

SUNSHINE DURATION ON MT OLYMPUS-GREECE

by

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(received 2.7.73)

Abstract: *The first results of sunshine duration measurements during the summer season (July - September) upon the mountain mass of upper Olympus - Greece, are studied. These measurements have been effected in the two meteorological stations belonging to the Institute of Meteorology and Climatology of the Aristotelian University of Thessaloniki. Observations in the met. station Olympus Scientific Center (O.S.C.) (elev. 2.817 m., Ayios Antonios peak) cover the period of summers 1962-1971, and in the Skiing Center (S. C., elev. 1.850 m., inside the Ag. Antonios - Sparmos ravine) cover the summers of 1965-1971.*

Simultaneous observations in the two stations during the years 1965 - 1971 are compared, and it is observed that the Skiing Center has smaller sunshine duration values, due to the local ground relief.

The Institute of Meteorology and Climatology of the Aristotelian University of Thessaloniki started in 1962 the installation of a meteorological network upon the mountain mass of Olympus (LIVADAS, 1963⁴, KYRIAZOPOYLOS, 1966³).

Each summer within the enclosure of the met. station in the Olympus Meteorological Observatory (Mt. Olympus Scientific Center, elev. 2817 m) a Campbell- Stokes sunshine recorder (manuf. R. Fuess) is set up. Another similar sunshine recorder (manuf. C. F. Casella) is set up ever since the summer of 1965 at the met. station of the Skiing Center (elev. 1850 m). The bird's flight distance between the two sites is 2,6 km. These two sites differ from each other not only as to the elevation (difference of about 1000 m), but also as to their horizon. The Ayios Antonios peak has an entirely free horizon; every point of the «local horizon», except for the other two peaks of Olympus' mountain mass (Skoleion-elev. 2910 m and Zeus' Throne or Mytikas elev. 2917 m) which stand at a horizontal distance of 1,8-2,0 km to the north of Ayios Antonios peak, coincides with the «ideal horizon.»

