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MEASUREMENT OF ATMOSPHERIC TRANSMISSION OVER LONG PATHS
IN THE INFRARED S. (U) TECHNION - ISRAEL INST OF TECH
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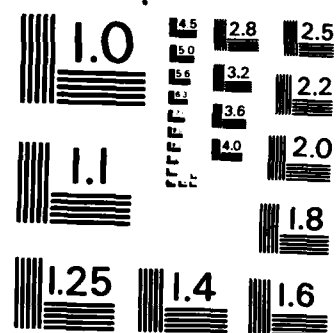
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MICROCOPY RESOLUTION TEST CHART
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Grant AFOSR-83-0023

AD-A161 258

Final Scientific Report

MEASUREMENT OF ATMOSPHERIC TRANSMISSION OVER LONG PATHS
IN THE INFRARED SPECTRAL REGION

by

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15 April, 1985.

Final Scientific Report, 1 Jan. 1984 -31 March, 1985.

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London, England.

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FIELD EXPERIMENTS

Although several field experiments were planned for the period 1 Jan. 1984 - 31 Mar. 1985 only one trip was successful. This trip fulfilled our hope of obtaining high values of absolute humidity, and water vapor amount. It was carried out in the coastal plain of Israel, near the settlement of Palmachim, about 20 km south of Tel Aviv. The experiment was carried out during September 20 and 21, 1984.

Another experiment was attempted on the Golan Heights in the winter of 1984/85 (on March 31, 1985) but had to be abandoned because of prevailing fog and rain.

The Palmachim experiment was carried out over a north-south optical path of 8.6 km length, along the shore of the mediterranean. The black-body source was kept at 2100°C and the dual-channel spectroradiometer was used to measure the spectrum, using circular variable filters with 4% resolution. Full details of the experiment were described in our previous Interim Scientific Report dated February 29, 1984 (Grant AFOSR-83-0023).

The optical path ran parallel to the seashore at a distance of about 100 meters. The altitude was 40 meters. The latitude of the site was $30^{\circ} 55'$. The experiment was carried out as a series of "runs", numbered consecutively PAL 1, PAL 2, PAL 34. Not all runs were included with this report, because many were devoted to calibrations and were therefore not relevant. PAL 9 to PAL 20 were made after nightfall of September 20, 1984, between 6 and 11 p.m. The rest of the runs from PAL 21 to PAL 34

were taken between 6 and 11 a.m. on September 21, 1984 (after sunrise).

The transmittance was designated $T(L2)$ and plotted as a function of wavelength in the attached figures. Each figure has a legend of 7 lines with the following entries:

<u>Name of entry</u>	<u>Explanation of entry</u>
Name of experiment	Running number (PAL 1, etc.); detector InSb or CMT (cadmium mercury telluride); date.
Temperature	Temperature in degrees C.
Distance	Optical path in km.
Relative humidity	Relative humidity in percent.
H2O pressure	Partial pressure of water vapor in torr.
Visibility	Visual range (human observer)
Pressure	Total atmospheric pressure in millibar.

Each figure contains two curves: the full curve represents the experimental transmittance, while the dotted curve represents the calculated transmittance according to LOWTRAN 4, with a resolution of 5 cm^{-1} , convoluted with a triangular slit function of 25 cm^{-1} .

The LOWTRAN calculation was carried out assuming a midlatitude summer model. It should be noted that the full curve looks "broken" because of the finite resolution of the graphics. There are 16 figures in the 3 to 5 micron range, and 17 figures in the 8 to 13 micron range.*

* Digital results are available in table format for all figures.

The maximum amount of water vapor in the path was approximately 17 g/cm^2 .

A systematic study of these curves is now under way.

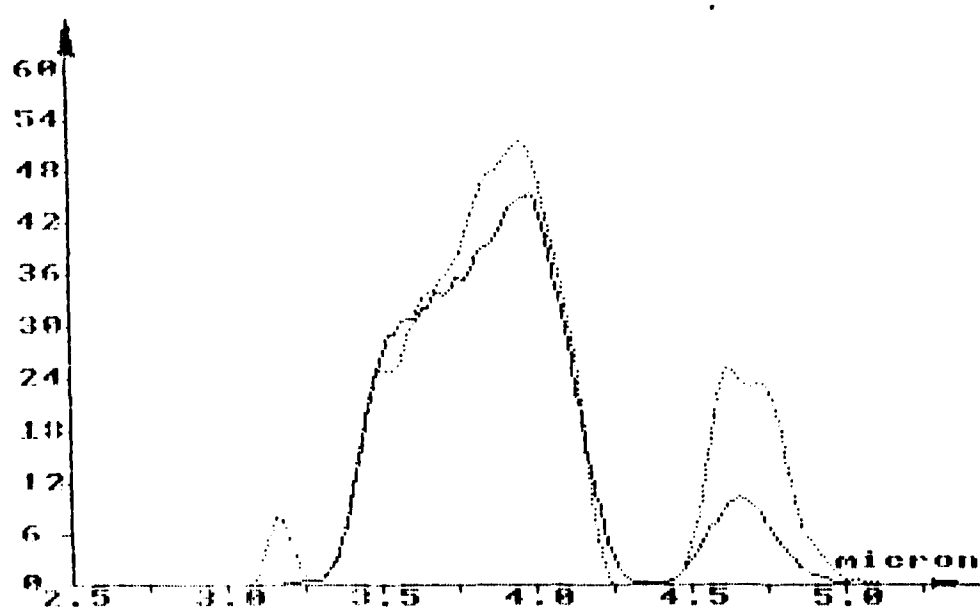
PUBLICATIONS

During the period under consideration two papers were read at international meetings:

1. A. Ben-Shalom, A.D. Devir, S.G. Lipson, U.P. Oppenheim and E. Ribak, "Absorption of IR radiation by atmospheric water vapor in the regions 4.3-5.5 micron and 8-13 micron", Third International Conference on IR physics, Zurich (1984).
2. A. Ben-Shalom, A.D. Devir, S.G. Lipson, U.P. Oppenheim and E. Ribak, "Absorption of IR radiation by atmospheric water vapor in the regions 4.3-5.5 micron and 8-13 micron", Topical Meeting on optical remote sensing of the atmosphere, Incline Village, Nevada (1985).

I(L2) %

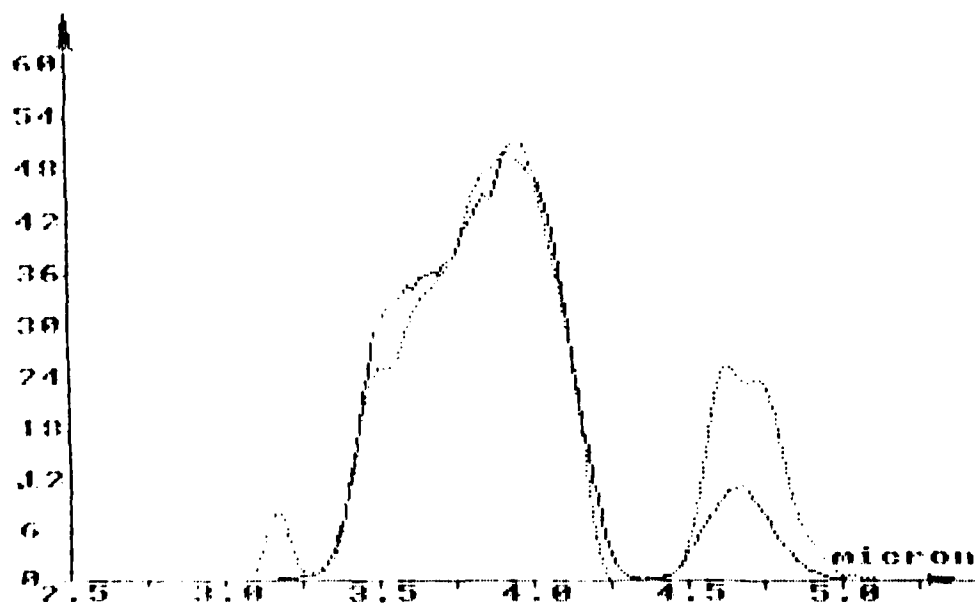
TRANSMITTANCE



NAME OF EXPERIMENT	PAL10	INSB	20/9/84
TEMPERATURE	26.4 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	76%		
H2O PRESSURE	19.7 mmHG		
VISIBILITY	15 km		
PRESSURE	1008 mb		

