LEP Note 558
and

INTERNAL REPORT
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ENVIRONMENTAL MONITORING FOR THE LEP PROJECT

MEASURING RESULTS OF PREOPERATIONAL BACKGROUND PARAMETERS DURING 1985

A. Bonifas, Ch. Nuttall and G. Rau

SUMMARY

The present report summarizes the results of measurements performed in 1985 to determine levels of natural radiation, radioactivity and toxic gases in the environment of the future LEP site.

1. INTRODUCTION

The purpose of environmental monitoring around nuclear installations is to measure and control the release of radioactivity and toxic substances into air and water and their dispersion in various environmental media as well as direct or stray radiation that may escape from such installations during operation.

In order to be able to assess the impact of a nuclear installation on the environment, measurement results obtained during operation have to be compared with those specific for the area due to natural or common man-made sources.

Therefore a LEP preoperational environmental monitoring programme was set up to determine the natural radiation, radioactivity and toxic substances in various environmental media which could be influenced by the operation of this installation later on.

A similar programme was carried out for the SPS project (Ref. 1), and environmental background measurements have been made continuously since 1975 in areas adjacent to the present CERN installations. Taking into consideration the results of all these measurements the programme to be implemented for the LEP project could therefore be kept to a minimum.

2. DESCRIPTION OF THE PROGRAMME

When establishing the LEP preoperational environmental monitoring programme, experience with accelerators already in operation and their impact on the environment were taken into consideration. As the LEP accelerator and its experimental facilities are all located deep underground, direct or stray radiation from machine operation are not to be expected on the site in quantities discernible from the natural fluctuations of the background radiation. Detailed calculations and estimates for the production and release of radioactivity and toxic gases (O_3, NO, NO_x) from the LEP tunnels and underground areas have been made (Ref. 2) which show that the impact of LEP on the environment will be insignificant.

The measurements to be carried out within this preoperational programme are concentrated around future air release points of the LEP ventilation system, with one measuring station in each of the CERN host countries. Figure 1 shows the location of these stations in Switzerland (pit No. 1) and France (pit No. 5).

The stations are equipped with monitors continuously recording neutron and gamma radiation, an aerosol sampler, and instruments for measuring the O_3, NO and NO_x concentrations in air. Sampling points for various environmental media are also shown in Fig. 1. Integrating thermoluminescence dosimeters (TLD) are distributed on Swiss territory together with dosemeters provided by Swiss authorities for intercomparison.

Table 1 summarizes the LEP preoperational environmental monitoring programme. This routine programm will be complemented by special measurements to study particular environmental protection aspects, but during limited periods only. The programme started in July 1984 (Ref. 3) but will continue until LEP comes into operation. Thereafter these measurements will be carried on within the already existing CERN environmental monitoring programme for the CERN Meyrin and Prévessin sites (Ref. 4).

The instrumentation and measuring methods used are described in Ref. 5.

3. RESULTS OF RADIATION AND RADIOACTIVITY MEASUREMENTS

Detailed measuring results are presented in the form of tables and figures attached.

3.1 Natural radiation

The total doses measured with monitor stations PMS 912 and PMS 952 in 1985 were:

	Gamma (μSv)	Neutron (μSv)	Total (μSv)
PMS 912	710	60	770
PMS 952	650	60	710

Monthly dose values as measured by these monitors are shown in Fig. 2. Gamma dose measurements with TLDs gave the following results:

TLD No.	Location (Fig. 1)	Dose (μSv/y)
7	Meyrin	850
8	PMS 912	730
9	Mategnin	610
10	Vireloup	690
11	PMS 952	-

3.2 Radioactivity in air

The mean air (aerosol) activity concentrations sampled by the fixed-filter stations PMA911 and PMA 951 during 1985 were:

	Total beta activity (mBq/m^3)	^{7}Be (mBq/m^3)
PMA 911	6.1 E-1	3.4
PMA 951	3.2 E-1	1.9

Figure 3 shows the seasonal variation of ^{7}Be - also a typical accelerator produced isotope - in the air attached to aerosol.

3.3 Radioactivity in water

Four water samples were taken from the Versoix river (near Collex-Bossy, point SWV1) in March, June September and December respectively. The following mean activity concentrations were found:

Total β : 4.8 E-2 Bq/l
^{40}K : 2.4 E-2 Bq/l
^{3}H : <9 Bq/l (= detection limit).

Results of water sample analyses from the rivers Le Lion and Allondon, also flowing through future LEP areas, are also given in the annex, even though the analysis of these samples is part of the present CERN environmental monitoring programme.

Samples of drinking (underground) water were taken twice in 1985 (March, September) at the fountain of the Versonnex commune (sampling point UWVX). The following mean activity concentrations were measured:

Total β : 1.9 E-2 Bq/l
^{40}K : 1.7 E-2 Bq/l
^{3}H : <9 Bq/l (= detection limit).

3.4 Radioactivity in mud

Together with water samples, mud samples were taken four times during 1985 from the Versoix river (sampling point MUV1), showing the following mean activity concentration:

Total β : 4.2 E-1 Bq/g dry material
^{40}K : 3.1 E-1 Bq/g dry material

3.5 Radioactivity in vegetation (grass)

Grass samples were taken twice during 1985 approximately 100 m from the LEP pit No. 5 (sampling points GRC1, GRC2), which will be a future air release point of the LEP main ring ventilation system. The sampling points are located approximately in the two main wind directions typical for this area. The following results were obtained:

Mean total β activity : 8.7 E+2 Bq/kg dry material,
Mean ^{40}K activity : 8.0 E+2 Bq/kg dry material,
Mean ^{7}Be activity : 8.7 E+1 Bq/kg dry material.

4. MEASUREMENT OF OZONE AND OXIDES OF NITROGEN

Continuous measurements of ozone and oxides of nitrogen were carried out in 1985. The analytical methods used are absorption in the ultraviolet which is specific for ozone (O_3) and chemical luminescence for the oxides of nitrogen (NO + NO_x). The measurements are made continuously and transmitted, by radio, to LEP/CV where the hourly average is calculated and can be presented in graphical or tabular forms.

Figures 4-7 show the variation in ozone concentrations between Cessy and Meyrin in July and December:

Fig. 4 - Cessy - July
Fig. 5 - Meyrin - July
Fig. 6 - Cessy - December
Fig. 7 - Meyrin - December

It is evident that, as expected, December ozone concentrations are much smaller than those in July and it is interesting to note that the concentrations at Cessy are considerably lower than at Meyrin.

The oxides of nitrogen monitors gave considerable trouble in the hot summer months and it was not until the autumn that reliable results were obtained.

Fig. 8 NO - Cessy - December
Fig. 9 NO_x - Cessy - December
Fig. 10 NO - Meyrin - December
Fig. 11 NO_x - Meyrin - December

The Meyrin monitor shows oxides of nitrogen concentration in excess of those at Cessy, which is to be expected given the proximity of the Route de Meyrin and the "Cité Satellite". The instruments are now running more reliably.

