	26.91[14]	25.33[15]	30.34[14]	22.54[20]	23.38[27]	23.99[25]	22.39[26]	26.26[30]	25.68[28]
	1973	22.39[26]	25.33[26]	24.94[31]	26.01 [7]	22.89[17]	27.82[18]	24.64 [9]	23.82[13]	24.24 [5]
	max	31.32/26,71	26.66/22,71	30.34/14,72	26.01/7,73	27.11/18,71	30.31/28,71	34.51/18,71	32.41/19,71	40.88/7,71
Thessaloniki	1965	18.90[12]	17.82[28]	10.68[29]	23.89[13]	13.31[13]	13.59[30]	13.87[22]	9.65[25]	10.29 [8]
	1967	11.10[12]	10.84[11]	12.41[11]	12.27[28]	6.22[29]	9.55 [2]	13.63[24]	9.58[18]	13.94[16]
	1968	19.58[23]	9.14[23]	12.28[21]	11.83[20]	14.48[21]	22.01[20]	23.12[26]	19.58[26]	25.13[26]
	1970	16.92[18]	13.76[18]	15.37[18]	17.21[27]	7.88[26]	13.11[12]	22.94[29]	14.39[28]	19.70[27]
	1971	18.44[21]	15.63 [2]	16.43[15]	17.79[10]	12.94[28]	21.44[28]	25.13 [7]	21.33[19]	27.26[19]
	1972	16.62 [4]	14.31[16]	19.52[16]	23.22 [5]	13.81[24]	17.72 [4]	25.83[28]	24.42[29]	30.73[28]
	1973	16.82[13]	11.01[27]	18.12[11]	16.32[15]	11.61[27]	11.11[28]	22.62[12]	19.22[28]	15.42[28]
	max	19.58/23,68	17.82/28,65	19.52/16,72	23.89/13,65	14.48/21,68	22.01/20,68	25.83/28,71	24.42/29,72	30.73/28,72

TABLE IIIb

Absolute minimum cooling power values at the three stations reduced at sea-level.
(the asterisc demotes overheating and indexes denote dates)*

		July			August			September		
		08:30	13:30	18:30	08:30	13:30	18:30	08:30	13:30	18:30
Olympus Scientific Center	1965	13.12[22]	7.70[22]	15.99[20]	13.03[11]	11.22 [5]	18.04[24]	13.98[30]	13.73[10]	15.62 [3]
	1967	19.20[20]	13.04[22]	15.74[17]	16.40[10]	11.38 [5]	14.64 [6]	13.78[28]	15.83[31]	14.89[13]
	1968	12.91[11]	13.88[16]	18.17[10]	17.40[18]	15.86 [7]	21.22 [7]	12.93 [7]	8.91[17]	15.79[17]
	1970	10.20[19]	14.16[24]	15.46[14]	13.83[19]	12.77 [4]	20.17 [1]	16.16[25]	15.00[14]	20.56[20]
	1971	15.61[15]	12.82[14]	13.75[30]	16.35[13]	13.61[12]	13.18[13]	16.03 [6]	13.01[24]	20.78[27]
	1972	14.58[22]	14.65[24]	19.08[28]	21.32[29]	13.75[13]	22.78[23]	18.22[11]	21.32 [7]	21.87[22]
	1973	13.75 [1]	12.22[16]	23.01[20]	19.33 [5]	16.96[11]	20.38[31]	14.58[24]	17.17[15]	14.99[24]
	min	10.20/10,70	7.70/22,65	13.75/30,71	13.03/11,65	11.22/5,65	13.18/13,71	13.93/7,68	8.91/17,68	14.89/13,67
Skiing Center	1971	9.78[30]	9.48[31]	10.81[30]	9.91[24]	9.80 [2]	8.27 [3]	10.07[13]	9.87[11]	9.67[13]
	1972	8.50[21]	8.60[24]	10.20[10]	8.44[18]	7.93 [3]	6.66 [3]	10.00 [9]	9.27 [8]	11.32[10]
	1973	7.98[19]	6.09[19]	5.83[18]	11.31[30]	11.96 [5]	9.53 [7]	7.84[24]	8.53[11]	8.72[23]
	min	7.98/19,73	6.09/19,73	5.83/18,73	8.44/18,72	7.93/3,72	6.66/3,72	7.84/24,73	8.53/11,73	8.72/23,73
Thessaloniki	1965	4.83[21]	*	4.53[21]	5.15[15]	*	5.87[21]	4.59 [6]	4.36[28]	5.10 [6]
	1967	*	*	*	*	*	*	4.36 [1]	*	*
	1968	5.61[30]	3.15[22]	6.26[31]	4.86 [4]	*	4.83[11]	6.42[18]	2.61[17]	5.20[16]
	1970	3.08[15]	*	2.73 [9]	3.64 [4]	*	2.80 [8]	5.54 [3]	2.97[4,6]	5.42[15]
	1971	4.82 [9]	1.52[15]	2.39[29]	3.63 [3]	*	2.23 [5]	2.50 [5]	3.75 [3]	4.34[17]
	1972	3.10[31]	*	2.60[24]	3.00 [2]	*	2.60[11]	5.31 [6]	5.60 [10]	5.81 [2]
	1973	3.40 [8]	*	*	3.70[22]	2.20[22]	3.20[22]	4.60 [6]	3.80 [4]	4.40 [5]
	min	*	*	*	*	*	*	2.59/5,71	*	*