I(L2) %

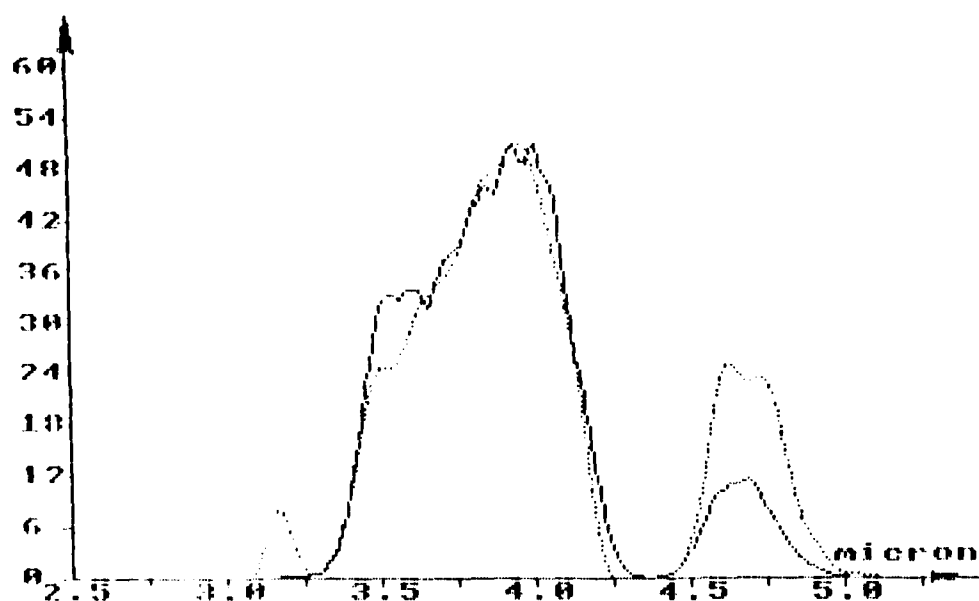
TRANSMITTANCE



NAME OF EXPERIMENT	PAL12	INSB	20/9/84
TEMPERATURE	24.9 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	81%		
H2O PRESSURE	19.2 mmHG		
VISIBILITY	15 km		
PRESSURE	1008 mb		

ICL2) %

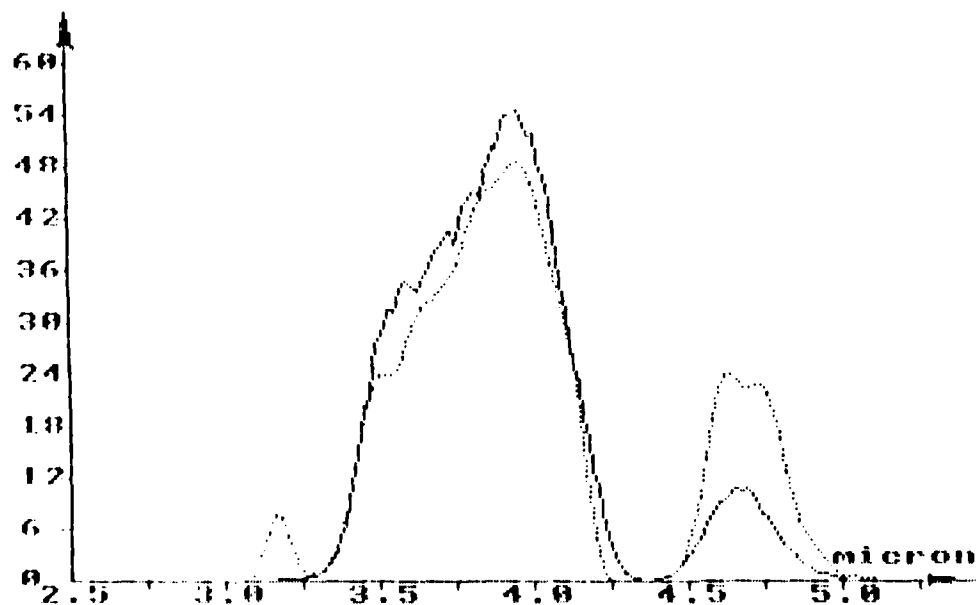
TRANSMITTANCE



NAME OF EXPERIMENT	PAL13	INSB	20/9/84
TEMPERATURE	24.5 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	85%		
H2O PRESSURE	19.6 mmHg		
VISIBILITY	15 km		
PRESSURE	1008 mb		

ICL2) %

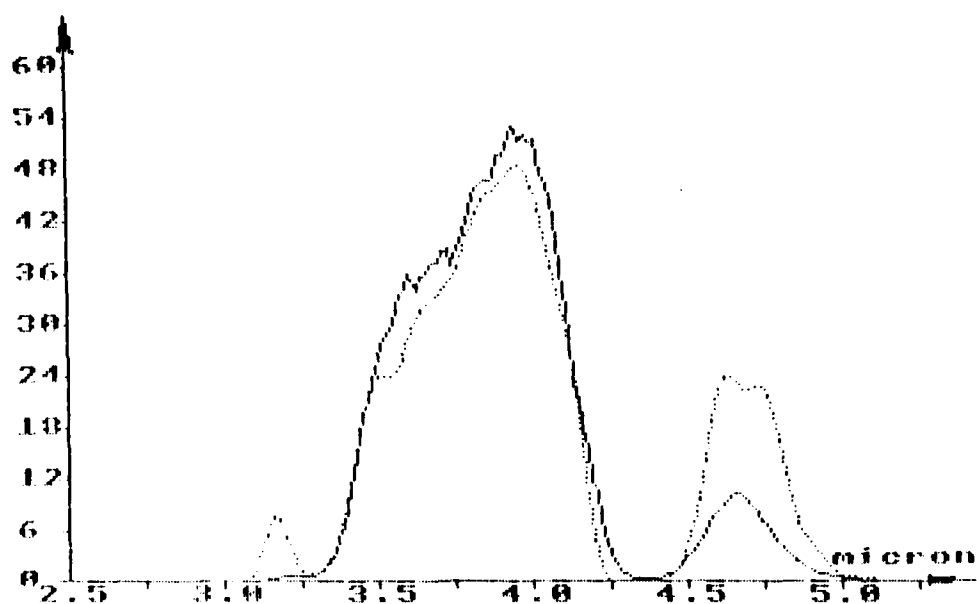
TRANSMITTANCE



NAME OF EXPERIMENT	PAL14	INSB	20/9/84
TEMPERATURE	22.9 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	88%		
H2O PRESSURE	18.5 mmHg		
VISIBILITY	12 km		
PRESSURE	1008 mb		