REFERENCES

1. G. Rau and D. Schwenke, Environmental radiation measurements around the 300 GeV accelerator area, SPS/RA/NOTE/76-6 (1976).
2. K. Goebel (editor), The radiological impact of the LEP project on the environment, CERN 81-08 (1981).
3. A. Bonifas and G. Rau, Environmental monitoring for the LEP project, July-December 1984, TIS-RP/IR/85-15 (1985).
4. A. Bonifas and G. Rau, Environmental monitoring on the CERN sites during 1985, TIS-RP/IR/86-06 (1986).
5. B. Moy, G. Rau and D. Schwenke, The instrumentation for monitoring the environment around CERN, HS-RP/050 (1980).

TABLE 1

Programme for the determination of preoperational environmental background parameters around the future LEP area

I. Radiation monitoring:

Monitored subject	Radiation/ radio-activity	Measuring instruments	Location/ sampl.point (Fig. 1)	No. of points	Frequency
1. Ambient radiation	γ n	Argon-filled ionization chamber, moderated BF_3 counter	PMS 912 (CH) PMS 952 (F)	1 1	Continuous
	γ	TLD	PMS 912 PMS 952 Swiss territory	1 1 3	4x per year
2. Aerosol	Total β γ	Large-area prop.counter Ge(Li) or Ge diode	PMA 911 (CH) PMA 951 (F)	1 1	Continuous sampling; Filter change 2x per month
3. Surface water	Total β γ ^{40}K ^{3}H	Large-area prop.counter Ge(Li) or Ge diode Flame photometer Liquid scintillation counter	SMV1 SWA1 SWL4	1 1 1	4x per year
4. Tap- and underground water	Total β γ ^{40}K ^{3}H	Large-area prop.counter Ge(Li) or Ge diode Flame photometer Liquid scintillation counter	UWVX	1	4x per year

(continued)

Table 1 (continued)

Monitored subject	Radiation/ radio-activity	Measuring instruments	Location/ sampl.point	No. of points	Frequency
5. Mud	Total β γ ^{40}K	Large-area prop.counter Ge(Li) or Ge diode	MUV1 MUA1 MUL3	1 1 1	4x per year
6. Grass and vegetation *)	Total β γ ^{40}K	Large-area prop.counter Ge(Li) or Ge diode	Near pit 5 GRC1 GRC2 (F)	2	2x per year

*) Ashed substance for all measurements.

II. Monitoring of toxic substances:

Monitored substance	Type	Measuring method	Location	No. of points	Frequency
7. Air	O_3	UV absorption,	PMU 912	1	Continuous
	NO, NO_x	Chemoluminescence	PMN 952	1	

TABLE 2

Radioactivity in grass samples
(in Bq/kg dry material)

Date	Sampling point	Weight of dry mat. (in g)	Total β	^{40}K	^{7}Be
23 Apr.	100 m east of pit 5 (GRC 1)	239	1.0 E+3	9.9 E+2	1.5 E+2
21 Oct.	- " -	147	9.9 E+2	8.6 E+2	< DL
23 Apr.	100 m west of pit 5 (GRC 2)	243	9.4 E+2	8.7 E+2	1.2 E+2
21 Oct.	- " -	243	5.5 E+2	4.8 E+2	4.7 E+1

DL (Bq/kg). Detection limit; ^{7}Be: 3.0 E+1.

TABLE 3

Radioactivity in water samples
(in Bq/l)

Surface water (rivers):

Date	Sampling point	Total β	^{40}K	^{3}H
20 March	SWA1	7.9 E-2	7.1 E-2	<DL *)
	SWL4	7.2 E-2	6.2 E-2	<DL
	SWV1	4.3 E-2	2.5 E-2	<DL
6 June	SWA1	8.0 E-2	4.5 E-2	<DL
	SWL4	7.5 E-2	5.9 E-2	<DL
	SWV1	4.7 E-2	1.4 E-2	<DL
24 Sept.	SWA1	1.9 E-1	1.9 E-1	<DL
	SWL4	6.0 E-2	5.0 E-2	<DL
	SWV1	3.2 E-2	3.1 E-2	<DL
5 Dec.	SWA1	1.7 E-1	1.4 E-1	<DL
	SWL4	7.1 E-2	4.3 E-2	<DL
	SWV1	6.8 E-2	2.5 E-2	<DL

*) DL = 9 Bq/l (detection limit).

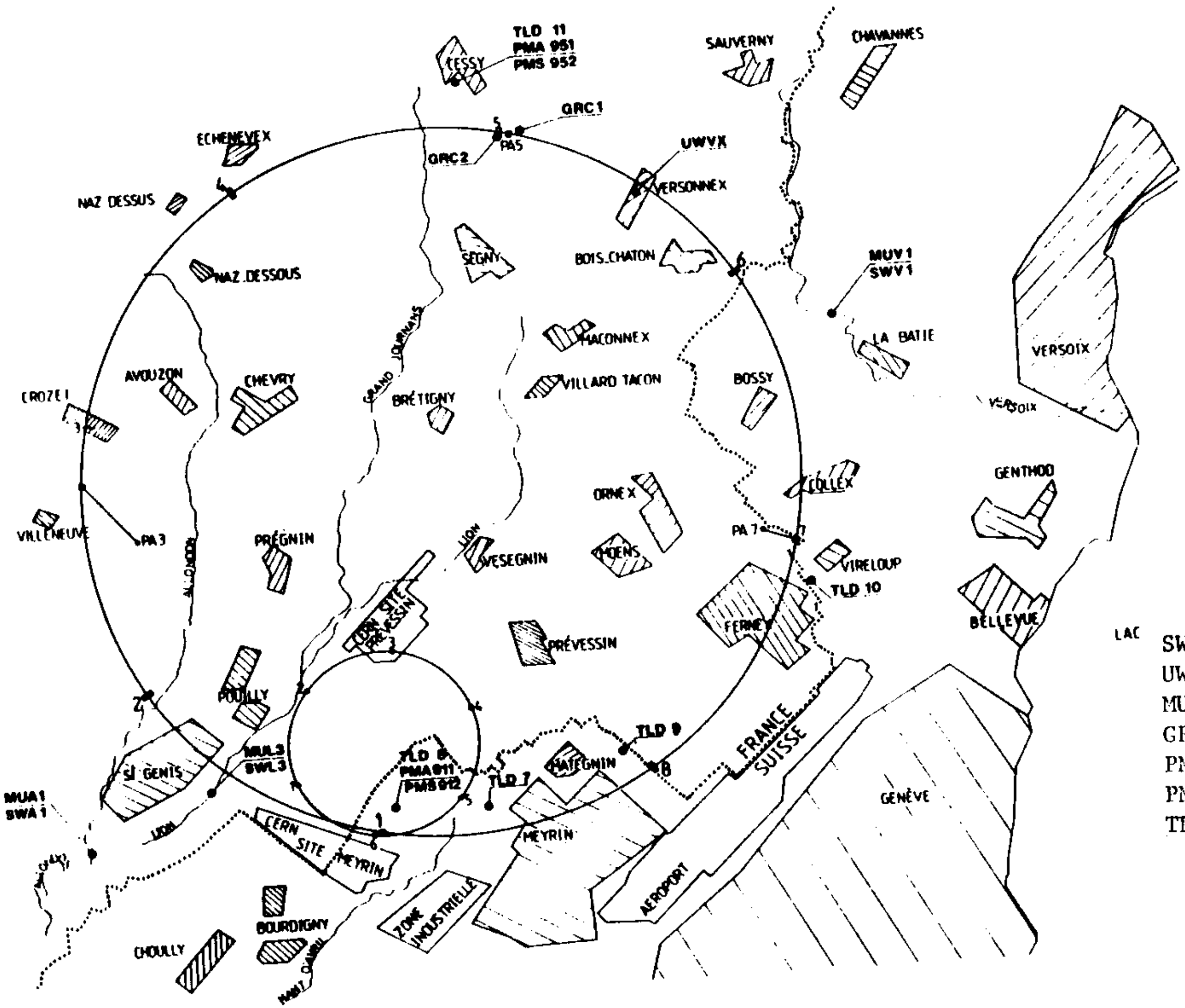
Drinking water (fountain Versonnex):