d) In Table IIIa we observe that c.p. values increase with height: Thus the absolute maximum c.p. value for the period examined is:

-A.U.T.: 30.73 mg.cal.cm^{-2} sec^{-1} (18:30/28-IX-72)
-Sk.C.: 40.88 mg.cal.cm^{-2} sec^{-1} (18:30/7-IX-71)
-O.S.C.: 121.71 mg.cal.cm^{-2} sec^{-1} (18:30/9-IX-72)

We observe again that for the first 1800 m of height difference the increase of the absolute maximum value is rather small (40.88/30.73= 1.33), while it is quite strong for the remaining 1000 m of height difference (121.71/40.88=2.98).

e) From Table IIIb, we observe that the absolute minima at the O.S.C. station stand as a rule between 10-20 mg. cal.cm^{-2} sec^{-1} (abs min. 7.70/22-VII-1965/13:30), at the Sk. C. such values are as a rule smaller than 10 mg. cal.cm^{-2} sec^{-1}, while finally at Thessaloniki (A.U.T.) we have cases of overheating due to extremely hight temperatures.

Standard deviation has been calculated for daily c. p. values (1.2%) with considerable deviation ($>\pm 3\sigma$), while at the O.S.C. such cases amount to 12 (0.7%).

Such c. p. values were recorded on days with very bad weather conditions (i. e. at 13:30/28-IX-72, at the O.S.C. station we had: $t_{air} = 2.3^{0}$C, V = 32.0 m/sec and rain, while the station was in the damp cloud; thus the c.p. recorded 118.33 mg. cal.cm^{-2}sec^{-1}).

3. Comparison between c.p. valnes of the three stations.

Examination of c.p. data from the three above mentioned stations, indicates an increase of these c. p. values with height; this is better illustrated in Graph 1.