On the other hand the Skiing Center stands inside a narrow ra-

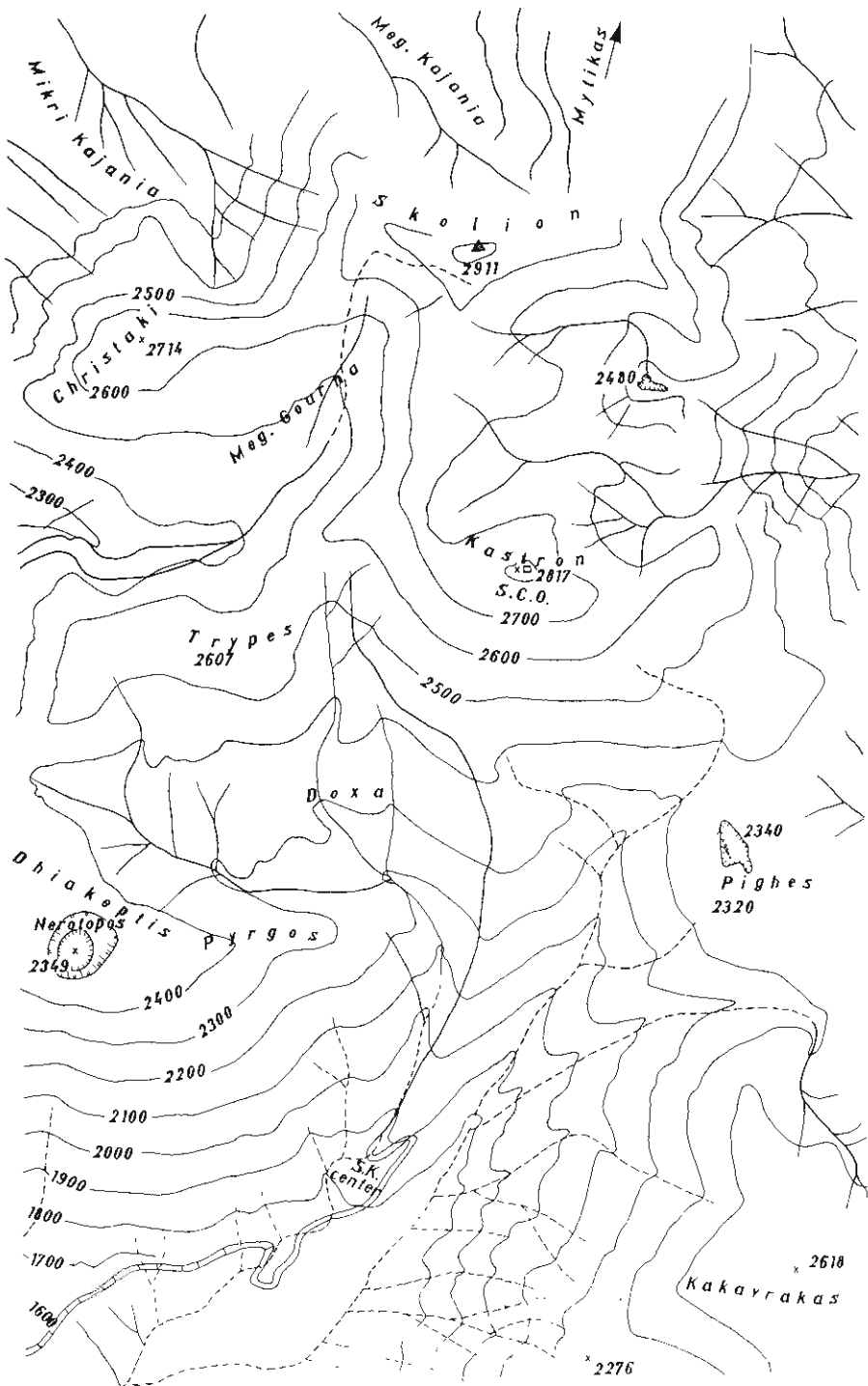


Fig. 1 - Contour map of the area

vine with a north-south axis which is open to the south (without any natural obstructions), while its sides are formed by the mountain masses of Kakavrakas (elev. 2618 m) to the east and Dhiakoptis (elev. 2349 m) to the west.

MATERIAL: Sunshine duration measurements in the Mt Olympus Scientific Center (O.S.C.) have been effected each summer season since the year 1962. In the met., station of the Skiing Center (S.C.) measurements began in 1965. It should be mentioned that, for various reasons, the operation of Olympus Scientific Center on a permanent basis has not been possible till today. That is why the Inst. of Met. and Climatology has to organize each year, during the summer season from June to October, scientific expeditions, which work in the area of Upper Olympus.

The dates of the ascent and descent of this expedition, depend on the snow cover, especially in elevations > 2600 m. If its depth is > 50 cm, pack animals, on which depends the supply and victualling of the Scientific Center, cannot advance on the snow-bound trail. Difficulties start when the snow cover is ≥ 20 cm deep, and this is the main reason for our leaving the Center, and working there during the snow-free period only. The routine followed by the expedition, is to settle first in the Skiing Center (elev. 1850 m) and thence to ascent to the Ayios Antonios peak (elev. 2817 m), on which rises the building of the Olympus Scientific Center (KYRIAZOPOULOS³). This is the reason why, during all the common periods of sunshine-duration measurements in both stations since 1966, the observational period is longer in the Skiing Center than in O.S.C. (see Table I).

A. SUNSHINE DURATION IN O.S.C.

The elevation of Olympus Scientific Center is the highest of all meteorological stations around the Mediterranean, and one of the highest in Europe, while as far as we know it holds a very good place among the twenty most elevated meteorological stations of this planet. Met. stations, like that of Ayios Antonios peak, have an entirely free horizon, where all natural obstacles stand at negative elevations as to the level of the peak, especially towards the Aegean Sea (East-South). The only mountain masses standing in this direction are Mt Athos (elev. 2033 m) on the namesake peninsula at a distance of some 170 km, and the peak of Kakavrakas (elev. 2618 m) at a dista-

TABLE I
Duration (in days) of observational periods of sunshine duration in Upper Olympus

O.S.C	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	T
June	—	—	7	—	6	14	4	2	7	2	42
July	14	8	31	29	31	31	31	31	31	31	268
August	34	31	31	31	31	31	31	31	31	31	310
September	13	30	30	30	30	30	30	30	30	30	283
October	—	—	2	9	15	15	15	15	2	0	73
Total	58	69	101	99	113	121	111	109	101	94	976
S. C.	—	—	—	—	—	—	—	—	—	—	—
June	—	—	—	—	14	14	5	2	10	6	51
July	—	—	—	15	31	31	31	31	31	31	201
August	—	—	—	30	31	31	31	31	31	31	216
September	—	—	—	30	30	30	30	30	30	30	210
October	—	—	—	12	31	19	16	24	6	3	111
Total	87	137	125	113	118	108	101	789			

nce of 3,8 km. Thus the only obstacle of sunshine duration due to local relief is the curvature of the earth.

On the west the range of Pindos mountains, which runs along western Greece, with elevations ≤ 2800 m, stands at a horizontal distance of 160 km and consequently cannot be considered as a natural obstacle to sunshine duration.