Date	Sampling point	Total β	^{40}K
2 April	UWVX	1.8 E-2	1.6 E-2
4 Sept.	UWVX	1.9 E-2	1.8 E-2

TABLE 4

Radioactivity in sediment of rivers
(in Bq/g dry material)

Date	Sampling point	Total β	^{40}K
20 March	MUA1	5.5 E-1	2.9 E-1
	MUL3	2.8 E-1	2.6 E-1
	MUV1	3.8 E-1	3.0 E-1
6 June	MUA1	4.2 E-1	2.2 E-1
	MUL3	4.7 E-1	3.7 E-1
	MUV1	4.1 E-1	2.9 E-1
29 Sept.	MUV1	4.5 E-1	2.5 E-1
	MUL3	4.0 E-1	2.4 E-1
	MUA1	4.9 E-1	3.4 E-1
5 Dec.	MUV1	4.6 E-1	2.2 E-1
	MUA1	3.9 E-1	2.3 E-1
	MUL3	4.1 E-1	3.2 E-1



SW = surface water
UW = underground water
MU = mud
GR = grass
PMA = aerosol sampler
PMS = site radiation monitor
TLD = thermoluminescence dosimeter

Fig. 1

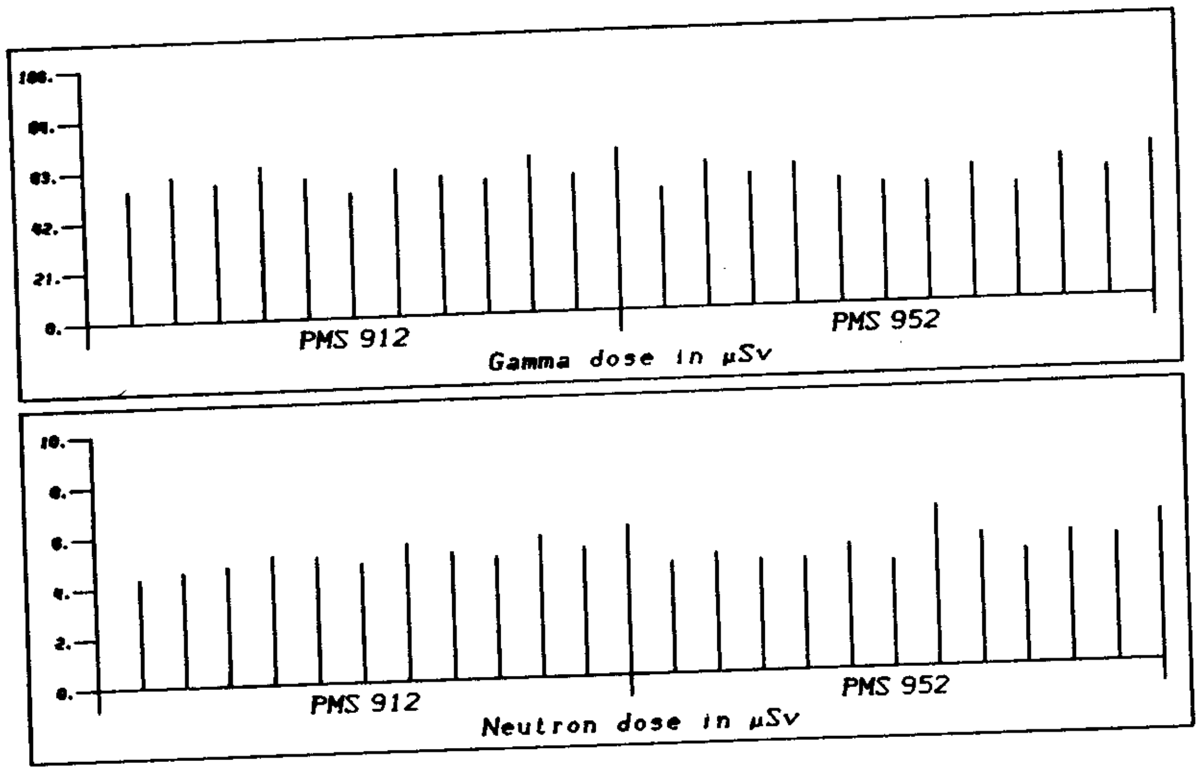

PMS 912
PMS 952
Gamma dose in μSv
PMS 912
PMS 952
Neutron dose in μSv

Fig. 2

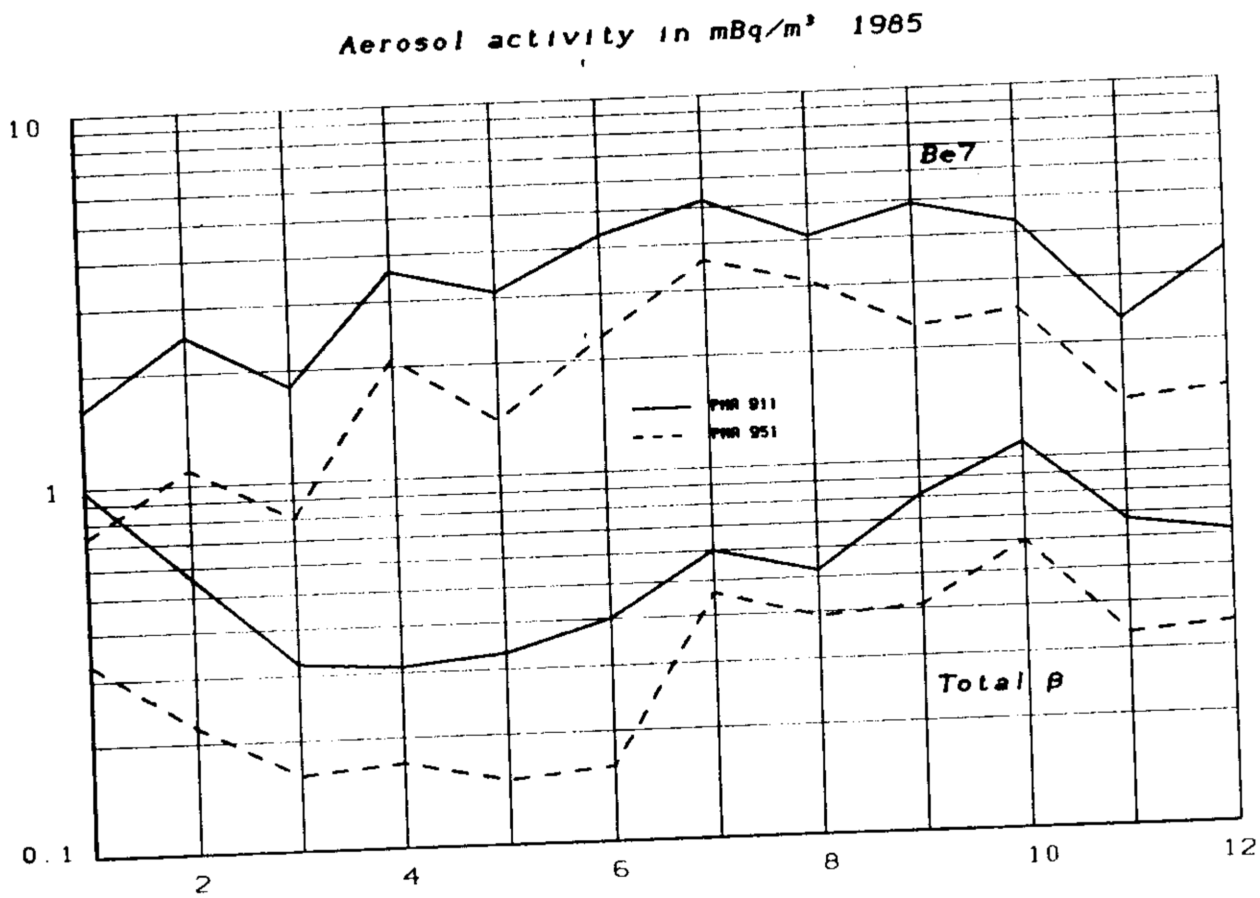
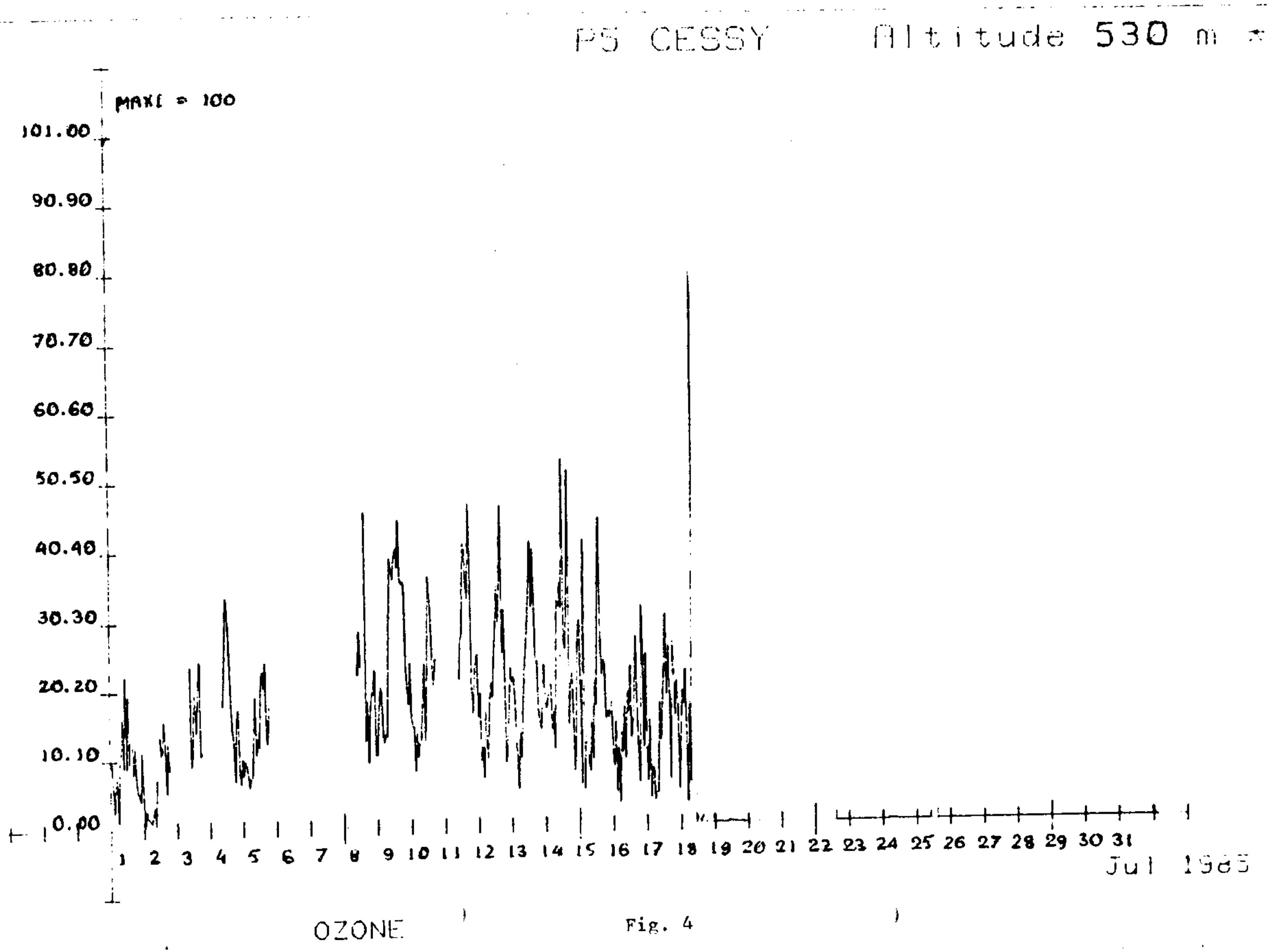

Aerosol activity in mBq/m³ 1985
Be7
Total β
PMA 911
PMA 951
10
1
0.1
2
4
6
8
10
12

