Degree of Wintriness

by

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SUMMARY

Classifieation of the winters of Thessaloniki is attempted by proposing the term "degree of wintriness". This is the sum total of two partial sums: the sum of eertain values of air temperature and the sum resulting from data of water-vapour eondensations.

As a rule, when the partial sum of eondensations is higher than the partial snm of temperatnres the degree of wintriness is presented by a small figure and the winter is mild.

When the partial sum of temperatures is higher than the partial sum of water-vapour condensations, the degree of wintriness is higher and the winter is defined as normal or rigid.

ΠΕΡΙΛΗΨΙΣ

Ἐπιχειρεῖται ἡ ταξινόμησις τῶν χειμώνων τῆς Θεσσαλονίκης, προτεινομένου τοῦ ὅρου «βαθμὸς χειμεριότητος». Οὗτος ἀποτελεῖ ὁλικὸν ἄθροισμα δύο μερικῶν ἀθροισμάτων· τοῦ ἀθροίσματος ὡρισμένων τιμῶν τῆς θερμοκρασίας τοῦ ἀέρος καὶ ἀφ' ἑτέρου τοῦ ἀθροίσματος ὅπερ προκύπτει ἔκ τινων στοιχείων τῶν ἀτμοσφαιρικῶν ὑδροσυμπυκνώσεων.

Κατὰ κανόνα, ὅταν τὸ μερικὸν ἄθροισμα τῶν ἀτμοσφαιρικῶν ὑδροσυμπυκνώσεων εἶναι μεγαλύτερον τοῦ μερικοῦ ἀθροίσματος τῶν θερμοκρασιῶν ὁ βαθμὸς χειμεριότητος ἔχει μικρὰν τιμὴν καὶ ὁ χειμὼν εἶναι ἤπιος· ὅταν τὸ μερικὸν ἄθροισμα τῶν θερμοκρασιῶν εἶναι ὑψηλότερον τοῦ μερικοῦ ἀθροίσματος τῶν ἀτμοσφαιρικῶν ὑδροσυμπυκνώσεων ὁ βαθμὸς χειμεριότητος ἔχει μεγάλην τιμὴν καὶ ὁ χειμὼν εἶναι κανονικὸς ἢ δριμύς.

RÉSUMÉ

On entreprend la classification des hivers de Thessaloniki en proposant le terme de «degré d'hivernalité». Celui-ci est le resnltat de la sommation de deux sommes partielles dont l'une est la somme de certaines valenrs de la température de l'air et l'autre de certains éléments dues à la condensation de la vapenr d'eau contenue dans l'atmosphère.

En règle générale quand la somme des condensations est supérieure à celle des températures, le degré d'hivernalité est bas, l'hiver est doux. Quand au contraire la somme des températures est supérieure à celle des condensations le degré d'hivernalité est haut, l'hiver est normal ou rigoureux.

ZUSAMMENFASSUNG

Es wird eine Klassifikation der Winterperioden von Thessaloniki versucht und der Terminus "Winterlichkeitsgrad" vorgeschlagen.

Dieser wird als die Totalsumme von zwei Partialsummen definiert: einerseits, der Summe gewisser Werte der Lufttemperatur, und andrerseits derjenigen, die sich aus gewissen Elementen der atmosphärischen Wasserkondensation ergibt.

In der Regel, wenn die Partialsumme der kondensation grösser als die der Temperaturen ist, dann hat der Winterlichkeitsgrad einen niedrigen Wert und der Winter ist mild; ist die Partialsumme der Temperaturen dagegen höher als diejenige der Wasserkondensation, so ist der Wert des Winterlichkeitsgrads auch höher, und der Winter ist normal oder streng.

CLASSIFICATIONS OF GREEK WINTERS

The following two special studies have been published on the characterization and gradation of winters in Greece from the point of view of the cold: By A. Livathinos (1927); it is concerned with the classification of the winters in Thessaly, period 1893 - 1924, and based on the data of the meteorological stations of Larissa, Trikala and Volos *. Three methods are used in that attempt of classification. Of those, one is based on the monthly sums of daily minimums of temperature below zero; the second on the deviation of monthly means of air temperature from the normal monthly values; and the third on the number of frost days. Livathinos considers this last method to be the most satisfactory for the classification of Thessalian winters, which he distinguishes into sweet, heavy and severe.

"The classification of winter in Athens in the period 1859 - 1949" by P. Karapiperis, was published in 1950 and is based on the deviations of the average temperature of each individual winter from the

* Meteorological Station of Larissa $\varphi = 39^o\,37$ $\lambda = 1^h\,29^m$ H = 25 m.
» » » Trikala $\varphi = 39^o\,33'$ $\lambda = 1\;\;27$ H = 113 m.
» » » Volos $\varphi = 39^o\,21'$ $\lambda = 1\;\;32$ H = 2 m.

normal winter temperature. A supplementary criterion is hereby introduced concerning:

a) Frequency percentage of minimum temperatures lower than normal minimum with regard to cold and rigid winters.

b) Frequency percentage of maximum temperatures higher than normal maximum with regard to mild and sweet winters. By this method the winters of Athens are divided into sweet, mild, normal, cold and rigid.

At an earlier date D. Eginitis (1896) when he mentions the exceptionally cold winters of Athens also characterizes them according to the absolute minimum temperatures and, in some cases, according to the duration of the cold, yet without any definite criterion.

Those classifications are based on the evaluation of temperatures, especially their minimum values, and they are meant to estimate the *coldness* of winter periods.

THE UNFAVOURABLE FACTORS OF GREEK WINTERS

Cold as well as great heat, temperatures that is, which are higher or lower of what is normal for human habit in a given geographical area, contribute to a lowering of our vitality and good spirits for they cause an over-increase or over-decrease in the speed by which heat is emitted from the human body. Besides low temperatures, however, other weather or climatic factors in combination with these also influence, psychologically too, the level of well-being felt by man in a given environment in winter.