Consequently, besides the inability of Campbell-Stokes sunshine-recorders to record the first minutes after sunrise and the last before sunset, the only factor that reduces or obstructs sunshine duration is cloudiness. As a matter of fact, cloudiness appears considerably higher around the peaks of Upper Olympus, than in other regions of Aegeatic Greece; this happens because the mountain mass of Olympus and especially the Ayios Antonios peak, because of its relief as well as its nearness to the warm Aegean Sea (horizontal distance 18 km) con-

TABLE II

Sunshine duration in O.S.C. during the warm season of the years 1962 - 1971.

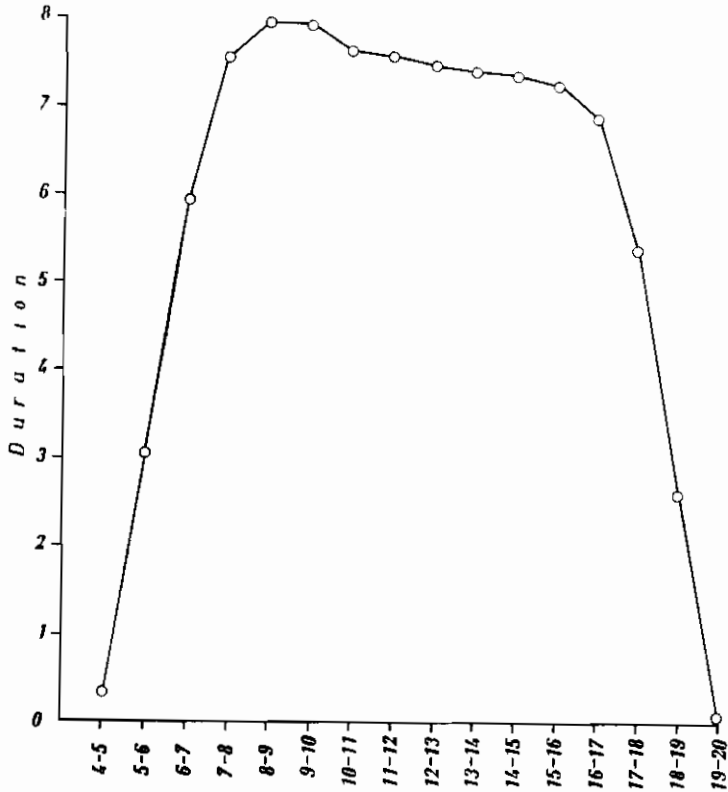
	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13
June	0.030	0.429	0.619	0.726	0.754	0.705	0.666	0.689	0.684
July	0.068	0.560	0.688	0.741	0.752	0.739	0.732	0.754	0.770
August	0.003	0.426	0.790	0.848	0.863	0.847	0.815	0.814	0.783 →
September	—	0.023	0.396	0.703	0.746	0.758	0.738	0.708	0.667
October	—	—	0.080	0.655	0.771	0.815	0.831	0.770	0.762
Mean of warm season	0.021	0.314	0.587	0.757	0.787	0.783	0.764	0.758	0.740
	13-14	14-15	15-16	16-17	17-18	18-19	19-20	Total	
June	0.635	0.611	0.621	0.645	0.619	0.353	0.008	8.794 H/day	
July	0.762	0.760	0.760	0.735	0.679	0.456	0.024	9.980 »	
August	0.780	0.776	0.788	0.767	0.701	0.352	0.002	10.355 »	
→ September	0.676	0.687	0.649	0.579	0.322	0.027	—	7.679 »	
October	0.739	0.720	0.641	0.544	0.065	—	—	7.392 »	
Mean of warm season	0.736	0.734	0.722	0.681	0.534	0.260	0.008	9.187 »	

sists a basis for the formation of cumuliform clouds (KYRIAZOPOULOS³).

The development of these cumuliform clouds, produces as an average a systematic decrease of sunshine duration at the O.S.C. The sun-

shine maximum appears between 08:00 and 10:00 hours, and then although its values remain high enough, it starts decreasing continuously. This means that in the area of Upper Olympus one should expect a diurnal variation of sunshine of the *Continetal type* (Table II, Graph. I).

GRAPH I



From the above Table II we find that daily mean values of sunshine duration in O.S.C. have the maximum in August, instead of July which has the maximum of theoretical as well as the observed sunshine duration values, at least in the lowland area of Thermaikos Gulf, whose southern boundary is Mt Olympus and its northern is the city of The-

saloniki (LIVADAS-FLOCAS⁸). This however happens only on the Ayios Antonios peak, because of the pronounced effect of cloudiness, while in the met. station of the Skiing Center (elev. 1850 m) July has the daily mean maximum. Here again cloudiness plays an important role: In the months of July and August the condensation level of cumuli clouds is > 2000 m (LIVADAS-CAROULIAS⁷); as a consequence sunshine is not obstructed by clouds rolling along the ground of the met. station, as is the case of O.S.C. (elev. 2817 m).

