A CASE OF COLOURED RAIN IN THE AREA OF THESSALONIKI

by

V. E, ANGOURIDAKIS

A CASE OF COLOURED RAIN IN THE AREA OF THESSALONIKI

by

V. E, ANGOURIDAKIS

The phenomenon of coloured rain is quite usual in the lands around the Mediterranean (B. Kyriazopoulos and G. Marinos [1]), and it is caused by depressions, which invading North Africa from the Atlantic, get deeper as they move eastwards over the deserts [2,3]. These depressions, in their trajectory, stir up large quantities of fine grained dust, thus developing dust - clouds which, rising to heights of 5 or 7 km, are transported by the prevailing air masses to great distances — transportation of dust from the north african coasts as far as Danemark has been proven — falling as coloured rain on regions like the above [1,2,3].

Such a case of coloured rain has occured in Thessaloniki, during the night of April 8th to April 9th, 1970 under the following conditions: During the above mentioned night a light rain (0.0 m.m.) of short duration has been observed. On the morning of April 9, 1970 we found out that all surfaces exposed in the open air during the previous night were covered by numerous spots, mostly round in form, 0,1 - 2,0 cm in diameter, and light - yellow in colour. On certain surfaces (i.e. inclined or vertical) these spots were pear - shaped or resembled miniature rivulets (Pictures 1, 2).

A macroscopic examination proved that these spots consisted of extremely fine - grained dust. The phenomenon has been observed in the whole area of Thessaloniki, where the above mentioned rain fell.

We have carried out a sampling of dust from the above mentioned spots, from various receiver - surfaces.

Part of the dust thus collected was sent to the «Democritus» Nuclear Research Center in Athens, for radioactivity control. We give below the results of this control:

Collection date : 9.4.1970.

Quantity measured : 0,7023 gr.

Counts per minute : 55.00 ± 0.88.

Radioactivity (total β) : 150,35 pCi. g^{-1}.

Another part of the dust collected — in two samples — was sent to the Laboratory of Soil Science of the Faculty of Agriculture and Forestry of the University of Thessaloniki, for physical and chemical as well as radiographic analysis. We give below the results of these analyses:

Sample No 1.

Grain sizes of the order of silt or very fine sand (0,1 - 0,002 m.m.).
Calcium Carbonate : 22 %.
Magnesium Carbonate from Dolomite (Magnesium lime stone) : 7 %.
Quartz : 30 %.
Kaolinite : 10 %.
Montmorillonite + Chlorite : 10 %.
Various (felspar etc.) : 10 %.

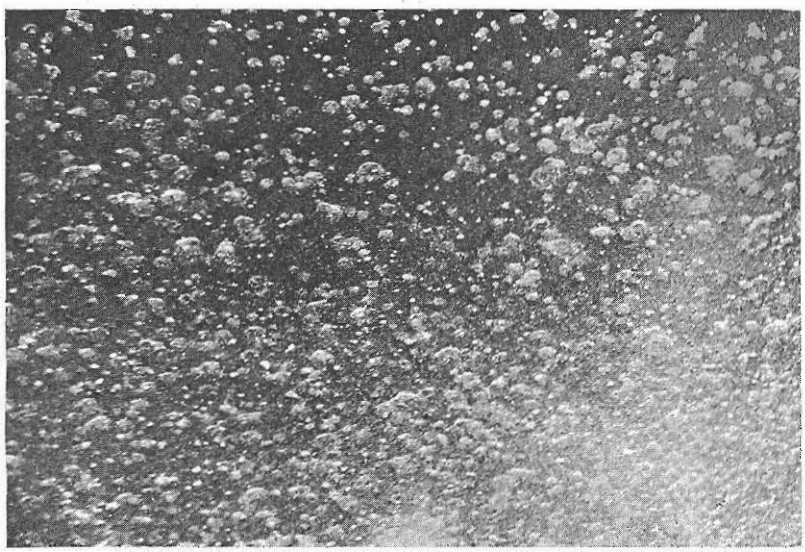
Sample No 2.