Such atmospheric elements closely related to the conditions of *climate comfort* are: the wind; heavy cloudiness and fog lasting long and limiting both solar radiation and visibility; high frequency of rain and snow, especially in countries not well organized to face them.

Winter is not only considered but actually is the most unfavourable of all seasons in climatic areas like Northern Greece. It sometimes causes discomfort and difficulty in every-day life. It often influences activities especially in rural areas; it handicaps transport and technical works, while sickness (generally not widespread), is relatively more extended in that season. As a rule these disfavours are wholly attributed to low temperatures and causes are being looked for in their low values; at times, also in the prolongation of the cold.

Yet discomfort and difficulties caused by a *bad* winter are not solely due to the factor *cold;* they are also due to the other factors mentioned above that, except the wind, variously express products of atmospheric water - vapour condensations. Particularly in Greece atmospheric condensations are both more abundant and more frequent during the colder period, adding their difficulties to those caused by the cold. This also holds for the town of Thessaloniki, which will concern us in this paper. It is not very frequent for other atmospheric factors to take annoying values in this town. Thus, wind is hardly a considerable weather adversity. The local wind, dry and strong, called *Vardaris,* causes the temperature to fall and at times handicaps the work in rural areas; however, it is not very frequent and it blows under a cloudless sky. *Chortiatis,* the eastern local cold wind in Thessaloniki, is not frequent either. Likewise the sea surface is seldom disturbed by high waves unless there is a strong southern weather. Finally, fog, not very frequent either, sometimes limits visibility to the minimum; but it almost always clears before noon and is followed, as a rule, by fine weather.

It is well - known that winter disfavours in general are felt more intensely towards the end of the cold season, because of the physical strain on us, caused by the precediug prolonged winter too. For one third of the winter periods in Thessaloniki air minimum temperatures are below zero in the month of March, and those values are often repeated for a series of days during that month *.

In Thessaloniki, moreover, the mean temperature in March as well as the mean minimum temperature and the absolute minimum of that month are considerably lower than the corresponding ones in November. And what is more, frost days, days of snowfall and snow-covered ground are in the average many more in March than they are in November; and the values of those elements in March hardly ever differ from the corresponding ones in December. On the other hand in the one fourth of the cases of Decembers examined, the temperature has not presented values below the freezing point. It is because of them that March has a "wintrier" character than November, despite the fact that in November the number of overcast days has a slightly higher figure and the rain an even higher one; whereas the number of rainy days is much the same in the first month of spring as it is in the last month of autumn (Kyriazopoulos, 1939).

* E. g. in March 1949 the thermometer indicated minimum temperatures below — 2°, 2 for six days, while in March 1940, when minimum temperature was also below — 2₀, 1 for six days, an absolute minimum value of — 4₀, 7 was noted.

For the above reasons in this paper we considered March as belonging to winter for Thessaloniki.

DEGREE OF WINTRINESS

In this paper we have attempted to express by a single figure the degree of winter disfavours in Thessaloniki. The value of that figure will depend on those meteorological elements that mainly have an influence on the making of winter aspect in Thessaloniki, as it is felt by its average inhabitant.

There have been difficulties in the search for a most suitable form for the constituting factors to enter the calculation; and also in the definition of the real weight each one bears into the synthesis towards the final arithmetical size characterizing the degree of weather disfavour of winter. That figure we have called **degree of wintriness**.*

In the degree of wintriness the element of temperature is represented by low values and by the frequency of certain of those.

On the average the frost days in Thessaloniki (diurnal minimum temperature $\leq 0°$) are something more than 23 at every winter period (Table I). From the same table we can see that, with no exception, all winters examined, have frost days in Thessaloniki, while during the cold season 1931 - 32, for instance, mercury went below zero for 49 days.

But temperatures slightly lower than 0° can also occur because of a strong nightly heat radiation. Such cold and clear ningts when hoar frost is usually formed, are followed, as a rule, by a beautiful, cloudless and sunny day, while the preceding frost-night has hardly been sensed (Kyriazopoulos, 1939). It should be noted in this connection that nights of hoar frost are usually over 20 a year during the four months of December - March in Thessaloniki; and in 193 out of 439 cases of hoar frost nights, in 23 years, the minimum air temperature in screen was below freezing point, while in most of them morning cloudiness was insignificant or limited, which means that there followed a sunny morning. That is the reason why we have chosen to take into account the total sums of minimum temperatures below zero (Table II) rather than the number of frost days.

Independently of heat radiation, however, it so happens that the thermometer indicates frequent falls of mercury below zero, yet of only

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* In Greek: βαθμὸς χειμεριότητος.

a few tenths of a degree. The winter is only then felt to be heavy when such light frosts are frequent enough to bring the sum of negative temperatures to a considerable figure.

Days when the minimum temperature is lower than —4° C are not seldom in Thessaloniki. They amount to an average of about 4.5 a year (Table I); of the 45 winters on the table, 32 have such values whereas during the heavy winter of 1941 - 42, for example, 17 times there has been a temperature of below —4° C, and the sum total of minimum day temperatures $\leqq$—4° has gone up to 111.°5 on that year (Table II).

Cases of such temperature falls in Thessaloniki always follow after a whole series of frost days; and the coldest winters in that town are usually marked by their frequent repetition. For those reasons and because temperatures lower than —4° C cause an unpleasant sensation of heavy cold, do we add again the sum of $\leqq$—4° day temperature minimums onto the above original sum total of day temperature minimums below 0° C. Thus in composing the degree of wintriness, the daily $\leqq$—4° temperatures are taken twice (Table II).