TABLE III

Distribution and percentages of daily sunshine duration values

<i>Seate</i>	<i>J</i>	<i>(%)</i>	<i>A</i>	<i>(%)</i>	<i>S</i>	<i>(%)</i>	<i>N</i>	
14.50-15.49	3	4.12	—	—	—	—	3	0.0035
13.50-14.49	55	20.45	23	7.42	—	—	78	0.0905
12.50-13.49	40	14.87	92	29.68	1	0.35	133	0.1543
11.50-12.49	29	10.78	36	11.61	27	9.54	92	0.1067
10.50-11.49	19	7.06	38	12.26	62	21.91	119	0.1381
9.50-10.49	22	8.18	26	8.39	28	9.89	76	0.0882
8.50- 9.49	13	4.83	20	6.45	42	14.84	75	0.0870
7.50- 8.49	23	8.55	21	6.77	17	6.01	61	0.0708
6.50- 7.49	12	4.46	16	5.16	15	5.30	43	0.0499
5.50- 6.49	11	4.46	9	2.90	11	3.89	31	0.0371
4.50- 5.49	7	2.60	5	1.61	17	6.01	29	0.0336
3.50- 4.49	8	2.97	8	2.58	7	2.47	23	0.0267
2.50- 3.49	8	2.97	3	0.97	18	6.36	29	0.0336
1.50- 2.49	8	2.97	6	1.94	8	2.83	22	0.0255
0.50- 1.49	8	2.97	3	0.97	8	2.83	19	0.0220
0.01- 0.49	1	0.37	1	0.32	10	3.53	12	0.0139
0	1	0.37	3	0.97	12	4.24	16	0.0186
Total	268	99.98	310	100.00	283	100.00	861	1.0000

TABLE IV

Percentage of days with various sunshine durations in the O.S.C.

	<i>July</i>	<i>August</i>	<i>September</i>	
≡	11.50	47.21 %	48.71 %	9.89 %
^	1.50	3.72 %	2.26 %	10.60 %
^	0.49	0.74 %	1.29 %	7.77 %
=	0	0.37 %	0.97 %	4.24 %

As to the distribution of daily values (Tables III and IV) we observe that during the whole July-September trimester, 58.19 % of the daily sunshine duration values are > 9.50 h/day (July: 62.46 %, August: 69.36 % and September: 41.69 %), while about 50 % of the days of the main two summer months have sunshine durations ≥ 11.50 h/day. On the contrary, the sunless (duration=0) or practically sunless (duration $0+ < 0,49$) days, total 28 out of 861 observational days, that is 3.25%. Also the sunless or practically sunless days are very few during the main two summer months, July and August, and they increase in September. It is true that the second fortnight of September marks the beginning of winter on the peak of Ayios Antonios.

TABLE V

Groups of consecutive sunless or practically sunless days in the O.S.C.

«O»	Duration				Σ_1	Σ_2	Σ_1/Σ_2
	2	3	4	5	Total of groups	Total of days	%
J	—	—	—	—	—	1	—
A	—	—	—	—	—	3	—
S	2	—	—	—	4	12	33.33
Total of cases	2	—	—	—	—	16	
Total of days	4	—	—	—	—	16	
$0+ < 0,49$							
J	—	—	—	—	—	—	—
A	—	—	—	—	—	4	—
S	1	—	1	—	6	22	27.27
Total of cases	1	—	1	—	—	—	
Total of days	2	—	4	—	6	22	

From Table V, containing the duration of groups of consecutive sunless or practically sunless days, we find that no consecutive overcast days have been observed during the two above mentioned months, while in September we have groups of as many as four (4) consecutive overcast days.

As to the distribution of hourly sunshine values we have to observe the following:

(a) The number of clear (sunny) hours generally covers $\frac{1}{2}$ of the amount of observational days, while sunless hours hold a much smaller percentage; a large number of sunless hours occur during the sunrise or sunset, that is at times when sunshine cannot be recorded during the whole hour.

(b) The largest number of clear hours (sunshine duration=1 hour) are recorded during the first hours of daylight, that is between 07:00-10:00 h in July and August, and 08:00-11:00 h in September (Table VI). Besides, the smallest number of sunless or practically sunless hours in August and September, occur at the same time of day. This coincidence of the maximum number of clear hours and the minimum of overcast ones, accounts for the recorded maximum of sunshine duration in the O.S.C. at this time of day. (See Graph 1-Table 11).

(c) Intermediate values of sunshine duration during 1 hour intervals, appear tantamount during the whole summer season that is covered by our observations.

B. SUNSHINE DURATION IN THE SKIING CENTER

On an elevation of 1850 m, between the mountain mass of Kakavrakas and Dhiakoptis (elev. 2618 and 2349 m to the south of O.S.C.) rise the installations of the Military Skiing Center. These installations are the main base of the Olympus Scientific Expedition each summer.