Fig. 3



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Ppb
MAXI = 100
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90.90
80.80
70.70
60.60
50.50
40.40
30.30
20.20
10.10
0.00
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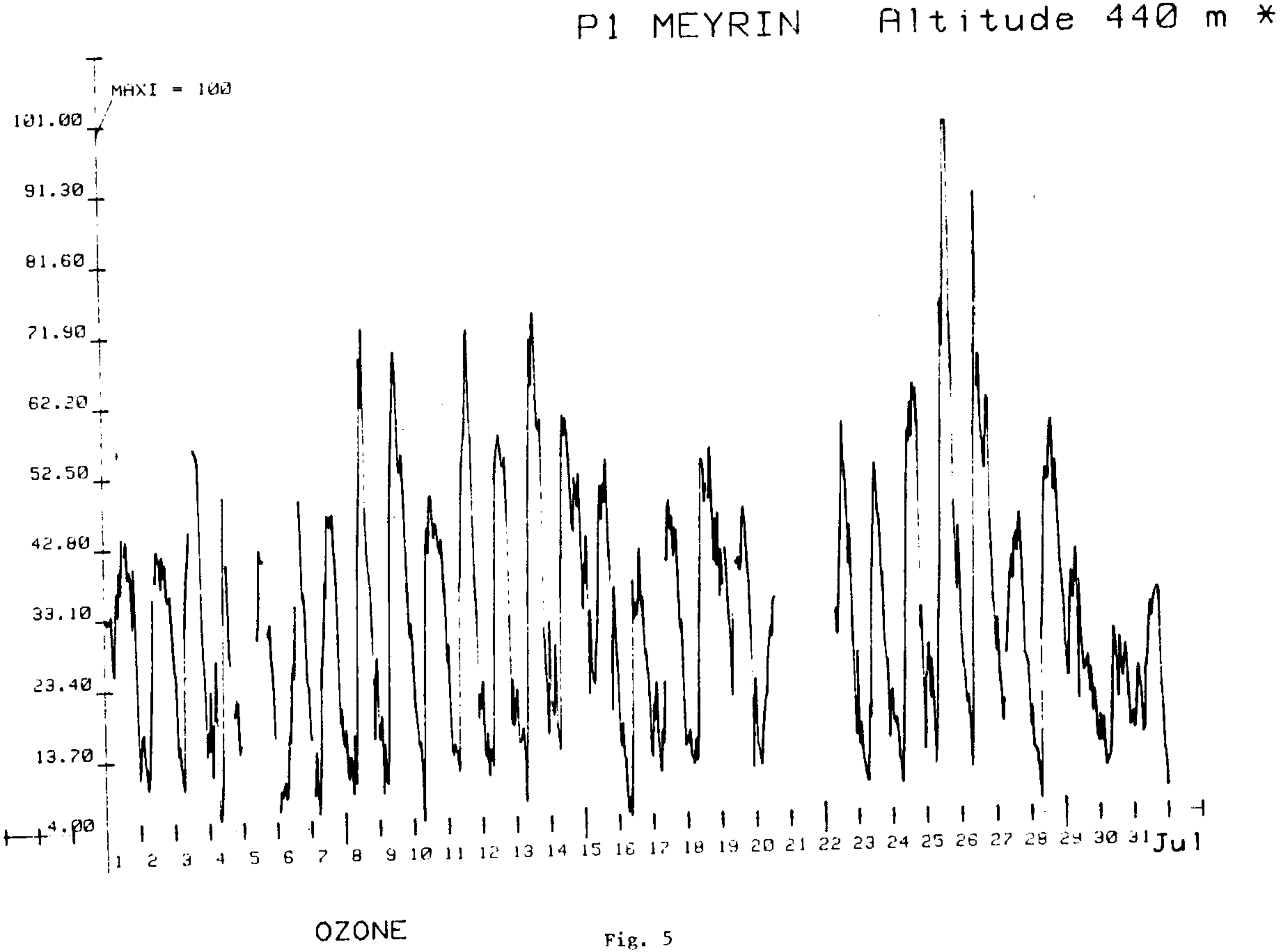
OZONE