Grain sizes of the order of silt or very fine sand (0,1 - 0,002 m.m.).
Calcium Carbonate : 18 %.
Magnesium Lime Stone : 6 %.
Quartz : 24 %.
Kaolinite : 10 %.
Montmorillonite : 10 %.
Various (felspar etc.) 10 - 20 %.

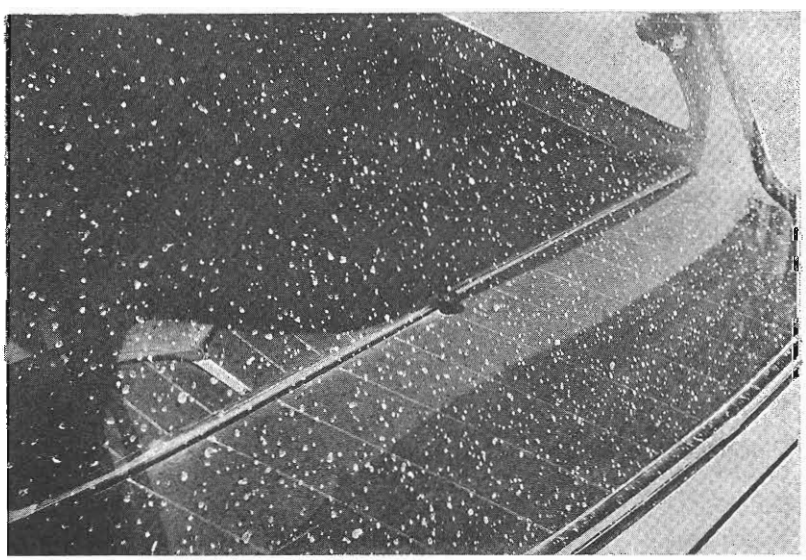
The above data show that, although Sample No. 1 comes from the glass - roof of the Meteorological Observatory, and Sample No. 2 from the roof of an automobile which had been left all night in the open air, at a distance of about 4 km from the Meteorological Observatory, yet the two samples are of almost identical composition. Besides the presence of dolomites (Magnesium carbonate) excludes the probability of the dust being of greek origin.

From information (and relative descriptions) furnished by Professor Mr. G. Lavrendiadis, we draw the conclusion that a similar phenomenon occured on the same day in Patras.

We give below photographs, taken in the morning hours of April 9, 1970, from several receiver - surfaces, in which the dust spots, formed after the evaporation of the rain - drops, are clearly discernible.



Picture 1



Picture 2

Photogradhs of coloured - rain traees (Thessaloniki 9.4.1970)

Meteorological conditions of the 5-day period between 5-9/4/70 in Thessaloniki.

From the records of the Surface Station of the Meteorological Observatory of the University, we have obtained the following data, for the period between 5 - 9 / 4 / 70 :