In the summer of 1965 a Campbell - Stokes sunshine recorder has been set up in the met. station of the Skiing Center. However, systematic measurements started only in the next summer season. Results of these measurements are included in Table VII. Here also we observe that: the maximum of hourly sunshine duration during the day, is recorded at the same time, that is between 08:00- 10:00 h a.m. A secondary maximum is recorded after midday, between 13:00-14:00 h. Anyway this value is smaller by about 1 hour than the maximum recorded early in the morning.

Examining the daily mean sunshine duration we observe that: (a) In the Skiing Center, July has the longest sunshine duration; meaning that the rule of July having the longest sunshine duration applies in elevations of 1850 m.

TABLE VI

Frequency of hourly values of sunshine duration.

<i>Month</i>	<i>Duration in hours</i>	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20		
<i>July</i>	0-0.29	200	90	72	58	49	57	53	48	37	40	45	41	50	65	108	229	1242	0.294
	0.30-0.69	23	39	22	20	29	26	31	27	36	35	29	39	31	35	64	2	488	0.116
	0.70-0.99	3	67	22	32	28	32	40	45	45	44	46	46	38	47	64	0	596	0.141
	1	0	73	153	159	163	154	145	149	152	148	149	151	141	127	33	0	1897	0.449
																			4.253
																			1.000
<i>August</i>	0-0.29	93	116	49	35	30	32	38	39	43	49	47	42	49	70	148	62	942	0.210
	0.30-0.69	0	105	24	18	21	28	31	32	38	30	38	38	40	42	99	0	584	0.130
	0.70-0.99	0	81	29	30	27	24	30	39	45	43	36	48	41	35	50	0	558	0.124
	1	0	8	208	227	232	226	211	200	184	188	189	182	180	163	13	0	2411	0.536
																			4.495
																			1.000
<i>September</i>	0-0.29	0	170	126	75	56	55	64	64	76	74	67	78	102	156	211	0	1374	0.362
	0.30-0.69	0	10	74	14	23	22	21	33	31	32	40	39	32	67	11	0	449	0.148
	0.70-0.99	0	0	58	26	33	25	26	28	32	35	30	33	32	35	1	0	394	0.104
	1	0	0	25	168	171	181	172	158	144	142	146	133	117	25	0	0	1582	0.446
																			3.799
																			1.000

(b) Sunshine duration is smaller in the Skiing Center during the whole summer season, while in August it is 2 hours shorter than that of the O.S.C.

TABLE VII
*Sunshine duration in the Olympus skiing center during the warm season
(1965 - 1971).*

	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13
June	—	0.010	0.592	0.832	0.827	0.753	0.741	0.541	0.526
July	—	0.016	0.518	0.770	0.788	0.766	0.741	0.719	0.727
August	—	—	0.254	0.811	0.858	0.830	0.779	0.730	0.703 →
September	—	—	0.005	0.373	0.732	0.685	0.640	0.616	0.614
October	—	—	—	0.028	0.558	0.671	0.588	0.579	0.568
Mean of warm period		0.005	0.274	0.563	0.753	0.741	0.698	0.637	0.628
	13-14	14-15	15-16	16-17	17-18	18-19	19-20		Total
June	0.683	0.595	0.495	0.549	0.469	0.150	—	7.763	H/day
July	0.732	0.718	0.683	0.656	0.576	0.228	0.001	8.639	»
August	0.715	0.691	0.656	0.643	0.512	0.142	—	8.324	»
→ September	0.623	0.602	0.524	0.345	0.130	0.005	—	5.895	»
October	0.553	0.548	0.442	0.196	0.010	—	—	4.742	»
Mean of warm period	0.661	0.631	0.560	0.478	0.339	0.105	0.000	7.073	»

One of the main factors diminishing sunshine duration in this station are the natural obstacles of the ground relief.

As to the distribution of daily values (Tables VIII, IX, and X), we observe that during the July-September trimester a percentage of 31.6 % of these daily values is ≥ 9.50 h/day (July: 103 days or 50.10%, August: 111 days or 51.4%, September: 34 days or 16.2%). The main two summer months have daily sunshine duration ≥ 11.50 h/day in the following percentages: July 22.13%, and August 8.33%.

Comparing the distribution data of the Skiing Center, with these of the O.S.C. (Table III and IV) we observe that the peak of Ayios Antonios (O.S.C.) has by far longer sunshine duration.