The opposite case also occurs. A short spell of a heavy cold - wave will cause a lowering of temperature by several degrees, though for a few days. In this way because of a period of five or ten cold days, from the viewpoint of absolute minimum temperatures, an otherwise mild winter may be presented as heavy. The winter of 1935 36 is a typical example of that. It is, therefore, necessary to take into account the duration or the frequency of temperatures below a certain limit.

The functiouning of a thermograph does not cover the whole period when meteorological observations were made in Thessaloniki; temperatnres $\leqq$+3° generally give to man the sensation of cold; finally, low temperatures are felt more when they occur during daytime; for these reasons, out of the three meteorological observations of the day, we are counting only those cases at which the thermometer indicated temperatures $\leqq$+3°. If, for example, the air temperature is $\leqq$+3° at all three day observations, that day will give the impression of having been cold, irrespective of the minimum value of the temperature; just as a winter presenting a large number of such cases (1908 - 09, Table II) would leave the feeling that it was heavy, eveu if the figures expressing the sum of temperatures below zero were not very high.

Thus, the partial sum of temperature that is being incorporated into the degree of wintriness comprises (Table II) the sum total of all $\leqq$0° day minimums of air temperature, plus the sum total of $\leqq$—4°

day minimums of temperature and the number of cases when temperature $\leq +3°$ was indicated at the hours of observation.

In order to fix the partial sum that expresses products of atmospheric water-vapour condensation we count up those days when total cloudiness, deriving from the average of the three meteorological observations of the day, is $\geq {}^{8}/_{10}$. A sky presenting such covering - overcast - during the cold season of the year, obviously contributes to an unpleasant or melancholy feeling, especially if low-cloud, usual for that period, covers a sunless sky during a long series of days, as it often happens in Thessaloniki during wintertime.

This unfavourable impression is more intense in winter *days of rain,* that also handicap the circulation in the country, if they are frequent.

A snowfall, insufficient to cover the ground, or forming a thin layer, melts during the day, and does not always create an unfavourable impression, although it is characteristic of wintertime. However, a thick cover of snow on the ground that stays there for a series of days, though often the result of a single snowfall, will cause a host of difficulties in the circulation and contribute to a continuation of low air temperatures. Besides, the days of snowmelting are, as we all know, the worst for pedestrians, even though mercury does not fall below zero every day. It is for those reasons that we consider the snow-covered ground as an essential feature of weather contrarieties and that is why we are taking twice the number of days with snow-covered ground (Table II).

Days of snowcovered ground present the frequency of a result derived from one form of water-vapour condensation. But low temperatures are both the cause and their characteristic. In that respect twice the number of days with snowcovered ground should be included in the partial sum of temperature. As, however, years with a small degree of wintriness are mild, wherever one includes days of snowcovered ground—that either do not exist in such years or are rare—we have left this element in its normal place. On the other hand, in mild winters snow is usually due to temporary cold invasions. So, for example, the winter of 1935-36 was running as exceptionally mild when, in February, a very violent snowstorm accompanying a short cold-wave, whitened the ground of Thessaloniki for six days (Papaioannou, 1936).

The whole of the disfavours that are due to condensations of atmospheric water vapours is thus expressed by the partial sum which includes: the number of overcast days, the number of rain days, and twice the number of days of snowcovered ground.

These two partial sums, of temperatures and of atmospheric vapour condensations, give, when added, the *degree of wintriness,* i.e. a final sum is obtained whose value is influenced by the main elements expressing the disfavours of winter in Thessaloniki *. These elements enter into the degree of wintriness in proportion to their importance for our gradation of the winters. Moreover, all those elements are repeated during almost all winters of Thessaloniki, and their sums are sufficient for their sum total to characterize even the mildest winters of that town.

CONCLUSIONS

1. In Table II and Fig. 1 are included the degree of wintriness and its element of cold seasons for 45 years—1891 to 1910 and 1928 to 1954—for which there are meteorological recordings for Thessaloniki.**

It is concluded from Tables II and III and Fig. 1 and 2, that during the above winters the value of the degree of wintriness fluctuated in this town between 98 (1901-02) and 457 (1941-42). The value of the partial sum of temperature between 9.5 (1950-51) and 367.5 (1928-29); and the value of the sum of water-vapour condensations between 50 (1901-02) and 176 (1953-54).

In the same tables we note the following:

— Whenever the number of cases when temperatures $\leqq +3°$ at the hours of observation is noted to be higher than 90, the winter is heavy, irrespective of the value other data have, and the degree of wintriness is higher than 290.

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* For a climatic area other than Thessaloniki, appropriate data must obviously be looked for and they must be taken in suitable proportions.

** About the meteorological stations that have functioned in Thessaloniki ($\varphi = 40° 37'$, $\lambda = 22° 57'$, Hp = 25 m) in the past vid *B. Kyriazopoulos*. The Climate of Greek Central Macedonia, p. p. 23 - 30. For the period of time since 1940 the following were taken into account: the recordings of the meteor. Station of the University of Thessaloniki and those of the German military meteor. Station once functioning, also a few supplementary data from the Meteorological Station of the American Farm School of Thessaloniki.

Since the degree of wintriness has a wide range—between the end points 98 and 457—and because of the nature of some of its components, the characterization of winters by degree of wintriness cannot be influenced considerably, if recordings of several meteorological stations of the same town are used.

— Whenever the sum of minimum day temperatures in the winter season is higher than 90, then the number of cases, when temperatures $\leq +3°$ are noted at the hours of observation, is larger than 80 and the degree of wintriness higher than 300 (heavy winter).

— Whenever the sum of minimum day temperatures is lower than 24, then the degree of wintriness does not exceed the figure 184 (mild winter).