Fig. 4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Ppb
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81.60
71.90
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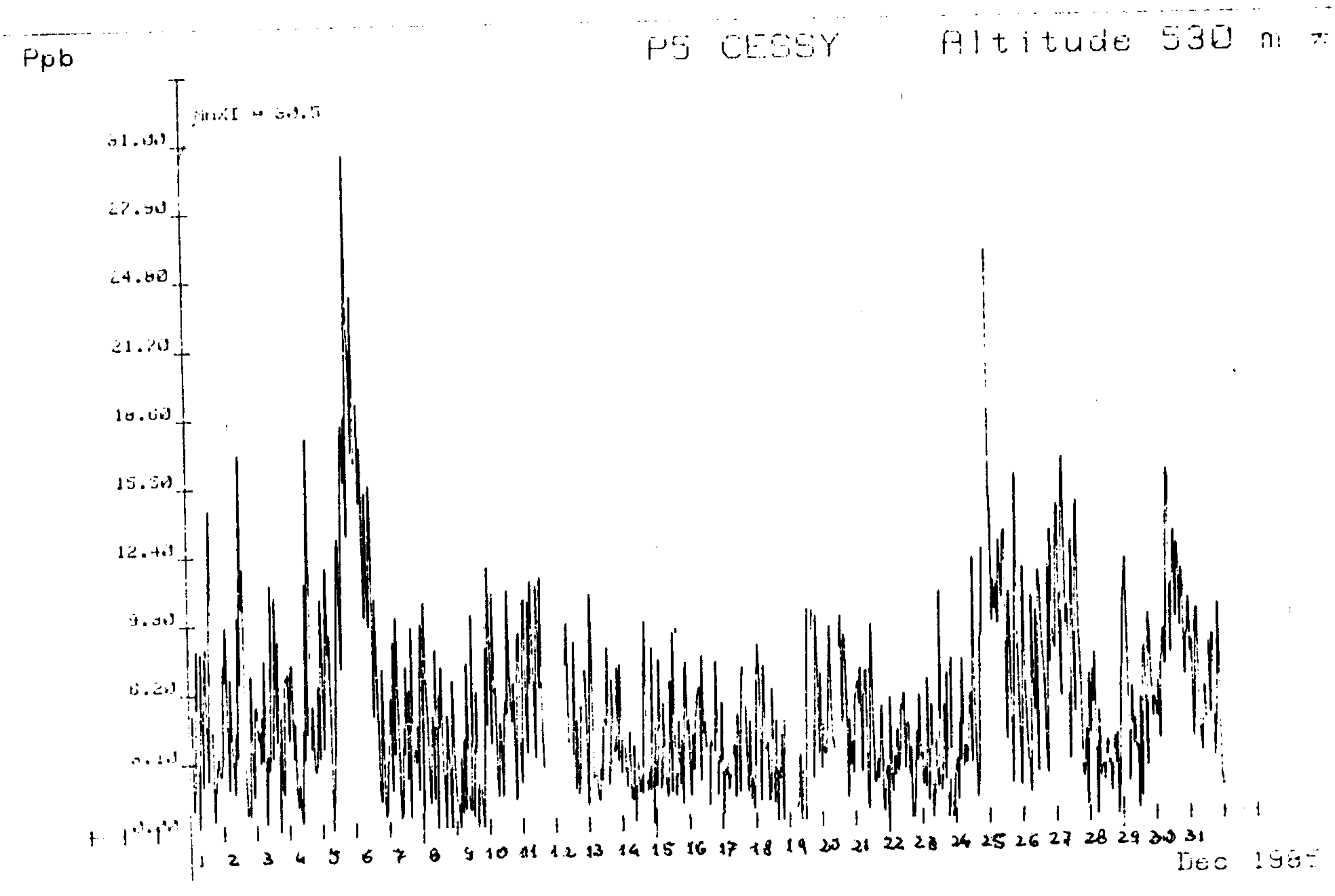
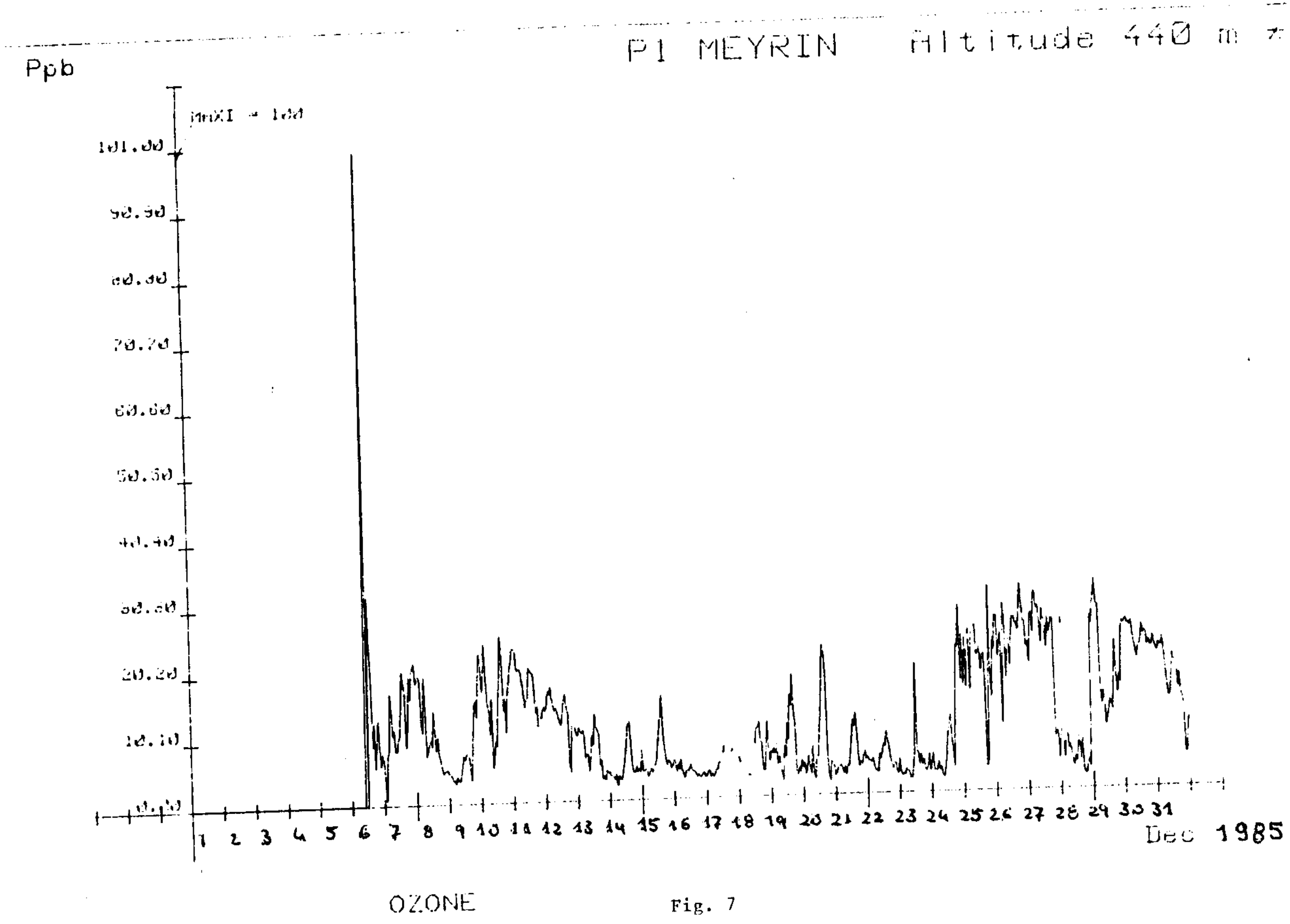
52.50
42.80
33.10
23.40
13.70
4.00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 Jul
OZONE

Fig. 5


PS CESSY
Altitude 530 m
Ppb
27.90
24.80
21.70
15.50
12.40
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Dec

OZONE

Fig. 6


P1 MEYRIN Altitude 440 m
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80.80
70.70
60.60
50.50
40.40
30.30
20.20
10.10
0.00
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Dec 1985
OZONE