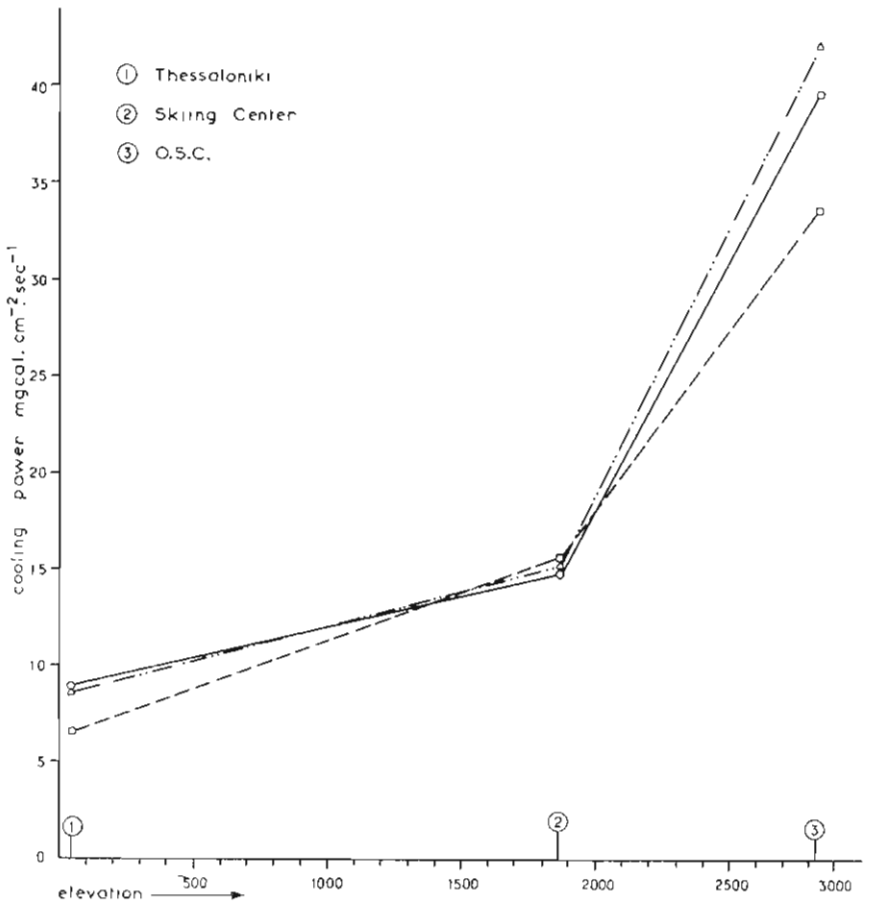
The curve in Graph 1 simply joins values of the three stations. It is not possible to plot the real curve of c.p. as a function of elevation because the variation of c.p. values does not depend absolutely on elevation alone; it depends also from the following factors:

a) Latitude: this factor may be disregarded here, as its amplitude is extremely small, especially for the two mountain-stations.

b) Local conditions (wind, radiation, air temperature, ground morphology).

As a matter of fact local conditions play an important role in cooling power values. Thus D o r n o[6] found that the c.p. value at various

elevations greately depends on the area's exposure to the wind; while Mörikofer[13] proved that in mountain areas, the behavior of c.p. depends more on local conditions, and especially on wind exposure, than on elevation.



GRAF 1. Seasonal mean values of c. p. (July to September) of the Northern Greece' stations as a function of altitude (1971 - 1973) (O = 08:30, □ = 13:30, Δ = 18:30 observation hours)

Of the two mountain-stations examined herein, that of O.S.C. is open to every wind, while that of Sk. C. is wind-protected by the surrounding mountain masses.

One more reason that does not allow the plotting of a real c.p.

TABLE IV

Monthly mean values of air temperature for the three observational hours at the three stations.*

	Thessaloniki			Skiing Center			Olympus Scientific Center		
	08:30	13:30	18:30	08:30	13:30	18:30	08:30	13:30	18:30
J	25.27 (25.62)	29.86 (30.48)	28.20 (28.09)	(13.43)	(15.61)	(15.24)	5.71 (5.22)	7.66 (6.84)	6.74 (6.15)
A	24.60 (25.43)	29.46 (30.19)	27.49 (27.89)	(13.31)	(15.86)	(15.33)	5.42 (5.23)	7.25 (7.08)	6.25 (6.06)
S	20.99 (23.97)	25.53 (24.91)	23.27 (22.54)	(9.77)	(11.87)	(11.41)	3.48 (2.72)	4.86 (4.20)	3.67 (3.06)
Mean	23.62 (25.01)	28.28 (28.53)	26.32 (26.17)	(12.17)	(14.45)	(13.99)	4.87 (4.39)	6.59 (6.04)	5.55 (5.09)

* Values between parentheses represent the period 1971-1973.

TABLE V

*Mean wind speed (m/sec) for the three observational hours at the three stations**.