I(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

FAL15

INSB

20/9/84

TEMPERATURE

22.9 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

88%

H2O PRESSURE

18.5 mmHG

VISIBILITY

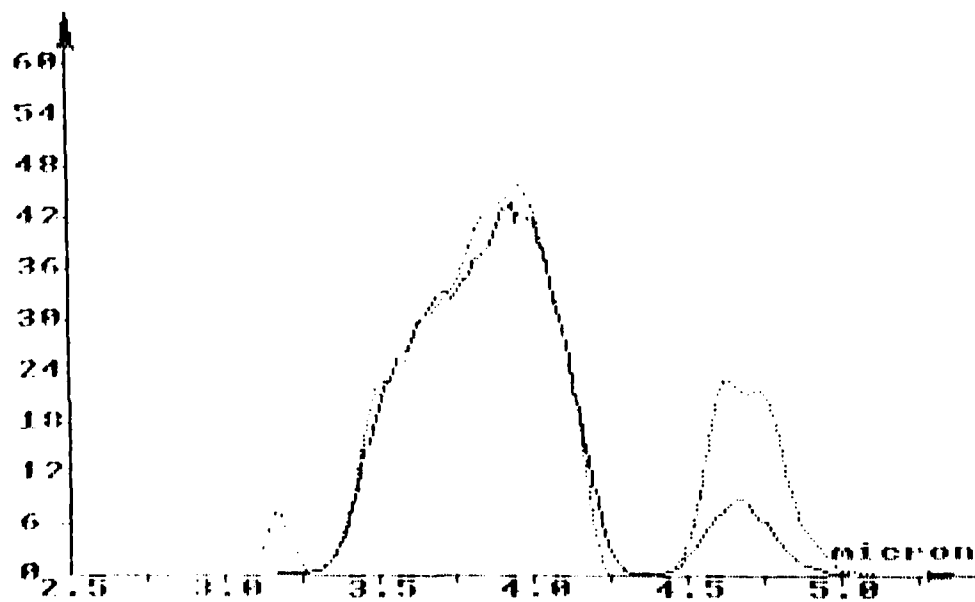
12 km

PRESSURE

1009 mb

I(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

FAL19

INSB

20/9/84

TEMPERATURE

21.3 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

95%

H2O PRESSURE

18.1 mmHG

VISIBILITY

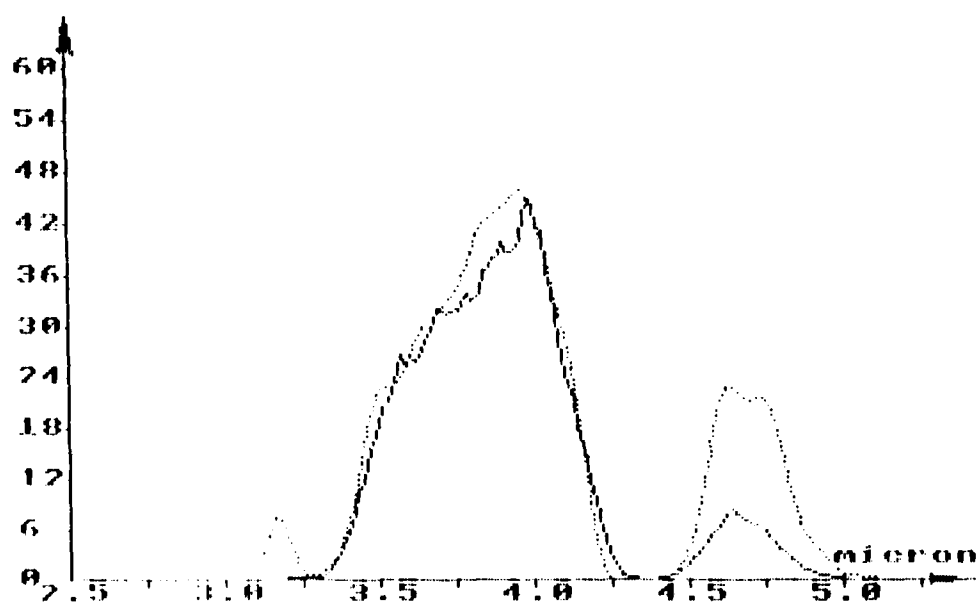
10 km

PRESSURE

1008 mb

I(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

FAL20

INSB

20/9/84

TEMPERATURE

21.3 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

95%

H2O PRESSURE

18.1 mmHG

VISIBILITY

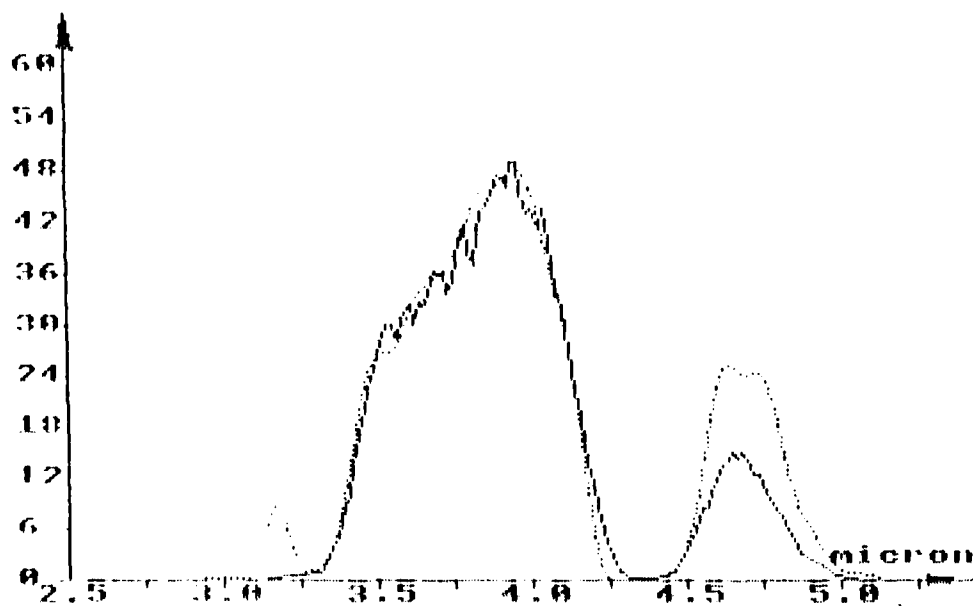
10 km

PRESSURE

1008 mb

I(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

FAL22

INSB

20/9/84

TEMPERATURE

19.1 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

86%

H2O PRESSURE

14.3 mmHG

VISIBILITY

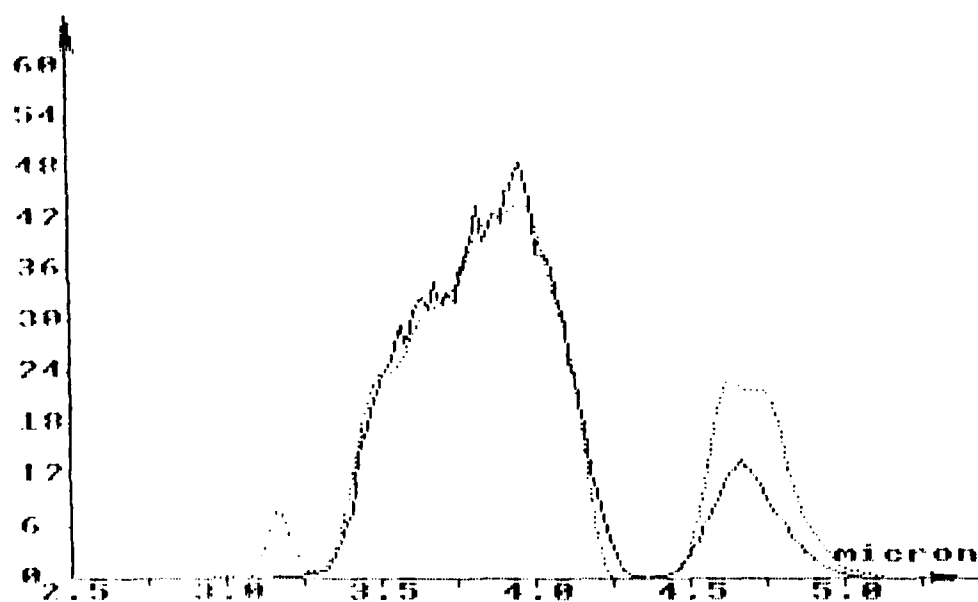
10 km

PRESSURE

1006 mb

1(L2) %

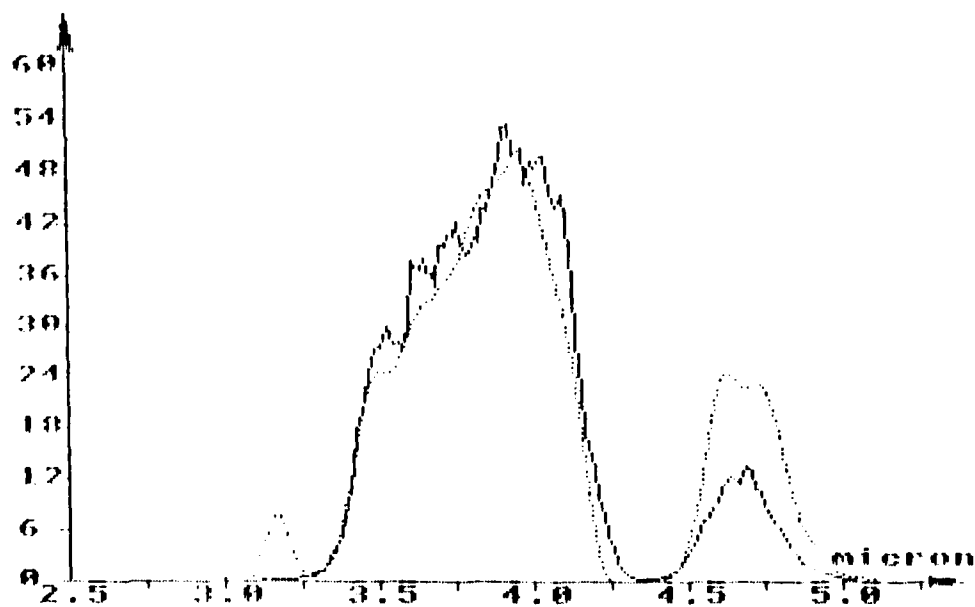
TRANSMITTANCE



NAME OF EXPERIMENT	PAL23	INSB	20/9/84
TEMPERATURE	20.5 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	82%		
H2O PRESSURE	14.9 mmHG		
VISIBILITY	8 km		
PRESSURE	1006 mb		