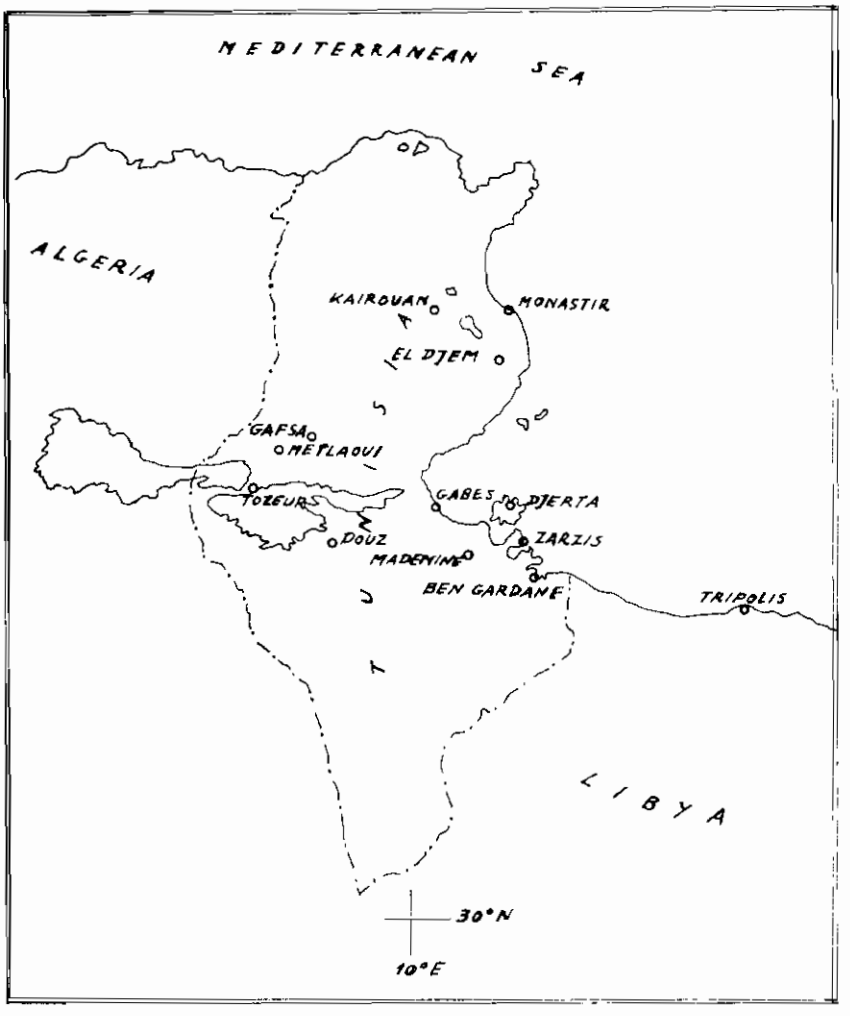
Date	Air Temperature			R.H.%	Cloudin.	Precipitation		
	Mean	Max.	Min.	Mean	(in eights) Mean	Duration	Intens.	Amount (in m.m.)
5.4.70	10.5	15.1	4.2	59	7	—	—	—
6.4.70	11.9	16.4	7.3	63	6	06h45-08h30	●	0.0
7.4.70	11.6	16.7	5.2	53	6	22h10-23h40	●	0.1
				Warm Air Mass				
8.4.70	14.1	18.0	9.0	74	8	Night of	●	0.0
9.4.70	18.1	24.4	11.6	67	3	8th to 9th		

From the above data is clearly seen a rise of the air temperature, especially during the last two days, when the greek area was under the warm sector of a depression (Map 11). According to the above data, relative humidity varied between 53 - 74 %, and cloudiness has been almost stable, while ou the 9th it started decreasing after the passage of the cold front.

For the same 5-day period, we have drawn the following Table of sand-storms in the area of Tunisia, based upon Daily Surface Weather Maps of the Service Météorologique de Tunisie.

Station	5/4	6/4	7/4	8/4	9/4
Ben Gardane		S	S		
Djerba				S	
Douz			SS	S	
El Djem			S		
Gabés	S	S	S	S	
Gofsa				S ≺	
Kairouan		S	SS		S
Medenine			S	S	
Metlaoui			S	S	S
Monastir			SS		

	5/4	6/4	7/4	8/4	9/4
Rêgneb			S		
Rennand		S	SS	S	
Tozeur			SS	S	S
Zarzis			SS	S	



MAP I

In Map I we give the positions of Stations in the area of Tunisia, where according to the above T a b l e sandstorms occured.