— Whenever the partial sum of temperatures has remained lower than 71 the degree of wintriness has not exceeded 184 (mild winter).

— Whenever the partial sum of temperature has exceeded 200, the degree of wintriness had values higher than 300 (heavy winters).

2. Classification of the 45 winters is carried out in Table III and Fig. 2. Figures are given in order of increasing values of wintriness. Alongside are given the partial sums of temperatures and water-vapour condensations as well as the yearly difference between them in two columns. In one of them are mentioned the resulting differences when the partial sum of water vapour condensations is larger than the sum of temperature ($T<W$); while the other column contains the difference when the partial sum of temperature is bigger than the partial sum of water-vapour condensations ($T>W$). The following rule is derived from that classification:

When the partial sum of water-vapour condensations, irrespective of value, is larger than the partial sum of temperatures, the winter is mild.

In fact, but for two exceptions to this general rule, the winters of 1934-35 and 1942-43, when the degree of wintriness fluctuated in Thessaloniki between 98 and 184, that is, when it occupied one of the lower parts in the scale of wintriness, the component of water-vapour condensations almost always exceeds the component of temperature. This means that when the weight of winter disfavours falls rather on the side of water abundance, the winter is generally mild. On the other hand, when disfavours of low temperatures weigh more at the classification of a winter, then it is normal, heavy or rigid. In the same Table III we note that the average height of rainfall in the 16 milder winters — low degree of wintriness — amounts to 175.8 mm while the average figure of the normal heavy and rigid winters only goes up to 143.5 mm. Average figures of days with rain prove the same.

3. In Table IV alongside, a classification of those 45 winter periods is attempted according to five different criteria of gradation. They are as follows: according to increasing degrees of wintriness; increasing values of sums of minimum temperatures below zero; number of frost

days; deviation from the normal value of average temperatures of the four winter months; and finally according to the value of absolute minimum temperatures.

Here are a few examples:

It is generally agreed that the winters of 1953 - 54 and 1941 - 42 have been the heaviest in the last 65 years at least in Thessaloniki. Indeed they indicate the highest degrees of wintriness, 454 and 457 (Tabl. III and IV, Fig. 1 and 2).

During the winter of 1953 - 54, the most prolonged of all, the absolute minimum air temperature had the unprecedented value of — 10° 3 (January 26th, 1954). Yet the sum of minimum day temperatures below zero was a great deal higher, and the sum of $\leq -4°$ minimum day temperatures twice as large in 1941-42 in respect to 1953-54. The leg of atmospheric water-vapour condensations, however, is by far bigger in 1953-54 than it is in 1941-42. The abundance of water-vapour condensations contributed much more in the rigidness of a winter in 1953-54 than it did in 1941-42. Indeed, during the four winter months of the former, 78 cloudy days were noted in Thessaloniki as opposed to 68 of the latter, 62 days of rain against 42, and 18 days of snow-covered ground against only 3 in 1941-42.

The winter of 1941-42, which holds the highest degree of wintriness in a classification according to the number of frost days, is characterized as having been a good deal milder (Table IV).

The winter of 1935-36 was a rather mild winter, degree of wintriness 184. That winter, as already mentioned, would have been the warmest of all, since till about the middle of February mercury had not fallen below zero. On the 11th of February, however, the most violent snowstorm swept into Thessaloniki. There have been several victims in the town and temperature suddenly fell to —8°9 and —7°9 on the following day. After two more frost days, temperature did not fall below zero any longer, for the rest of that winter. On the basis of absolute minimum temperature (Table IV) that winter would be called one of the heaviest. But if we accept a classification according to the degree of wintriness, very low temperatures of only four days are not enough to change the real position of that winter. Indeed, its degree of wintrines, 184, is due to the sum of temperatures by only 54 units and to the sum of water condensations by 130; thus, according to what was said above, it is called mild (Table III).

Of the milder winters, that of 1901-02 has a degree of wintriness 98, whereas that of 1950-51, has 126. In the former, 15 days of light frost were recorded. But there were only 23 overcast days, and 27 days of rain (amount of rainfall during the four winter months, 103 mm). In 1950-51 mercury fell below zero only twice, but its 65 overcast days, 51 days of rain (274 mm of rainfall) establish this winter as less mild than that of 1901-1902.

It is characteristic of a heavy winter in the harbour of Thessaloniki when in rare cases the surface of the sea along the coast of the inner part of the Thermaikos Gulf (Gulf of Thessaloniki) is covered by a layer of ice, temporary and thin. This is due to a lowering of temperature at the surface of the sea because of the intense heat radiation from it during a clear and calm night following a period of prolonged low temperature (Mariolopoulos et Alexandrou, 1933). Such cases that have taken place during these last years, occurred in the months of January and February, in winters of a high degree of wintriness, as that of 1903 (degree of wintriness 337), of 1905 (d. of w. 364), of 1929 (d. of w. 450), of 1932 (d. of w. 372) and of 1954 (d. of w. 454).

4. According to the degree of wintriness these 45 winters of Thessaloniki may be classified as follows: 16 of them (98-184), i. e. more than $^{1}/_{3}$, are characterized mild; 17 following these (191-274) normal or heavy and the last 12 (290-457), rigid.