1(L2) %

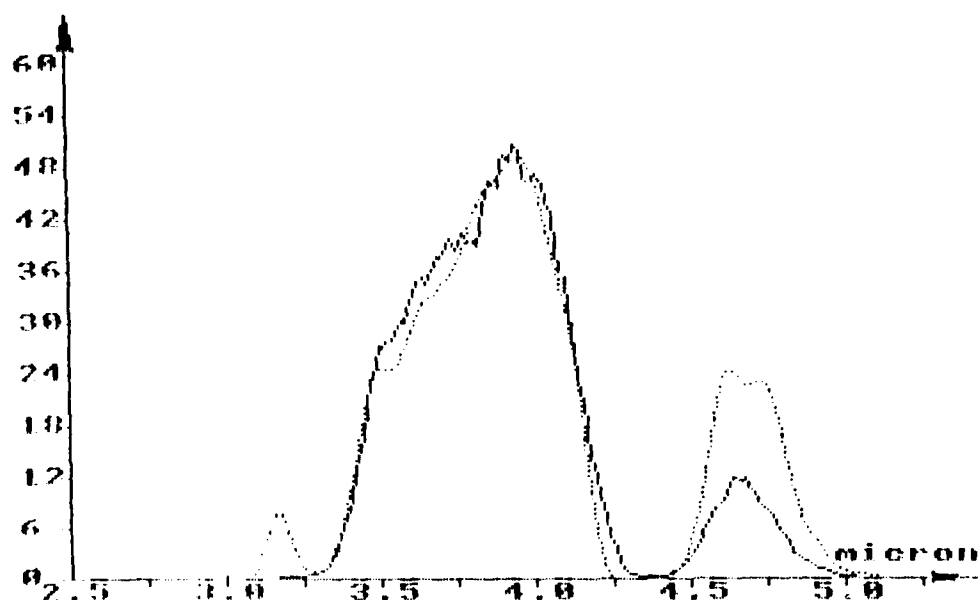
TRANSMITTANCE



NAME OF EXPERIMENT	PAL27	INSB	20/9/84
TEMPERATURE	25.5 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	75%		
H2O PRESSURE	18.4 mmHG		
VISIBILITY	12 km		
PRESSURE	1008 mb		

1(L2) %

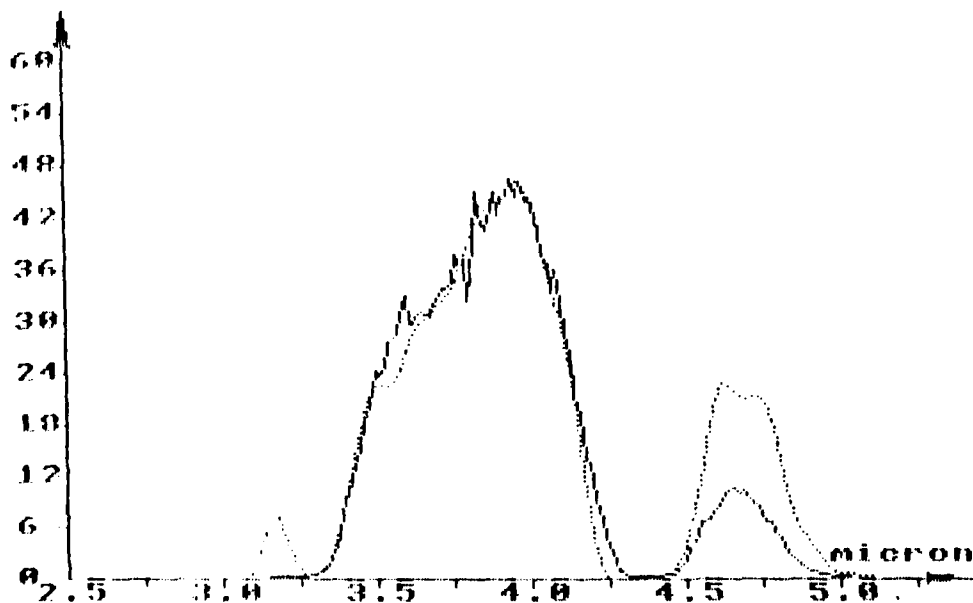
TRANSMITTANCE



NAME OF EXPERIMENT	PAL28	INSB	20/9/84
TEMPERATURE	25.5 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	75%		
H2O PRESSURE	18.4 mmHG		
VISIBILITY	12 km		
PRESSURE	1008 mb		

1(L2) %

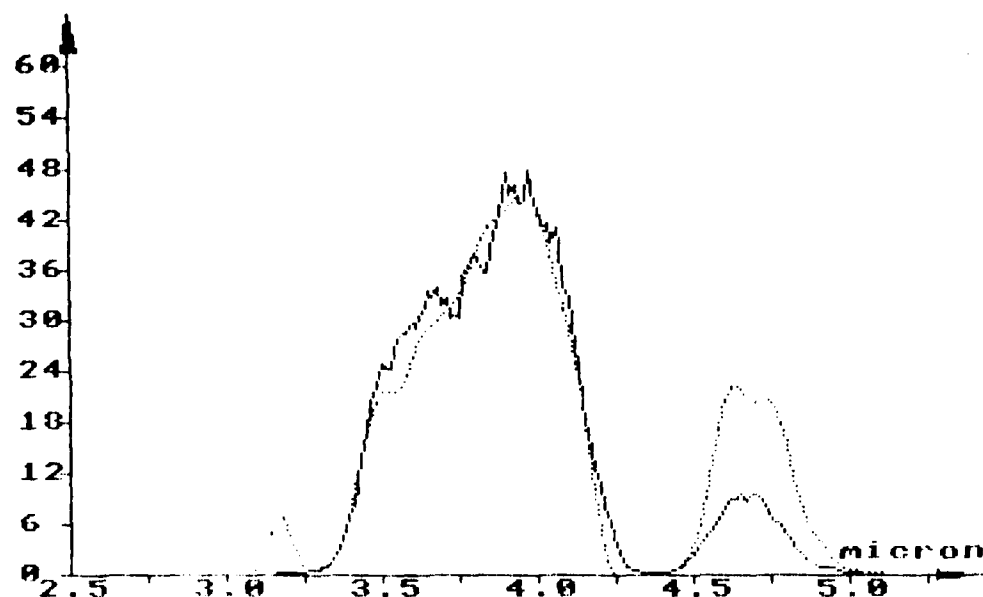
TRANSMITTANCE



NAME OF EXPERIMENT	PAL29	INSB	20/9/84
TEMPERATURE	25.5 C		
DISTANCE	8.6 km		
RELATIVE HUMIDITY	77.5%		
H2O PRESSURE	19 mmHG		
VISIBILITY	10 km		
PRESSURE	1008 mb		