Sunless days (duration=0) and practically sunless days (duration = 0+ < 0.49) have very small percentages during the first two months (2.3 %); their percentage gets higher in September, and even high-

TABLE VIII

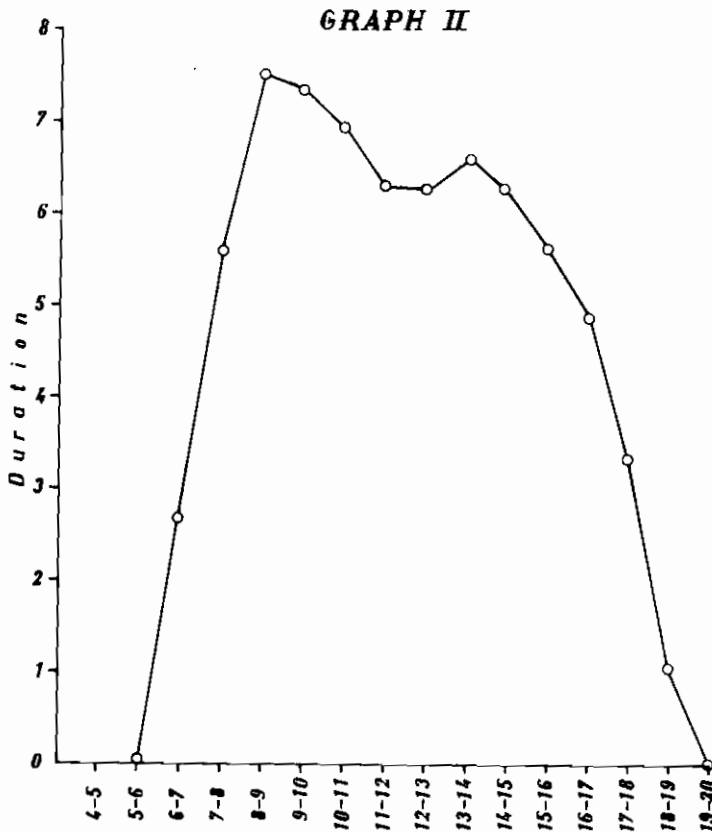
Distribution of daily values of sunshine duration in the Skiing Center

	J	J	A	S	O	Total	Σ_1/Σ_2
14.50-15.49	—	—	—	—	—	—	—
13.50-14.49	—	—	—	—	—	—	—
12.50-13.49	1	15	—	—	—	16	0.0204
11.50-12.49	7	40	18	—	—	65	0.0828
10.50-11.49	4	32	53	2	—	91	0.1159
9.50-10.49	6	16	40	32	—	94	0.1197
8.50- 9.49	5	14	20	30	11	80	0.1019
7.50- 8.49	6	17	18	25	14	80	0.1019
6.50- 7.49	6	10	10	13	19	58	0.0739
5.50- 6.49	4	17	13	18	8	60	0.0764
4.50- 5.49	2	9	13	18	10	52	0.0662
3.50- 4.49	1	10	9	16	5	41	0.0522
2.50- 3.49	3	7	6	18	8	42	0.0535
1.50- 2.49	2	6	7	10	10	35	0.0446
0.50- 1.49	2	7	4	9	8	30	0.0382
0.01- 0.49	—	—	4	11	3	18	0.0229
0	—	2	1	8	12	23	0.0293
	49	202	216	210	108	785	0.9998

TABLE IX

Percentage of daily values of sunshine duration in the Skiing Center

	J	J	A	S	O
14.50-15.49	—	—	—	—	—
13.50-14.49	—	—	—	—	—
12.50-13.49	2.04	7.43	—	—	—
11.50-12.49	14.29	19.80	8.33	—	—
10.50-11.49	8.16	15.84	24.54	0.95	—
9.50-10.49	12.24	7.92	18.52	15.24	—
8.50- 9.49	10.20	6.93	9.26	14.29	10.19
7.50- 8.49	12.24	8.42	8.33	11.90	12.96
6.50- 7.49	12.24	4.95	4.63	6.19	17.59
5.50- 6.49	8.16	8.42	6.02	8.57	7.41
4.50- 5.49	4.08	4.46	6.02	8.57	9.26
3.50- 4.49	2.04	4.95	4.17	7.62	4.63
2.50- 3.49	6.12	3.47	2.78	8.57	7.41
1.50- 2.49	4.08	2.97	3.24	4.76	9.26
0.50- 1.49	4.08	3.47	1.85	4.29	7.41
0.01- 0.49	—	—	1.85	5.24	2.78
0	—	0.99	0.46	3.81	11.11
	99.97	100.02	100.00	100.00	100.01



er in the first fortnight of October, when the clouds condensation level lies below the elevation of the Skiing Center (LIVADAS-CAROULIAS 7).

TABLE X
Percentage of hourly values in the Skiing Center.