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TABLES

TABLE I

DECEMBER - MARCH	FROST DAYS		Days with minimum temperature	DECEMBER - MARCH	FROST DAYS		Days with minimum temperature
	Frost Min. $\leq 0°$	Total Frost Max. $\leq 0°$	$\leq -4°$		Frost Min. $\leq 0°$	Total Frost Max. $\leq 0°$	$\leq -4°$
1891 - 1892	22	4	1	1931 - 1932	49	1	4
1892 - 1893	37	9	13	1932 - 1933	10	0	0
1893 - 1894	19	0	3	1933 - 1934	36	0	7
1894 - 1895	17	3	5	1934 - 1935	23	0	3
1895 - 1896	22	0	3	1935 - 1936	5	0	2
1896 - 1897	7	0	0	1936 - 1937	18	0	0
1897 - 1898	20	0	6	1937 - 1938	25	3	4
1898 - 1899	27	0	7	1938 - 1939	7	0	0
1899 - 1900	14	0	0	1939 1940	38	1	11
1900 - 1901	27	3	8	1940 - 1941	25	0	5
1901 - 1902	15	0	0	1941 - 1942	32	9	17
1902 - 1903	44	0	14	1942 - 1943	14	1	2
1903 - 1904	6	0	0	1943 - 1944	16	0	0
1904 - 1905	49	0	11	1944 - 1945	30	2	7
1905 - 1906	21	0	6	1945 - 1946	27	0	4
1906 - 1907	24	0	5	1946 - 1947	23	0	6
1907 - 1908	20	0	4	1947 - 1948	18	0	0
1908 - 1909	28	0	6	1948 - 1949	42	0	8
1909 - 1910	11	0	1	1949 - 1950	28	1	4
				1950 - 1951	2	0	0
1928 - 1929	47	0	12	1951 - 1952	24	0	2
1929 - 1930	9	0	0	1952 1953	16	0	0
1930 - 1931	4	0	0	1953 - 1954	38	2	9

TABLE II

DEGREE OF WINTRINESS IN THESSALONIKI

WINTER DECEMBER - MARCH	TEMPERATURES: Sum of min. day temperatures < 0° C	TEMPERATURES: Sum of min. day temperatures ≦ -4° C	TEMPERATURES: Cases with temperatures at the hours of observation ≦ +3° C	PARTIAL SUM OF TEMPERATURES	WATER-VAPOUR CONDENSATIONS: Days with average cloudiness ≧ 8/10	WATER-VAPOUR CONDENSATIONS: Rain Days > 0.0 mm	WATER-VAPOUR CONDENSATIONS: Twice the number of days with snowcovered ground	PARTIAL SUM OF WATER-VAPOUR CONDENSATIONS	DEGREE OF WINTRINESS
1891 - 1892	43.2	4.3	65	112.5	39	29	12	80	193
1892 - 1893	124.7	85.0	93	302.7	39	39	18	96	399
1893 - 1894	46.6	15.5	62	124.1	41	33	14	88	212
1894 - 1895	42.5	27.1	51	120.6	41	35	10	86	207
1895 - 1896	42.1	14.3	89	145 4	30	18	14	62	207
1896 - 1897	7.0	0	25	32.0	34	33	4	71	103
1897 - 1898	59.2	30.3	59	148.5	36	29	8	73	222
1898 - 1899	64.2	35.0	69	168.2	33	12	10	55	223
1899 - 1900	12.8	0	36	48.8	56	52	0	108	157
1900 - 1901	71.0	44.4	66	181.4	38	33	14	85	266
1901 - 1902	18.7	0	29	47.7	23	27	0	50	98
1902 - 1903	124.4	77.3	81	282.7	28	24	2	54	337
1903 - 1904	7.7	0	15	22.7	55	45	0	100	123
1904 - 1905	113.2	61.2	114	288.4	35	35	6	76	364
1905 - 1906	50.5	33.5	78	162.0	25	31	0	56	218
1906 - 1907	57.0	37.5	115	209.5	45	33	2	80	290
1907 - 1908	44.5	19.5	70	134.0	42	35	2	79	213
1908 - 1909	65.0	30.0	114	209.0	50	44	2	96	305
1909 - 1910	12.0	4.5	31	47.5	51	36	0	87	135
1928 - 1929	139.8	81.7	146	367.5	41	27	14	82	450
1929 - 1930	10.4	0	24	34.4	59	39	2	100	134
1930 - 1931	3.6	0	14	17.6	70	62	4	136	154
1931 - 1932	92.8	23.0	127	242.8	55	42	32	129	372

TABLE II (Continued)

DEGREE OF WINTRINESS IN THESSALONIKI

WINTER DECEMBER - MARCH	TEMPERATURES				WATER - VAPOUR CONDENSATIONS				DEGREE OF WINTRINESS
	Sum of min. day temperatures $< 0°$ C	Sum of min. day temperatures $\leq -4°$C	Cases with temperatures at the hours of observation $\leq +3°$ C	PARTIAL SUM OF TEMPERATURES	Days with average cloudiness $\geq 8/10$	Rain Days > 0.0 mm	Twice the number of days with snowcovered ground	PARTIAL SUM OF WATER-VAPOUR CONDENSATIONS	
1932 - 1933	5.7	0	40	45.7	64	39	8	111	157
1933 - 1934	75.4	33.1	63	171.5	47	32	6	85	257
1934 - 1935	40.8	13.2	59	113.0	62	51	14	127	240
1935 - 1936	23.2	16.8	14	54.0	64	54	12	130	184
1936 - 1937	22.0	0	49	71 0	44	30	12	86	157
1937 - 1938	56.5	21.5	64	142.0	37	28	14	79	221
1938 - 1939	6.3	0	33	39.3	60	44	4	108	147
1939 - 1940	110.1	62.7	104	276.8	56	41	40	137	414
1940 - 1941	50 4	23.4	68	141.8	60	54	18	132	274
1941 - 1942	139.2	111.5	90	340.7	68	42	6	116	457
1942 - 1943	23.1	11.8	42	76.9	41	16	12	72	149
1943 - 1944	6.9	0	50	56.9	43	35	6	84	141
1944 - 1945	92.7	40.4	95	228.1	39	40	16	95	323
1945 - 1946	37.3	17.6	66	120.9	61	46	6	113	234
1946 - 1947	50.9	32.2	60	143.1	66	36	22	124	267
1947 - 1948	16.7	0	37	53.7	48	36	14	98	152
1948 - 1949	113.5	45.5	99	258.0	46	32	32	110	368
1949 - 1950	59.8	29.4	55	144.2	49	32	10	91	235
1950 - 1951	2.5	0	7	9.5	65	51	0	116	126
1951 - 1952	37.5	12.8	53	103.3	40	29	12	81	184
1952 - 1953	20.8	0	43	63.8	43	33	8	84	148
1953 - 1954	109.6	56.4	112	278.0	78	62	36	176	454