Weather Analysis.

a) Surface Weather Maps :

From the Daily Surface Weather Maps of the Greek National Meteorological Service, we draw the following conclusions:

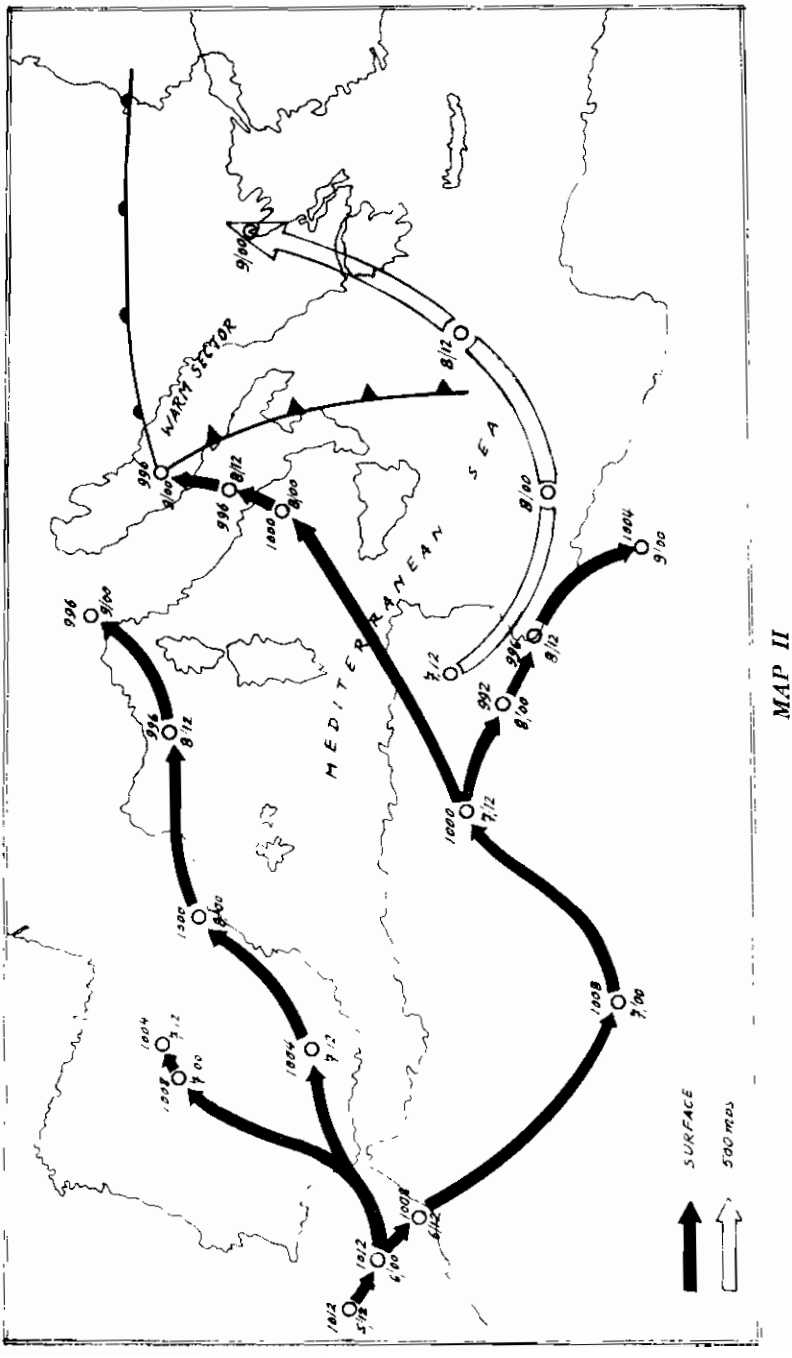
During the whole period from the 5th till the 9th of April 1970, Europe, the Mediterranean and northwestern Africa are covered by an extended area of lows, and depressions are moving from the west along the north - african coasts, the Mediterranean and Central Europe, eastwards.

The development of high pressures over the northeastern coasts of Africa and their extension over the eastern Mediterranean at first and then over Asia Minor, as well as the southward advancement of a wedge from the European-Russia high, determine the trajectory of the above mentioned depressions. Thus from Map II, we draw the following conclusions.

On the 5/4/70 (1200 GMT), a depression (1012 mb) invades northwestern Africa from the Atlantic, at the height of Casablanca.