	Thessaloniki			Skiing Center			Olympus Scientific Center		
	08:30	13:30	18:30	08:30	13:30	18:30	08:30	13:30	18:30
J	1.37 (1.34)	1.49 (2.00)	1.81 (2.12)	(2.13)	(3.02)	(2.56)	7.69 (8.14)	6.94 (7.80)	8.94 (9.77)
A	0.89 (0.94)	1.29 (1.51)	1.39 (1.70)	(1.71)	(2.50)	(1.98)	7.72 (8.39)	6.24 (6.25)	9.05 (9.68)
S	1.35 (1.24)	1.94 (1.56)	1.95 (1.45)	(1.89)	(2.47)	(1.84)	8.18 (10.46)	7.73 (8.82)	9.13 (10.79)
Mean	1.20 (1.17)	1 57 (1.69)	1.72 (1.76)	(1.91)	(2.66)	(2.13)	7.86 (9.00)	6.97 (7.62)	9 04 (10.08)

* Values between parentheses represent the period 1971-1973.

curve, is the lack of more stations that would stand in-between the three stations studied herein, thus covering the great height-difference among them.

In Tables IV and V we give respectively the monthly mean values of air temperature (° C) and wind velocities (m/sec) for the three stations.

A study of all the above mentioned Tables, allows the following description of conditions preaviling at each of the three stations:

A. Thessaloniki: This station, standing very near the seashore, has very high air temperatures[1] and small winf velocities[12] during the warm season (Tables IV, V).

The effect of such conditions is to produce very small c.p. values[14]. The range of coolong power values recorded at the city of Thessaloniki (Tables II and III) is explained by the fact that measurements are conducted on roof exposure and are not wind protected; thus the winds blowing in the sumer (mainly etesians) produce relatively high c.p. values, while whith calms prevailing we have quite small c.p. values[3,4,8,9]. Another factor reducing c.p. values is insolation, and this as depending from sunshine-duration is quite high during this season at Thessaloniki[10]

B. Skiing Center. Air temperature values are here almost half those of Thessaloniki (Table IV) while winds are not much stronger (Table V). This small increase of wind force is due to the presence of high mountain masses surrounding the station and preventing strong winds from blowing here.

Besides, the station's southward orientation is favorable for irradiation conditions, while sunshine duration is not much shorter than that of AUT[10] and O.S.C.[11] Such conditions produce the prerequisites for rather small cooling power values (Table II).

What is more important at this station, is the small range of monthly c.p. values. This small variation gives to the area a well balanced bioclimate.

It is also worth noting that the mean c. p. value of 13:30h is higher than those of 08:30 and 18:30. From Tables IV and V we observe that, while air temperature does not increase sensibly during the day, on the other hand wind velocity increases at mid-day[7] (valley breezes), and this results in the increase of cooling power also.

C. Olympus Scientific Center. Air temperature is quite small here as compared with that of the other two stations (Table

TABLE VI

Distribution of c.p. values in the grades of Conrad's classification and their percentages.

Thessaloniki

	08:30		13:30		18:30		Climate Classification
	No of Obser.	%	No of Obser.	%	No of Obser.	%	After V. Conrad
0 - 10.0	438	71.1	453	73.5	416	71.0	Hot Climate
10.1 - 20.0	150	24.4	72	11.7	139	23.7	Relaxing Climate
20.1 - 30.0	19	3.1	3	0.5	12	2.0	Mild but bracing Climate
30.1 - 40.0	0	0.0	0	0.0	1	0.2	Very Bracing Climate
>40.0	0	0.0	0	0.0	0	0.0	Very Cold Climate
Overheating	9	1.5	88	14.3	18	3.1	(Hot-very Hot Climate)
Posible	616	100.1	616	100.0	586	100.0	
No Data	28		28		58		
Total	644		644		644		

Skiing Center

	08:30		13:30		18:30		Climate Classification
	No of Obser.	%	No of Obser.	%	No of Obser.	%	After V. Conrad
0 - 10.0	19	6.9	16	5.8	23	8.5	Hot Climate
10.1 - 20.0	228	83.2	216	78.5	211	77.6	Relaxing Climate
20.1 - 30.0	25	9.1	40	14.5	37	13.6	Mild but bracing Climate
30.1 - 40.0	2	0.7	2	0.7	1	0.4	Very Bracing Climate
>40.0	0	0.0	1	0.4	0	0.0	Very Cold Climate
Overheating	0	0.0	0	0.0	0	0.0	(Hot-very Hot Climate)
Posible	274	99.9	275	99.9	272	100.1	
No Data	2		1		4		
Total	276		276		276		