TABLE III

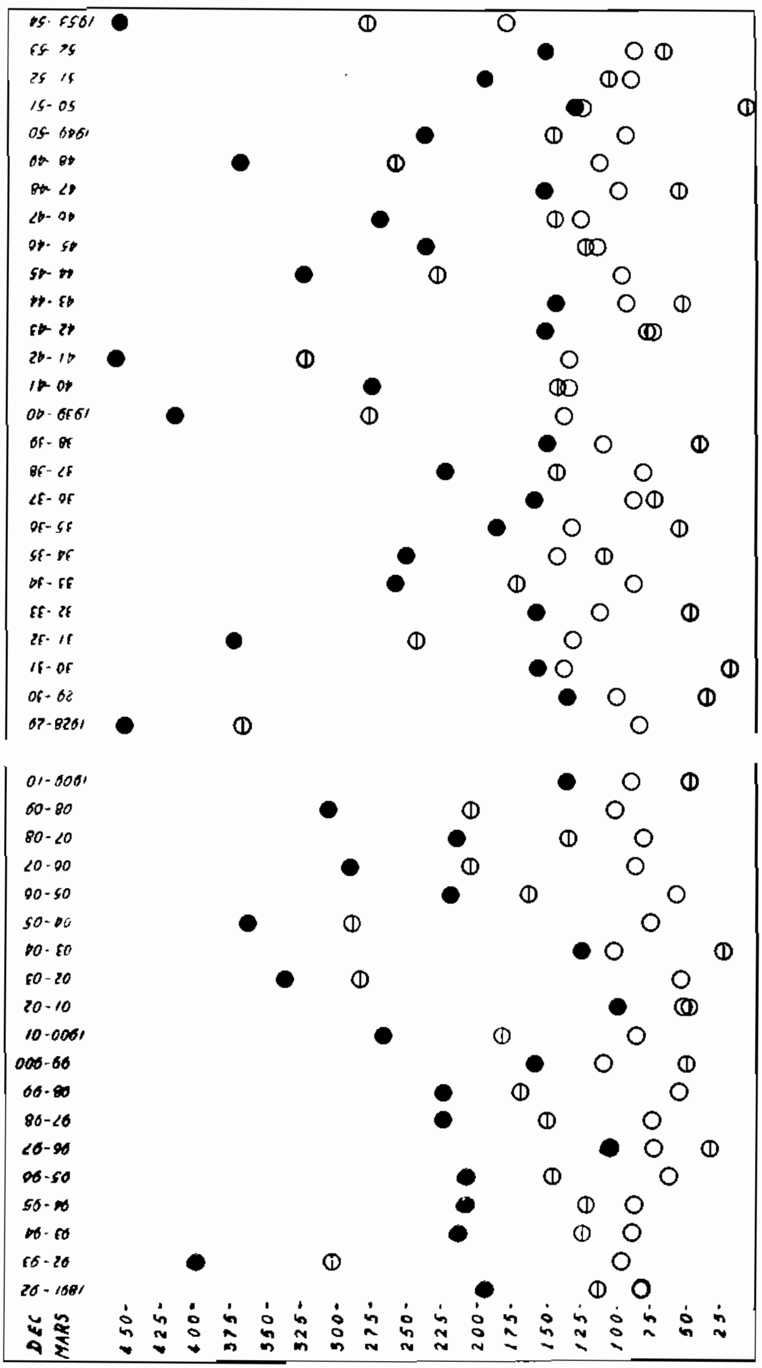
CLASSIFICATION OF WINTERS IN THESSALONIKI ACCORDING TO DEGREE OF WINTRINESS

No	WINTER	Degree of Wintriness	Partial sum of Tempera-tures (T)	Differ-ence when T>W	Differ-ence when T<W	Partial sum of water-vapour Condens-ations (W)	PRECIPITATIONS Rainfall mm		Rain Days >0.0 mm	
							Dec—March	Mean	Dec—March	Mean
1	1901 - 1902	98	47.7		2.3	50	103		27	
2	1896 - 1897	103	32.0		39.0	71	193		33	
3	1903 - 1904	123	22.7		77.3	100	216		45	
4	1950 - 1951	126	9.5		106.5	116	274		51	
5	1929 - 1930	134	34.4		65.6	100	144		39	
6	1909 - 1910	135	47.5		39.5	87	245		36	
7	1943 - 1944	141	56.9		27.1	84	113		35	
8	1938 - 1939	147	39.3		68.7	108	217		44	
9	1952 - 1953	148	63.8		20.2	84	169		33	
10	1942 - 1943	149	76.9	4.9		72	59		16	
11	1947 - 1948	152	53.7		44.3	98	155		36	
12	1930 - 1931	154	17.6		118.4	136	211		62	
13	1899 - 1900	157	48.8		59.2	108	116		52	
14	1932 - 1933	157	45.7		65.3	111	72		39	
15	1936 - 1937	157	71.0		15.0	86	147		30	
16	1935 - 1936	184	54.0		76 0	130	379	175.8	54	39.5
17	1951 - 1952	184	103.3	22.3		81	136		29	
18	1891 - 1892	193	112.5	32.5		80	141		29	
19	1894 - 1895	207	120.6	34.6		86	160		35	
20	1895 - 1896	207	145.4	83.4		62	54		18	
21	1893 - 1894	212	124.1	36.1		88	186		33	
22	1907 - 1908	213	134.0	55.0		79	119		35	
23	1905 - 1906	218	162.0	106.0		56	166		31	
24	1937 - 1938	221	142.0	63.0		79	98		28	
25	1897 - 1898	222	148.5	75.5		73	97		29	
26	1898 - 1899	223	168 2	113 2		55	40		12	
27	1945 - 1946	234	120.9	7.9		113	298		46	
28	1949 - 1950	235	144.2	53.2		91	162		32	
29	1934 - 1935	240	113.0		14.0	127	185		60	
30	1933 - 1934	257	171.5	86.5		85	148		32	
31	1900 - 1901	266	181.4	96.4		85	78		33	
32	1946 - 1947	267	143.1	19.1		124	205		36	
33	1940 - 1941	274	141.8	9.2		132	213		54	
34	1906 - 1907	290	209.5	129.5		80	132		33	
35	1908 - 1909	305	209.0	113.0		96	126		44	
36	1944 - 1945	323	228.1	133.1		95	146		40	
37	1902 - 1903	337	282.7	228.7		54	121		24	
38	1904 - 1905	364	288.4	212.4		76	72		35	
39	1948 - 1949	368	258.0	148.0		110	134		32	
40	1931 - 1932	372	242.8	113.8		129	123		42	
41	1892 - 1893	399	302.7	206.7		96	194		39	
42	1939 - 1940	414	276.8	139.8		137	129		41	
43	1928 - 1929	450	367.5	285.5		82	126		27	
44	1953 - 1954	454	278.0	102.0		176	254		62	
45	1941 - 1942	457	340.7	224.7		116	118	143.5	42	35.3

TABLE IV

CLASSIFICATIONS OF WINTERS IN THESSALONIKI

No	Degree of Wintriness	CLASSIFICATION				
		According to degree of Wintriness	According to sum of minim. temperatures <0°	According to Frost days	According to deviation of the mean temper. of 4 months from normal	According to the absolute minimum temperature of the year
1	98	1901 - 1902	1950 - 1951	1950 - 1951	1950 - 1951	1950 - 1951
2	103	1896 - 1897	1930 - 1931	1930 - 1931	1935 - 1936	1938 - 1939
3	123	1903 - 1904	1932 - 1933	1935 - 1936	1896 - 1897	1929 - 1930