On the 6/4/70 (0001 GMT) the same depression, stationed now a little eastwards, is bisected in two branches, still maintaining the same pressures (1012 mb). One of these branches advances over the Iberian Peninsula, and over its coasts north of Gibraltar, then is bisected again in two branches, the northern of which is getting deeper to 1008 mb on the 7/4/70 (0001 GMT), and 1004 mb on the 7/4/70 (1200 GMT), where it finally disappears a little to the north of Madrid. The southern of these last two branches, getting continuously deeper, moves along the south and eastern coasts of Spain, and a little to the north of Barcelona it enters the Gulf of Lion, and thence the Gulf of Genova, and on the 9/4/70 (0001 GMT) it attains the center of the triangle: Torino - Milano - Genova (996 mb).

The second of the initial two branches of the depression (the main one) invading northwestern Africa, south of the Atlas mountains, gets active because of the high temperatures of this area, deepening continuously till the 8/4/70 (0001 GMT), when it is stationed over the area of Tunisia. This same branch, on the 7/4/70 (1200 GMT) bifurcates into two branches, one of which crosses central Tunisia and terminates on the 9/4/70 (0001 GMT) south of Tripolis, and the other getting continuously deeper and crossing the Tyrrhenian Sea and central Italy, reaches on the 9/4/70 (0001 GMT) the Adriatic Sea (996 mb). In their place the warm sector of the depression, covers the Balkans.



MAP II

(b) 500 mbs Level.

From the 500 mb level charts of the Greek National Meteorological Service, we find that during this 5 - day period between 5 - 9/4/70, a l o w prevails over northern Europe, and a h i g h over Africa, with isobar systems favoring the flow of air masses of W to SW sector over northwestern Africa, central Mediterranean and the Balkans.

C o n c l u s i o n s .

From all the above mentioned, we draw the following conclusions:

— During the 5 - day period between 5 - 9/4/70 a deep depression over northwestern Africa, caused strong winds that stirred up large amounts of dust particles, in the form of dust-clouds, over northwestern Africa and the area of Tunisia. The most part of these sandstorms occur on the 7 and the 8/4/70.

— Dustclouds thus raised were included within the circulation of upper air masses (initially NW, then W, and finally SW) and thus transported over the Balkans (Map II).

Velocities of 50 - 100 knots, as marked on the 500 mb-level charts, fully justify how this distance between the rise of dust - clouds and the place of the occurence of the coloured rain phenomenon, was covered in 24 hours (or even less).

The 500 mb isobars and streamlines in the 500 mb - level, determine the transportation of dust particles through upper air currents, and their probable trajectory is indicated on Map II.

— The light rainfall that occured in Thessaloniki during the night of the 8th toward the 9th of April 1970, forced the landing of dust - particles (probably serving in this case as condensation nuclei) in the form of coloured rain.

A c k n o w l e d g e m e n t s .

We wish to thank herewith: The Chief of the Tunisian Meteorological Service, Moncef Ayadi (Ingénieur Principal), for furnishing us with valuable data; and the Director of the Meteorological Institute of the University of Thessaloniki, Professor George C. Livadas, who was the first to observe the phenomenon.

REFERENCES

1. KYRIAZOPOULOS, B. and MARINOS, G. 1939: «Sur les Substences Terreuses en Suspensiou dans l'Atmosphère des Régions Méditerrannéennes». Prakt. de l'Acad. d'Athènes.
2. METEOROLOGICAL OFFICE (GT. BRITAIN) 1962 : «Weather in the Mediterranean» Vol. I, Second Edition, General Meteorology, London, 1962.
3. AIR MINISTRY, METEOROLOGICAL OFFICE (GT. BRITAIN) 1937 : «Weather in the Mediterranean» Vol. I, General Information, London, 1937.
4. SERVICE MÉTÉOROLOGIQUE DE TUNISIE 1970 : «Bulletin Quotidien de Renseignements Météorologiques».
5. E. M. Y. (GREEK NATIONAL METEOROLOGICAL SERVICE) 1970 : «Daily Surface Weather Maps». Athens, 1970.