Olympus Scientific Center

	08:30		13:30		18:30		Climate Classification
	No of Obser.	%	No of Obser.	%	No of Obser.	%	After V. Conrad
0 - 10.0	0	0.0	2	0.3	0	0.0	Hot Climate
10.1 - 20.0	88	14.2	136	21.9	31	5.0	Relaxing Climate
20.1 - 30.0	172	27.7	233	37.6	150	24.0	Mild but bracing Climate
30.1 - 40.0	161	26.0	148	23.9	202	32.4	Very Bracing Climate
>40.0	199	32.1	101	16.3	241	38.6	Very Cold Climate
Overheating	0	0.0	0	0.0	0	0.0	(Hot-very Hot Climate)
Posible	620	100.0	620	100.0	624	100.0	
No Data	24		24		20		
Total	644		644		644		

IV) while the winds blowing are very strong (Table V). The combination of these two factors[14] produces very high cooling power values (Tables II, III).

We should note here the great variation of c.p. values, which is the result of the intense variations of wind speed, which very often reaches 40 m/sec[15].

This station stands free of any natural obstacle all around, and represents the real bioclimatic conditions prevailing at the beight of 2.800 m on the moutain mass of Olympus and especially of areas totally exposed to the wind.

From the above statements we can conclude that the magnitude of c.p. values greately depends on local conditions of each station. Of course the elevation factor plays also an important role because of air temperature decrease with height. Yet the relation between cooling power and elevation cannot be defined, because it is practically impossible to have stations with the same exposure conditions.

4. Climatic Classification according to Conrad.

The definition of the bioclimatic type of each station has been effected according to Cornad's classification[5].

Distribution of daily c.p. values in grades of Conrad's scale, produced Table VI.

From this Table VI we can define the thermal bioclimate of each station during the warm period, as follows:

1. Thessaloniki: The thermal bioclimate is characterized as «hot» during the mid-day hours, and as «hot-relaxing» during the morning and afternoon ones.

2. Skiing Genter: The thermal bioclimate is characterized overall as «relaxing».

3. Olympus Scientific Center: At this station the bioclimate varies from «mild bnt bracing» to «very cold climate», while at mid-day we have a number of observations with relaxing climate.

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MATERIAL

15. Ἀρχεῖον ταινιῶν Μετεωρολογικῶν καταγραφικῶν ὀργάνων τοῦ Ἰνστιτούτου Μετεωρολογίας-Κλιματολογίας Α.Π.Θ.
Archives of meteorological recorder charts of the Institute of Meteorology and Climatology A.U.T.

ΠΕΡΙΛΗΨΙΣ

ΤΑΧΥΤΗΣ ΑΠΟΨΥΞΕΩΣ ΚΑΤΑ ΤΗΝ ΘΕΡΜΗΝ ΠΕΡΙΟΔΟΝ ΕΙΣ ΔΙΑΦΟΡΕΤΙΚΑ ΥΨΟΜΕΤΡΑ

ὑπὸ

ΧΡΗΣΤΟΥ Ι. ΜΠΑΛΑΦΟΥΤΗ

Μελετᾶται διὰ τὴν πόλιν τῆς Θεσσαλονίκης καὶ τὴν ὀρεινὴν μάζαν τοῦ ἄνω Ὀλύμπου ἡ ταχύτης ἀποψύξεως κατὰ τὸ θερμὸν τρίμηνον (Ἰουλίου, Αὐγούστου, Σεπτεμβρίου) τῶν ἐτῶν 1965-1973 (ἐκτὸς 1966, 1969) διὰ τὸν σταθμὸν τῆς Θεσσαλονίκης καὶ Ἁγίου Ἀντωνίου Ὀλύμπου (ΕΚΟ) καὶ τῶν ἐτῶν 1971-1973 διὰ τὸν σταθμὸν ΚΕΟΑ.

Μελετῶνται αἱ τιμαὶ κατὰ σταθμόν, συγκρίνονται δὲ μεταξύ τους καὶ αἰτιολογοῦνται αἱ διαφοραὶ μεταξὺ τῶν σταθμῶν.

Καθορίζονται τὰ αἴτια τοῦ μεγέθους τῶν τιμῶν τῆς ταχύτητος ἀποψύξεως εἰς κάθε σταθμόν.

Τέλος δὲ προσδιορίζεται τὸ βιόκλιμα τῶν σταθμῶν αὐτῶν.