T(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

PAL30

INSB

20/9/84

TEMPERATURE

26.1 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

79%

H2O PRESSURE

20.1 mmHG

VISIBILITY

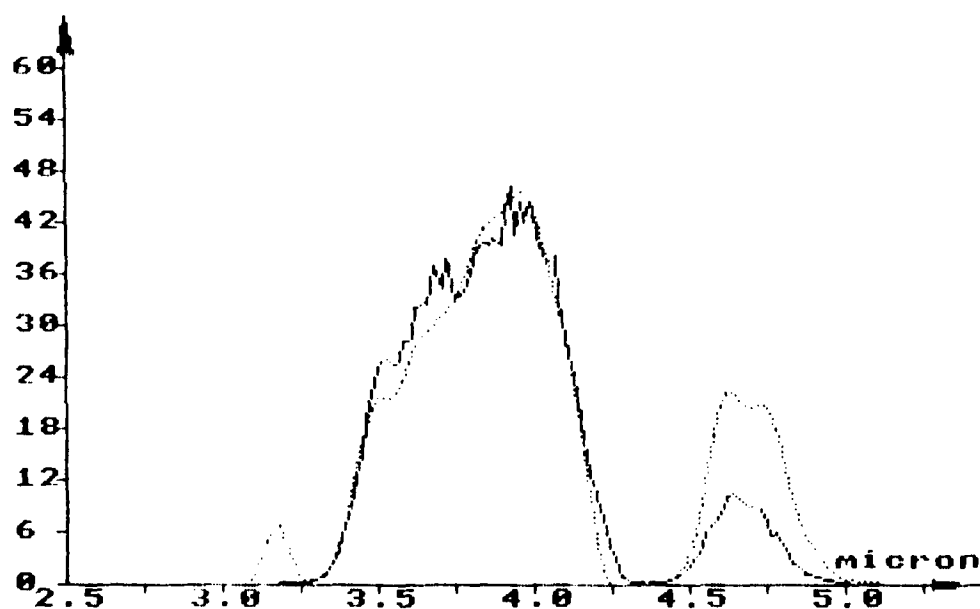
10 km

PRESSURE

1008 mb

T(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

PAL31

INSB

20/9/84

TEMPERATURE

26.1 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

79%

H2O PRESSURE

20.1 mmHG

VISIBILITY

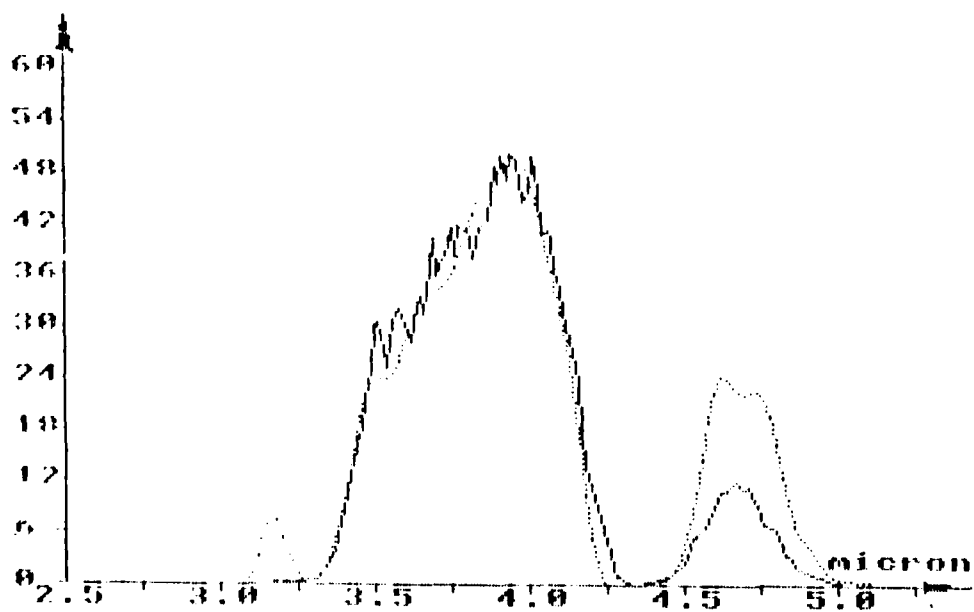
10 km

PRESSURE

1008 mb

1 (1.2) %

TRANSMITTANCE



NAME OF EXPERIMENT

PAL34

INSB

20/9/84

TEMPERATURE

27.4 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

73%

BARO PRESSURE

20 mmHG

VISIBILITY

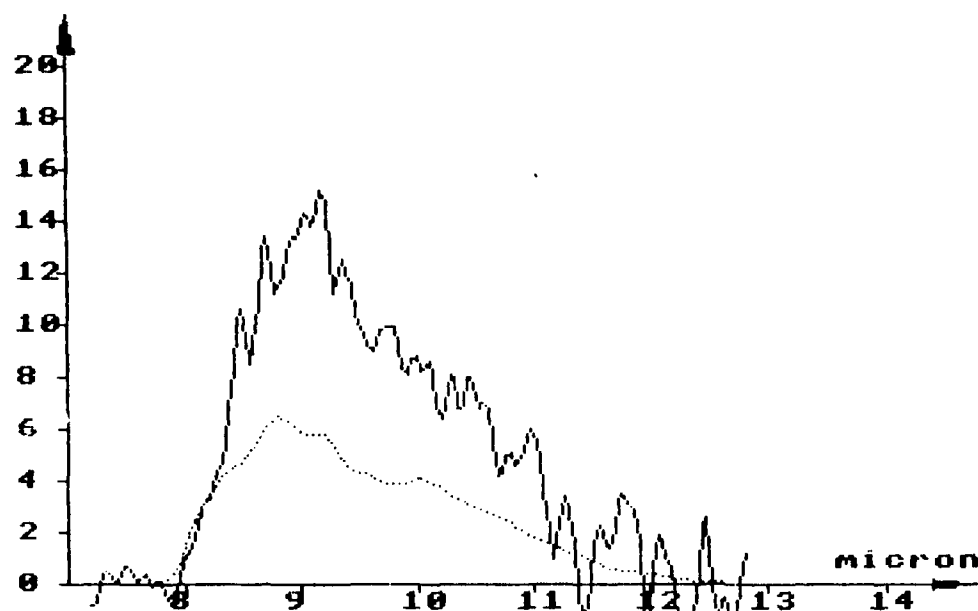
13 km

PRESSURE

1006 mb

T(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

PAL09

CMT

20/9/84

TEMPERATURE

26.4 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

76%

H2O PRESSURE

19.7 mmHG

VISIBILITY

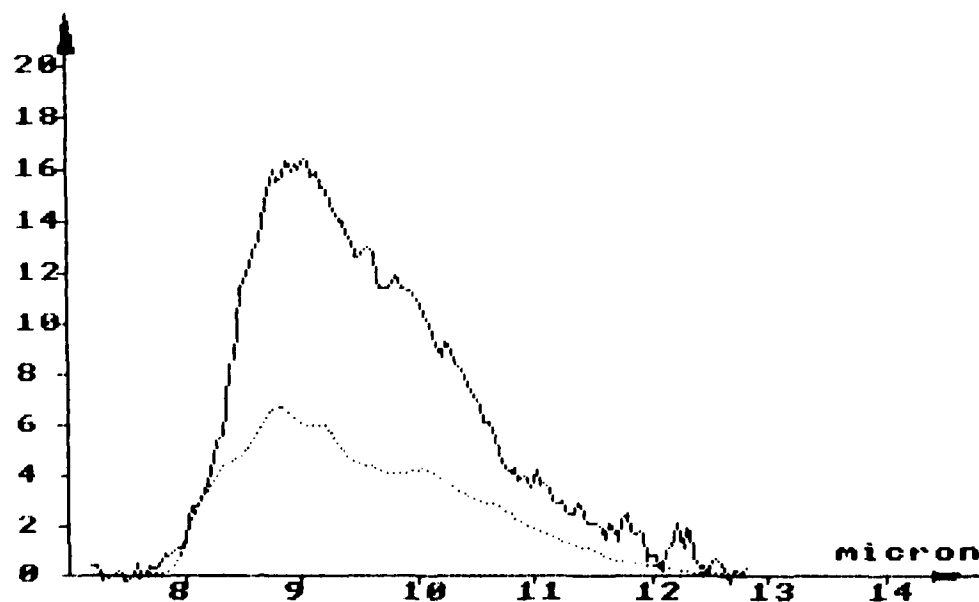
15 km

PRESSURE

1008 mb

T(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

PAL12

CMT

20/9/84

TEMPERATURE

24.9 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

81%

H2O PRESSURE