4	126	1950 - 1951	1938 - 1939	1903 - 1904	1901 - 1902	1930 - 1931
5	134	1929 - 1930	1896 - 1897	1896 - 1897	1903 - 1904	1932 - 1933
6	135	1909 - 1910	1943 - 1944	1938 - 1939	1952 - 1953	1896 - 1897
7	141	1943 - 1944	1903 - 1904	1929 - 1930	1930 - 1931	1903 - 1904
8	147	1938 - 1939	1929 - 1930	1932 - 1933	1909 - 1910	1943 - 1944
9	148	1952 - 1953	1909 - 1910	1909 - 1910	1899 - 1900	1947 - 1948
10	149	1942 - 1943	1899 - 1900	1899 - 1900	1947 - 1948	1899 - 1900
11	152	1947 - 1948	1947 - 1948	1942 - 1943	1949 - 1950	1901 - 1902
12	154	1930 - 1931	1901 - 1902	1901 - 1902	1898 - 1899	1952 - 1953
13	157	1899 - 1900	1952 - 1953	1943 - 1944	1936 - 1937	1936 - 1937
14	157	1932 - 1933	1936 - 1937	1952 - 1953	1938 - 1939	1891 - 1892
15	157	1936 - 1937	1935 - 1936	1894 - 1895	1946 - 1947	1951 - 1952
16	184	1935 - 1936	1942 - 1943	1936 - 1937	1929 - 1930	1909 - 1910
17	184	1951 - 1952	1945 - 1946	1947 - 1948	1951 - 1952	1934 - 1935
18	193	1891 - 1892	1951 - 1952	1893 - 1894	1894 - 1895	1945 - 1946
19	207	1894 - 1895	1934 - 1935	1897 - 1898	1940 - 1941	1940 - 1941
20	207	1895 - 1896	1895 - 1896	1907 - 1908	1900 - 1901	1933 - 1934
21	212	1893 - 1894	1891 - 1892	1905 - 1906	1943 - 1944	1895 - 1896
22	213	1907 - 1908	1894 - 1895	1891 - 1892	1902 - 1903	1898 - 1899
23	218	1905 - 1906	1907 - 1908	1895 - 1896	1932 - 1933	1904 - 1905
24	221	1937 1938	1893 - 1894	1934 - 1935	1907 - 1908	1907 - 1908
25	222	1897 - 1898	1940 - 1941	1946 - 1947	1891 - 1892	1893 - 1894
26	223	1898 - 1899	1905 - 1906	1906 - 1907	1937 - 1938	1897 - 1898
27	234	1945 - 1946	1946 - 1947	1951 - 1952	1897 - 1898	1946 - 1947
28	235	1949 - 1950	1906 - 1907	1937 - 1938	1893 - 1894	1948 - 1949
29	240	1934 - 1935	1937 - 1938	1940 - 1941	1942 - 1943	1937 - 1938
30	257	1933 - 1934	1897 - 1898	1898 - 1899	1934 - 1935	1931 - 1932
31	266	1900 - 1901	1949 - 1950	1900 - 1901	1945 - 1946	1905 - 1906
32	267	1946 - 1947	1898 - 1899	1945 - 1946	1905 - 1906	1908 - 1909
33	274	1940 - 1941	1908 - 1909	1908 - 1909	1933 - 1934	1894 - 1895
34	290	1906 - 1907	1900 - 1901	1949 - 1950	1895 - 1896	1900 - 1901
35	305	1908 - 1909	1933 - 1934	1941 - 1942	1944 - 1945	1944 - 1945
36	323	1941 - 1945	1931 - 1932	1933 - 1934	1939 - 1940	1939 - 1940
37	347	1902 - 1903	1944 - 1945	1892 - 1893	1908 - 1909	1902 - 1903
38	364	1904 - 1905	1939 - 1940	1939 - 1940	1904 - 1905	1942 - 1943
39	368	1948 - 1949	1953 - 1954	1953 - 1954	1892 1893	1941 - 1942
40	372	1931 - 1932	1904 - 1905	1944 - 1945	1948 - 1949	1935 - 1936
41	399	1892 - 1893	1948 - 1949	1948 - 1949	1953 - 1954	1949 - 1950
42	414	1939 - 1940	1902 - 1903	1902 - 1903	1941 - 1942	1928 - 1929
43	450	1928 - 1929	1892 - 1893	1928 - 1929	1906 - 1907	1892 1893
44	454	1953 - 1954	1941 - 1942	1904 - 1905	1931 - 1932	1906 - 1907
45	457	1941 1942	1928 - 1929	1931 - 1932	1928 - 1929	1953 - 1954