Fig. 7

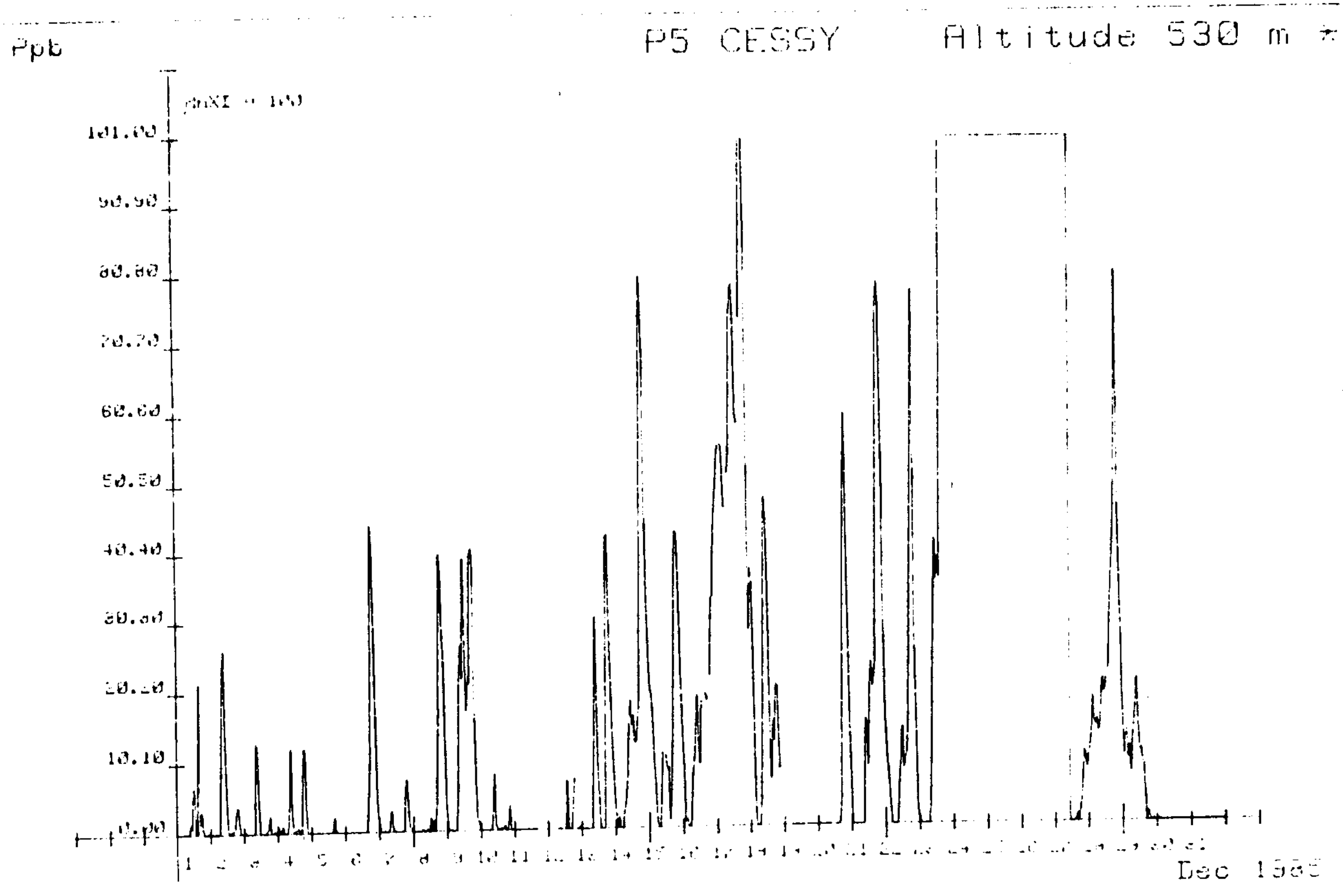

Fig. 8 OXYDE D'AZOTE - NO -

P5 CESSY Altitude 530 m

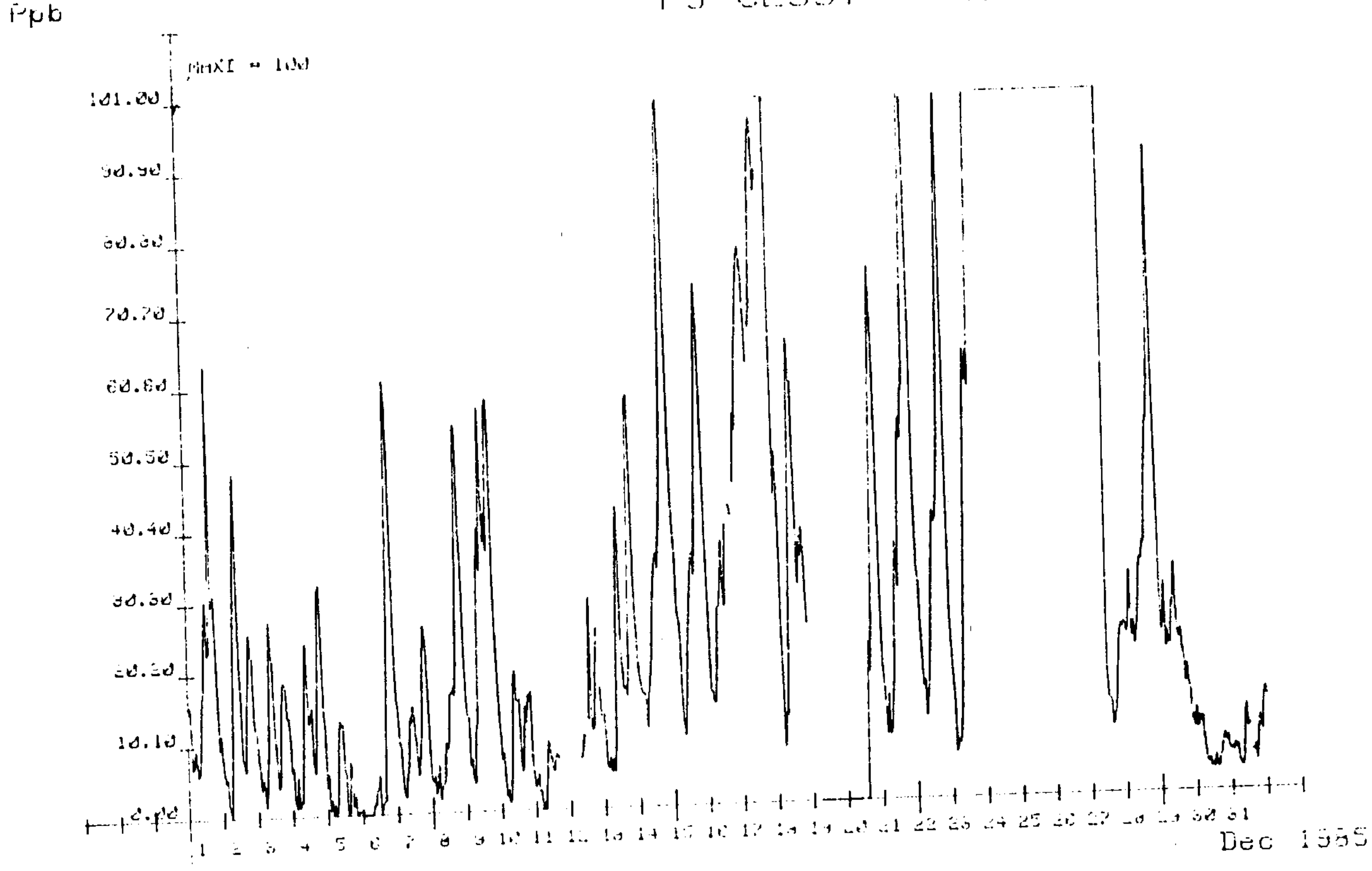