19.2 mmHG

VISIBILITY

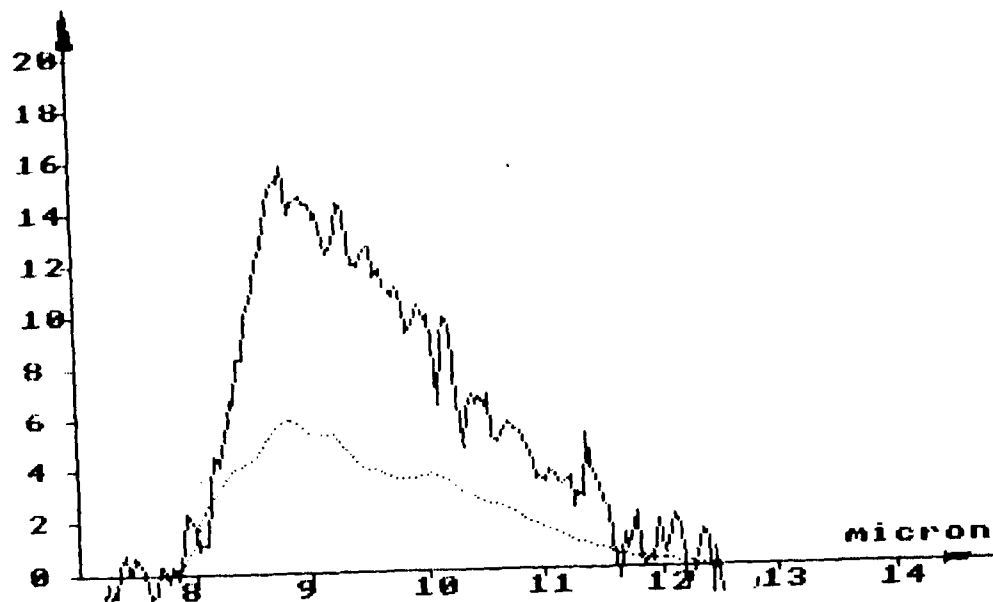
15 km

PRESSURE

1008 mb

I(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

PAL13 CMT 20/9/84

TEMPERATURE

24.5 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

85%

H2O PRESSURE

19.6 mmHG

VISIBILITY

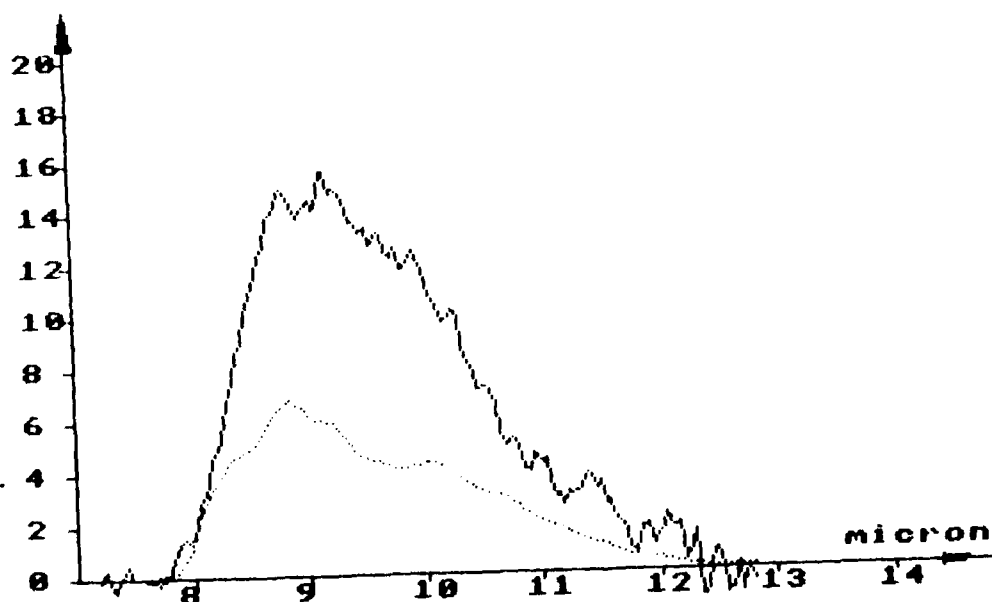
15 km

PRESSURE

1008 mb

I(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

PAL14 CMT 20/9/84

TEMPERATURE

22.9 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

88%

H2O PRESSURE

18.5 mmHG

VISIBILITY

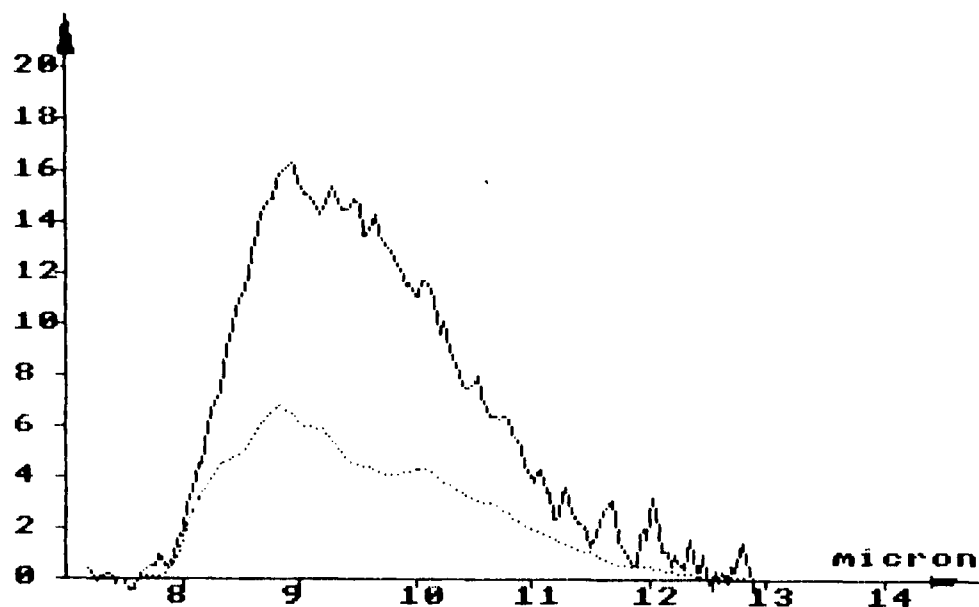
12 km

PRESSURE

1009 mb

T(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

PAL15

CMT

20/9/84

TEMPERATURE

22.9 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

88%

H2O PRESSURE

18.5 mmHG

VISIBILITY

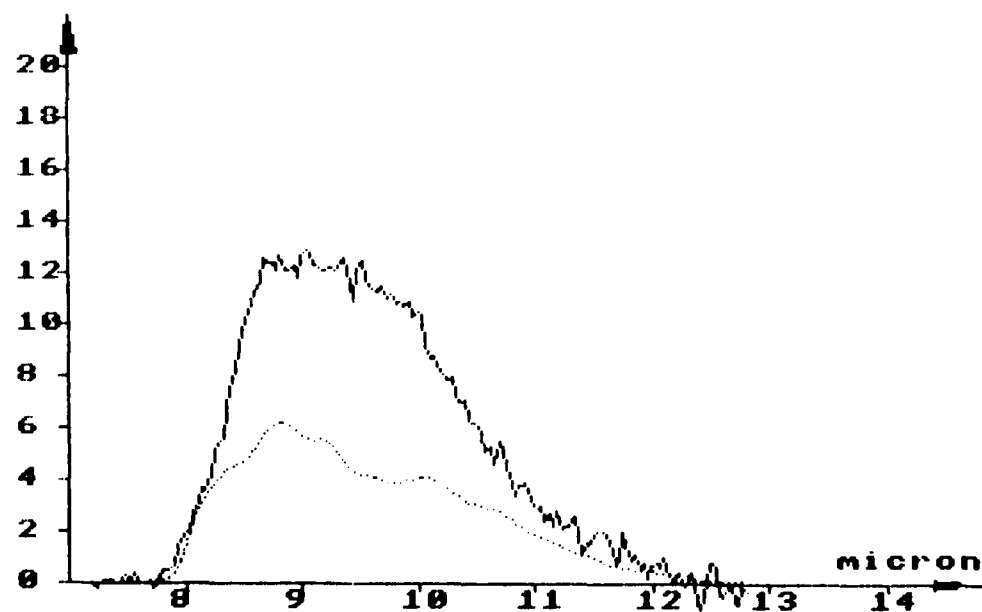
12 km

PRESSURE

1009 mb

T(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

PAL19

CMT

20/9/84

TEMPERATURE

21.3 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

94.5%

H2O PRESSURE

18.1 mmHG

VISIBILITY

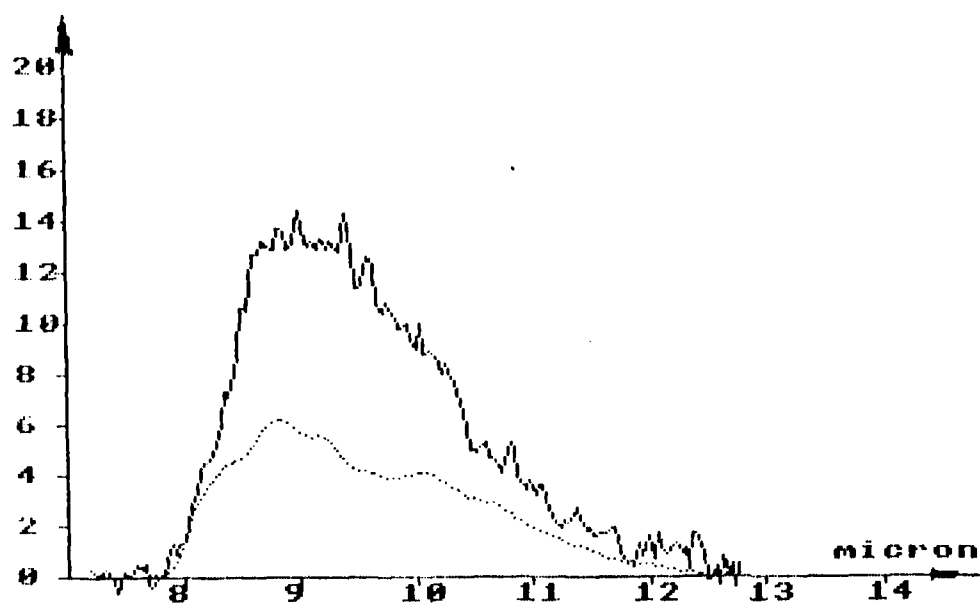
10 km

PRESSURE

1008 mb

TRANSMITTANCE

1(L2) %



NAME OF EXPERIMENT

PAL20

CMT

20/9/84