	J	J	A	S	O
≥ 11.50	16.33%	27.23%	8.29%	—	—
< 1.50	4.08%	4.46%	4.15%	13.33%	21.30%
≥ 0.49	—	0.99%	2.30%	9.05%	13.89%
≠ 0	—	0.99%	0.46%	3.81%	11.11%

We observe that at the Skiing Center also no consecutive sunless or practically sunless days occur in July; while August, with a total of 5 practically sunless days, has 2 groups of 2 consecutive days. Groups with more than three consecutive days have not been recorded at the Skiing Center.

TABLE XI
Groups of consecutive sunless or practically sunless days.

«O»	Duration				Σ_1 Total of groups	Σ_2 Total of days	Σ_1/Σ_2 %
	2	3	4	5			
J	—	—	—	—	—	0	—
J	—	—	—	—	—	2	—
A	—	—	—	—	—	1	—
S	1	—	—	—	2	8	25.0
O	2	1	—	—	7	12	58.3
Total of cases	3	1	—	—	—	23	
Total of days	6	3	—	—	9		
0 + < 0,49							
J	—	—	—	—	—	0	—
J	—	—	—	—	—	2	—
A	1	—	—	—	2	5	40.0
S	2	—	—	—	4	19	21.0
O	1	2	—	—	8	15	53.3
Total of cases	4	2	—	—	—	39	
Total of days	8	6	—	—	14		

As to the distribution of hourly values, we have to observe the following:

- The number of clear (sunny) hours during the main two summer months, is almost twice as high as that of sunless and practically sunless (sunshine < 0.29 h) hours altogether.
- The largest number of clear hours (sunshine duration: 1 hour) are recorded during the first hours of daylight, that is between 08:00-10:00 h in July and August and 08:00-11:00 h in September (Table XII). Moreover, during all the months of the warm period examined, the small-

TABLE XII
Frequencies of hourly values of sunshine duration at the Skiing Center.

<i>Month</i>	<i>Duration in hours</i>	4-5	5-6	6-7	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	Σ	%
<i>July</i>	0-0.29	—	62	58	31	33	37	41	41	41	35	40	49	55	63	77	30	693	25.9
	0.30-0.69	—	—	71	22	19	21	20	25	28	31	28	29	24	42	51	—	411	15.4
	0.70-0.99	—	—	48	25	17	20	28	31	29	34	41	33	31	40	27	—	404	15.1
	1	—	—	25	124	133	124	113	105	104	102	93	91	92	57	—	—	1163	43.5
<i>August</i>	0-0.29	—	—	139	25	23	27	29	43	43	39	43	51	57	82	65	—	666	24.6
	0.30-0.69	—	—	54	22	12	13	24	24	38	33	41	36	35	40	56	—	428	15.8
	0.70-0.99	—	—	23	32	16	25	42	31	33	47	38	38	41	45	3	—	414	15.2
	1	—	—	—	137	165	151	121	118	102	97	94	91	83	49	—	—	1208	44.5
<i>September</i>	0-0.29	—	—	60	90	43	52	60	64	64	60	64	80	117	81	58	—	893	38.2
	0.30-0.69	—	—	—	79	18	24	25	31	29	29	30	34	42	22	2	—	365	15.6
	0.70-0.99	—	—	—	33	34	24	30	22	31	35	39	29	14	13	—	—	304	13.0
	1	—	—	8	115	110	95	93	86	86	86	77	67	37	4	—	—	778	33.3

est number of hours with sunshine duration < 0.29 hours is recorded in the interval between 07:00-11:00 h. Besides the coincidence of the maximum number of clear hours and the minimum of overcast ones (with sunshine obscured by clouds,) accounts for the occurrence of the maximum sunshine duration at midday (see Graph 11).

(c) Intermediate values of sunshine duration, between 0.30-0.99 h per hour, appear tantamount during the whole period examined.

DISCUSSION

Comparing the diurnal variation of sunshine duration in the examined two met. stations of Mt. Olympus, we notice the following:

(a) Sunshine duration in the ravine station (Skiing Center) is always shorter than on the peak (O.S.C.). During the three months with

TABLE XIII

Sunshine duration in hours per day during each month of the observational period

	O.S.C.	S.C.	Δ
June	8.794	7.763	(1.031)
July	9.980	8.639	1.341
August	10.355	8.324	2.031
September	7.679	5.895	1.784
October	7.392	4.742	(2.650)

complete series of daily observations, differences are > 1 hour per day, while in August the difference is more than 2 hours.

This difference is mainly due to the ground relief of the two stations (a closed ravine against one of the highest peaks in the area).

(b) Cloudiness may be considered a secondary factor of this difference: as an average, more cloudiness is observed in the Skiing Center station than in that of O.S.C.