Fig. 9 OXYDE D'AZOTE - NOx -

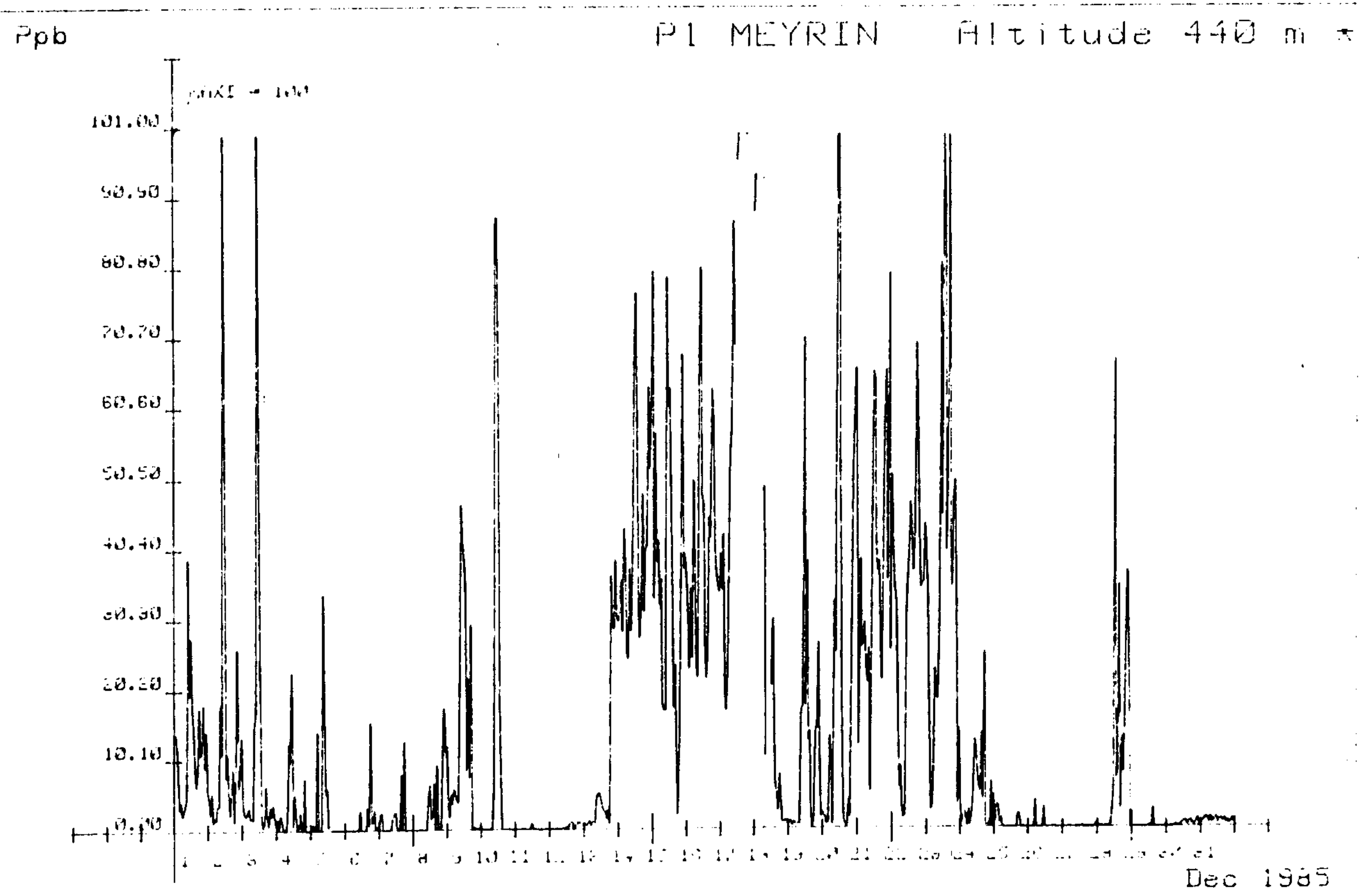

Fig. 10 OXYDE D'AZOTE - NO -

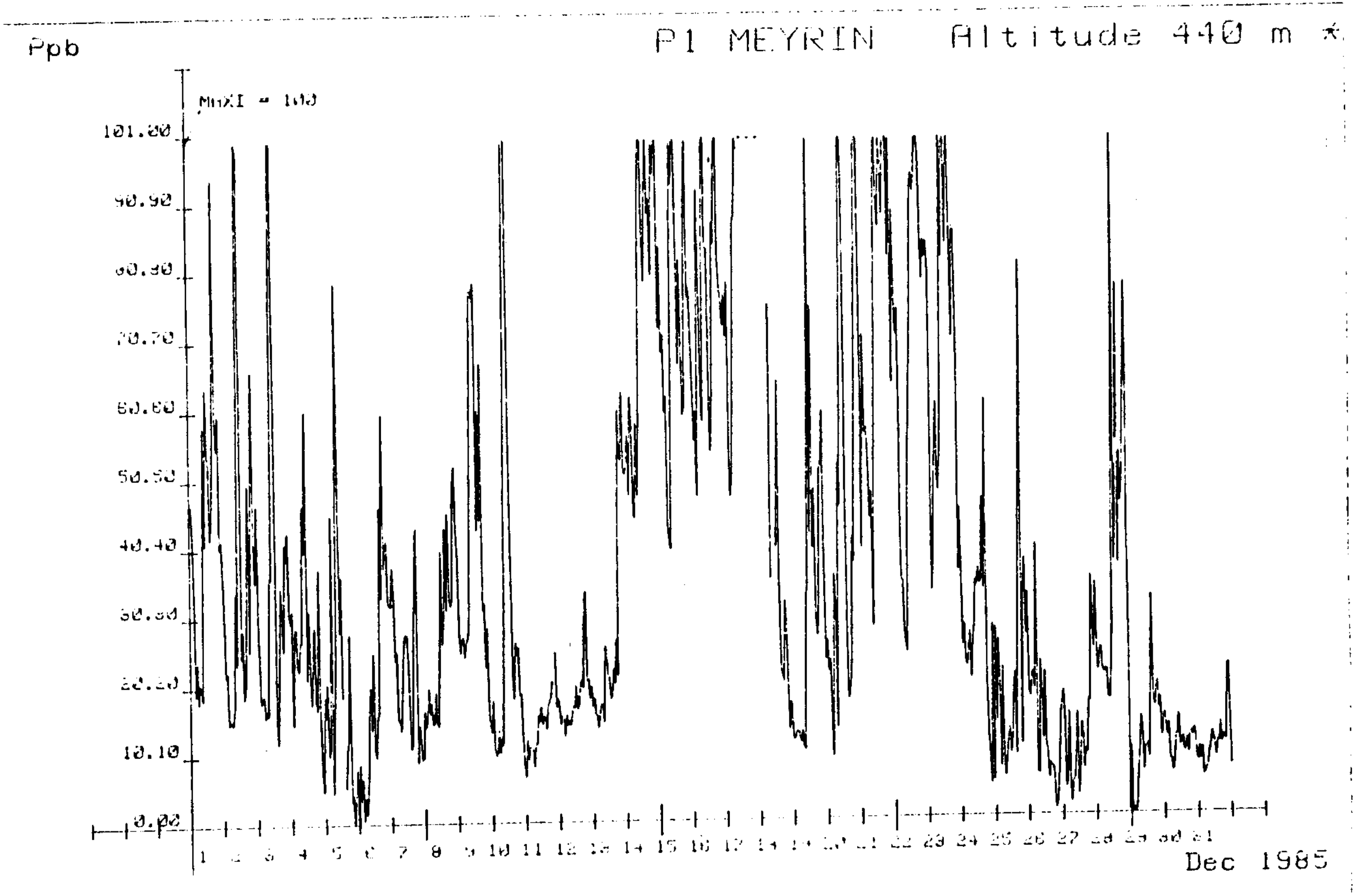

Fig. 11 OXYDE D'AZOTE - NOx -