TEMPERATURE

21.3 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

95%

WATER VAPOR PRESSURE

18.1 mmHG

VISIBILITY

10 km

PRESSURE

1008 mb

T(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

PAL22

CMT

20/9/84

TEMPERATURE

19.1 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

86%

H2O PRESSURE

14.3 mmHG

VISIBILITY

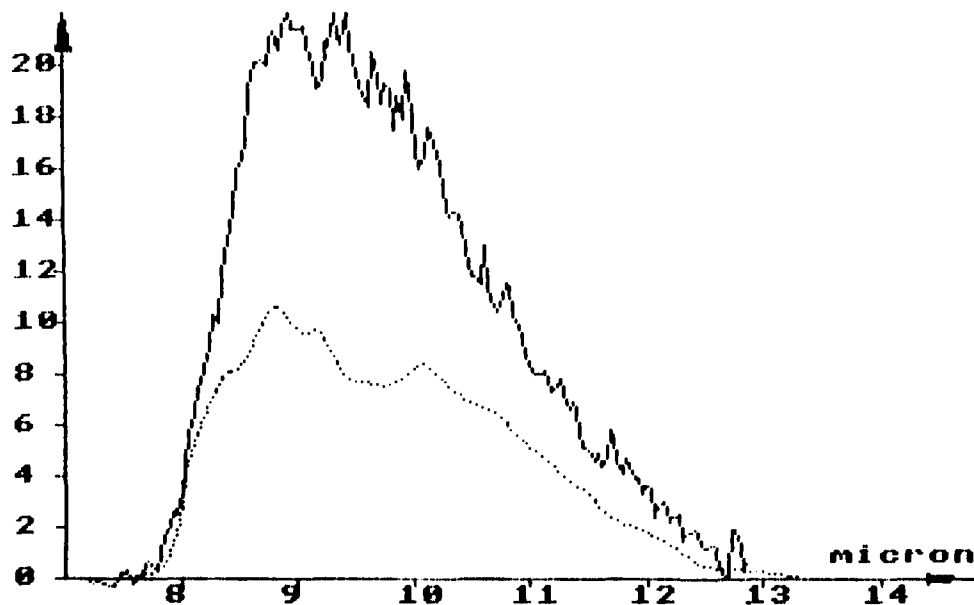
10 km

PRESSURE

1006 mb

T(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

PAL23

CMT

20/9/84

TEMPERATURE

20.5 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

82%

H2O PRESSURE

14.9 mmHG

VISIBILITY

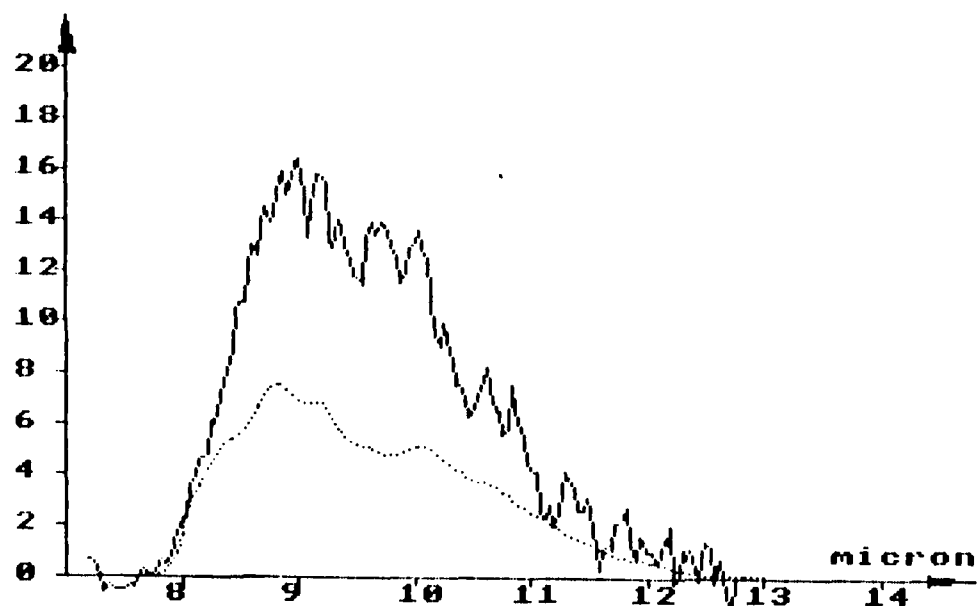
8 km

PRESSURE

1006 mb

I(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

FAL27

CMT

20/9/84

TEMPERATURE

25.5 C

DISTANCE

8.6 km

RELATIVE UMIDITY

75%

H2O PRESSURE

18.4 mmHG

VISIBILITY

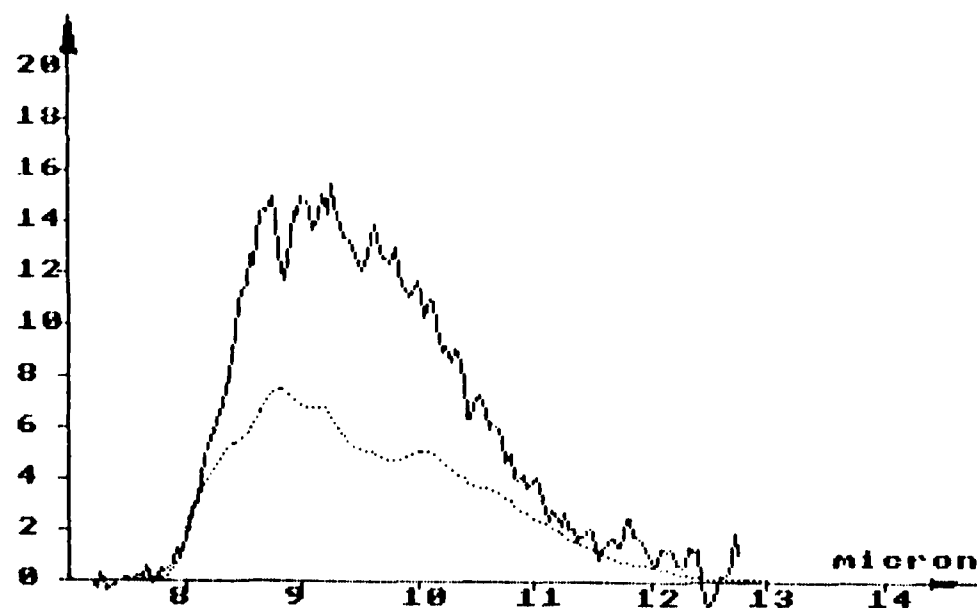
12 km

PRESSURE

1008 mb

I(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

FAL28

CMT

20/9/84

TEMPERATURE

25.5 C

DISTANCE

8.6 km

RELATIVE UMIDITY

75%

H2O PRESSURE

18.4 mmHG

VISIBILITY

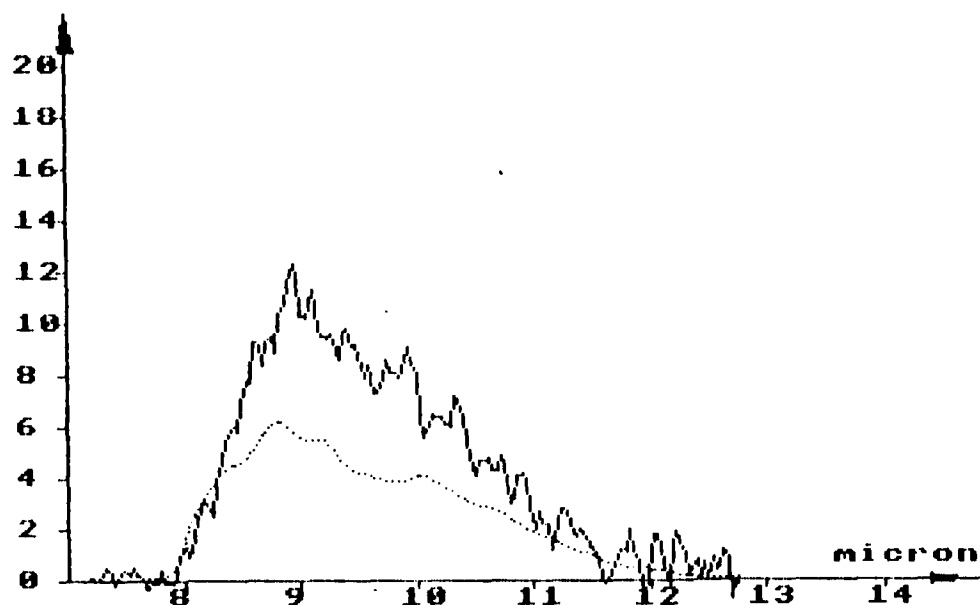
12 km

PRESSURE

1008 mb

I(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