Also during daytime, the comparatively dry air masses from the occluded plain of Thessaly, rise through the Sparmos- Skiing Center valley, forming cumulus clouds, whose base level sometimes lies below that of the Skiing Center (elev. 1850 m); but usually, during the main two summer months, the condensation and cloud-base level stands a few hundred meters above that of the met. station (LIVADAS-CAROULIAS ?). In both cases, however, the result is an increase of cloudiness and decrease of sunshine duration.

(c) Cloudiness also influences the diurnal variation of sunshine duration (Graphs I and II). The maximum sunshine duration is recorded in the early morning hours; then it begins decreasing as cloudiness, due to daytime convection, increases (table XIII).

Table XIV clearly illustrates the superiority of sunshine duration in the O.S.C. over that of the Skiing Center station during the whole day.

TABLE XIV

Hourly values of sunshine duration per hour in the two stations.

Hour.	O.S.C	S.C	Δ
4-5	0.021	—	0.021
5-6	0.341	0.005	0.336
6-7	0.587	0.274	0.313
7-8	0.757	0.563	0.194
8-9	0.787	0.753	0.034
9-10	0.783	0.741	0.042
10-11	0.764	0.698	0.066
11-12	0.758	0.637	0.121
12-13	0.740	0.628	0.112
13-14	0.736	0.661	0.075
14-15	0.734	0.631	0.103
15-16	0.722	0.560	0.162
16-17	0.681	0.478	0.203
17-18	0.534	0.339	0.195
18-19	0.260	0.105	0.155
19-20	0.008	0.000	0.008
Σ_1 4 ω -20 ω	9.213	7.073	2.140
Σ_2 6 ω -18 ω	8.583	6.963	1.620

Even if we exclude the early morning and late afternoon hours, when sunshine is obstructed by the local ground relief at the station of the Skiing Center, and if we take into account only the 06:00-18:00 h interval, again the O.S.C. station always exceeds that of the Skiing Center.

The difference gets smaller between 08:00 and 10:00, that is before the convection currents from the plains begin, the two stations have almost the same sunshine.

All the above indicate that cloudiness, during the warm season increases around midday on the mountain area of Olympus.

Metaxas¹⁰ in his study of the diurnal variation of cloudiness over the plain of Attica, comparing a coastal met. station (Hellenikon Airport) with an in-land station (Tatoi School of Aviation), comes to similar conclusions. On the contrary, studies of sunshine duration in coastal stations (Athens, National Observatory-KARAPIPERIS² Thessaloniki-LIVADAS⁵, LIVADAS and oth.⁶, LIVADAS - FLOCAS⁸) resulted in a plateau between 08:00-18:00 hours.

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Π Ε Ρ Ι Λ Η Ψ Ι Σ

ΔΙΑΡΚΕΙΑ ΗΛΙΟΦΑΝΕΙΑΣ ΕΙΣ ΤΟ ΟΡΟΣ ΟΛΥΜΠΟΣ

Ἵ π ὸ

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Μελετῶνται τὰ πρῶτα ἀποτελέσματα τῶν μετρήσεων τῆς διαρκείας τῆς ἡλιοφανείας, κατὰ τὴν θερινὴν περίοδον (Ἰούλιος - Σεπτέμβριος) ἐπὶ τοῦ ὄρεινου ὄγκου τοῦ ἄνω Ὀλύμπου, εἰς δύο μετεωρολογικοὺς σταθμούς, ἀνήκοντας εἰς τὸ Ἐργαστήριον Μετεωρολογίας - Κλιματολογίας τοῦ Ἀριστοτελείου Πανεπιστημίου Θεσσαλονίκης. Διὰ τὸν μετ. σταθμὸν τοῦ Ἐπιστημονικοῦ Κέντρου Ὀλύμπου (Ε.Κ.Ο., ὑψόμετρον 2817 μ., κορυφὴ Ἁγίου Ἀντωνίου) καὶ διὰ τὰ θέρη 1962 - 1971, ὡς καὶ διὰ τὸν μετ. σταθμὸν Κ.Ε.Ο.Α. (ὑψόμετρον 1850 μ., ἐντὸς τῆς χαράδρας Ἁγ. Ἀντωνίου - Σπαρμουῦ) διὰ τὰ θέρη 1965 - 1971.

Ἐπίσης γίνεται σύγκρισις ἐπὶ τῶν συγχρόνων μετρήσεων τῶν ἐτῶν 1965 - 1971 ὅπου καὶ σημειοῦται ὅτι ἡ διάρκεια τῆς ἡλιοφανείας εἰς τὸν μετ. σταθμὸν τοῦ Κ.Ε.Ο.Α. εἶναι μικροτέρα, τοῦτο δὲ ὀφείλεται εἰς τὴν ἐπίδρασιν τοῦ ἀναγλύφου.