⦶ *Sum of temperatures*
○ *Sum of water - vapour condensations*
● *Degree of wintriness*

Fig. 1

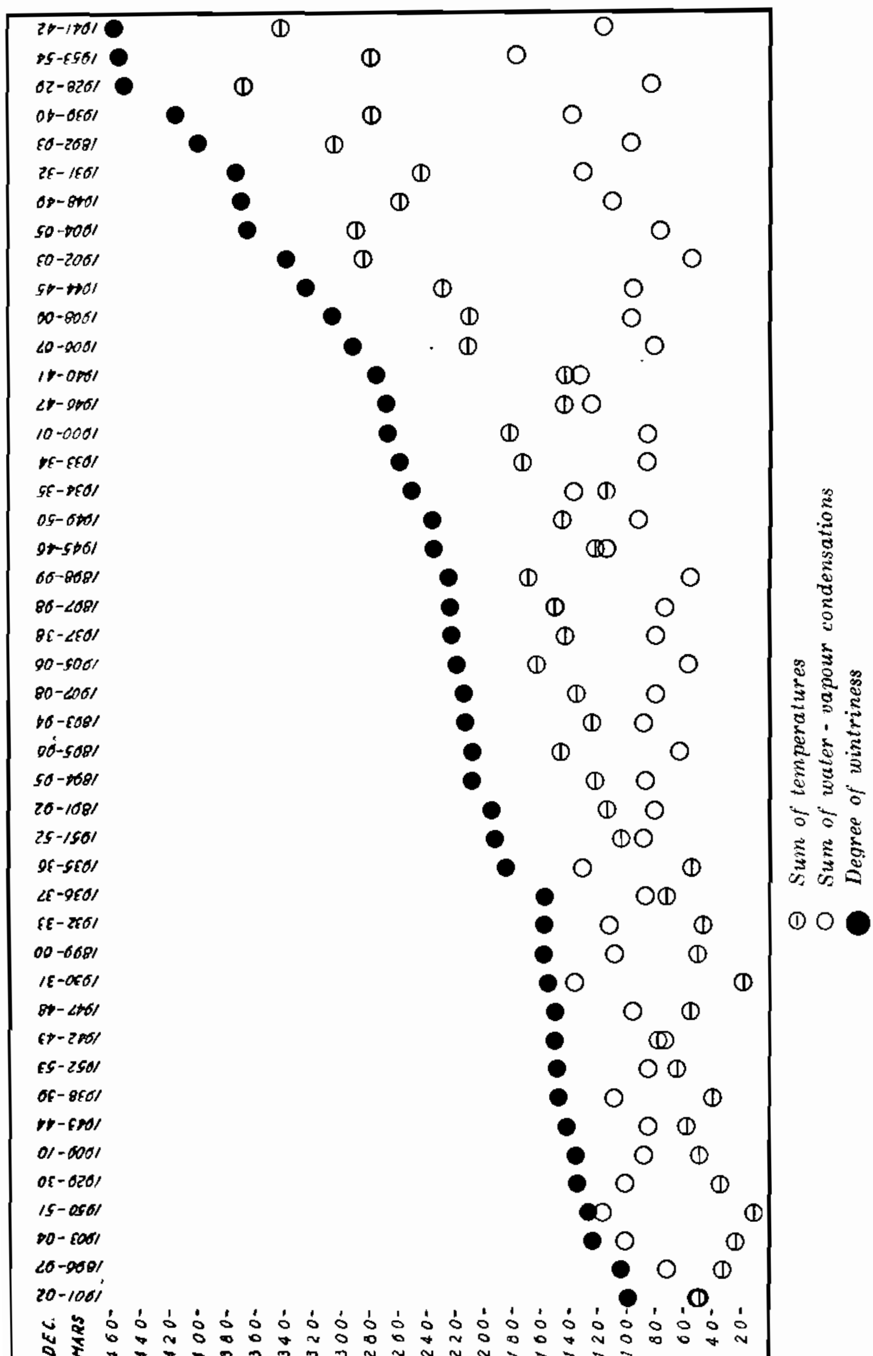

DEC.
MARS
Sum of temperatures
Sum of water - vapour condensations
Degree of wintriness

Fig. 2