PAL29

CMT

20/9/84

TEMPERATURE

25.5 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

77.5%

H2O PRESSURE

19 mmHG

VISIBILITY

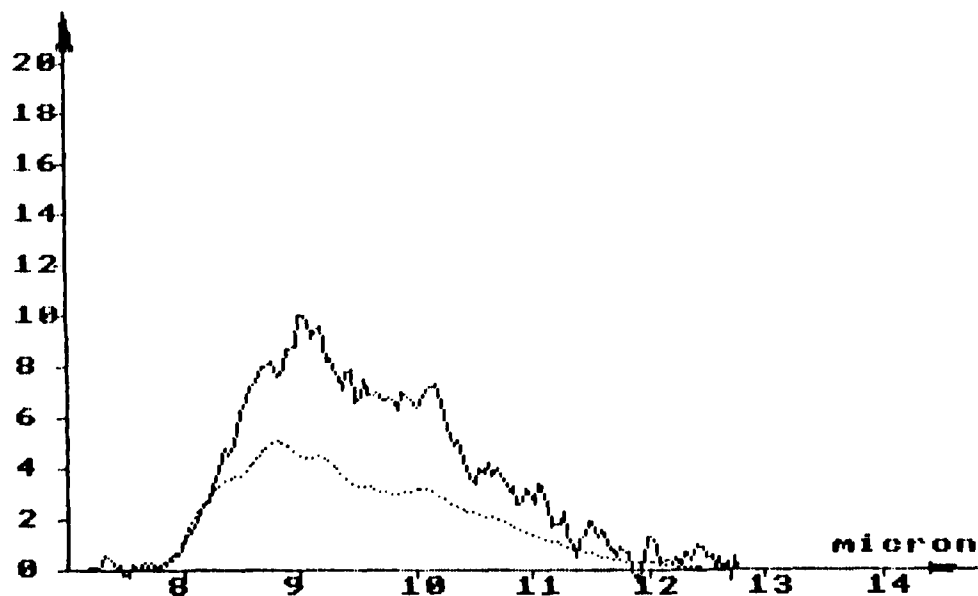
10 km

PRESSURE

1008 mb

I(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

PAL30

CMT

20/9/84

TEMPERATURE

26.1 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

79%

H2O PRESSURE

20.1 mmHG

VISIBILITY

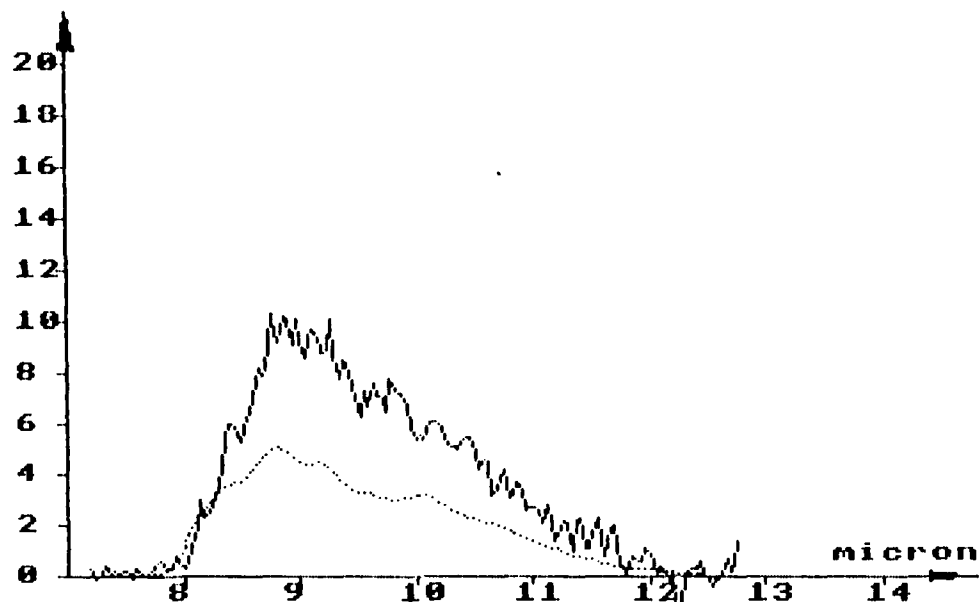
10 km

PRESSURE

1008 mb

T(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

PAL31

CMT

20/9/84

TEMPERATURE

26.1 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

79%

H2O PRESSURE

20.1 mmHG

VISIBILITY

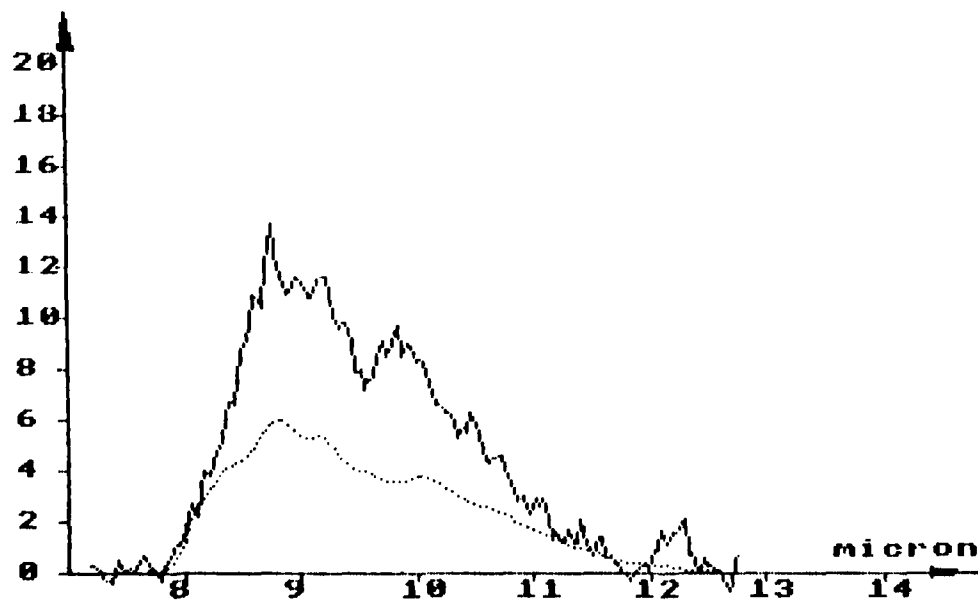
10 km

PRESSURE

1008 mb

T(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

PAL33

CMT

20/9/84

TEMPERATURE

27.4 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

73%

H2O PRESSURE

20 mmHG

VISIBILITY

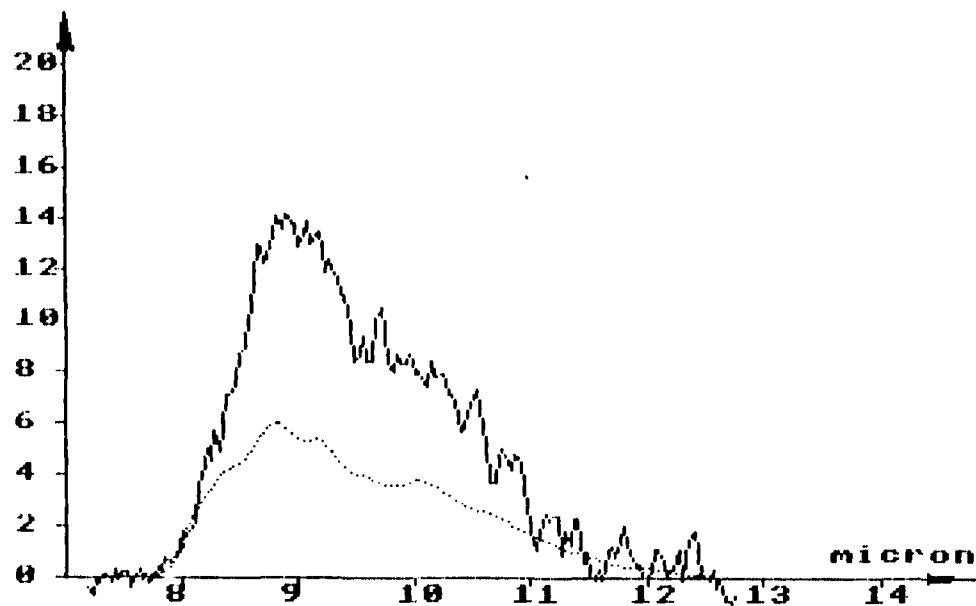
13 km

PRESSURE

1006 mb

I(L2) %

TRANSMITTANCE



NAME OF EXPERIMENT

PAL34

CMT

20/9/84

TEMPERATURE

27.4 C

DISTANCE

8.6 km

RELATIVE HUMIDITY

73%

H2O PRESSURE

20 mmHG

VISIBILITY

13 km

PRESSURE

1006 mb

END

FILMED

12-85

DTIC