EUR 3166.e

EUROPEAN ATOMIC ENERGY COMMUNITY - EURATOM

REPORT ABOUT CLIMATOLOGY OF DIFFUSION AT ISPRA

by

L. SANTOMAURO
(Brera Astr. Observatory, Milan)

1966

ORGEL Project

Report prepared by the Brera Astronomical Observatory,
Geophysical and Meteorological Department
Milan, Italy

Euratom Contract No. 138-63-5 ORGC

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Printed by SMEETS
Brussels, December 1966

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In the second part is treated the atmospheric boundary layer regarding Ispra area.

In the third part is treated the atmospheric diffusion of radioactive effluents. The effective height of stack is calculated. Using the Gifford's formula have been calculated the values of Kr and Xe concentrations from 0.5 to 20 Km for the various atmospheric equilibrium conditions for the different operations of the reactor and for two release heights.

This report is concluded by the influence of the topographic discontinuities on the radioactive airbornes diffusion and with a series of advices on the release of the effluents in the various atmospheric equilibrium conditions.

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FOREWORD

This report has to be considered in connection with the construction of the ESSOR *)-reactor at the Ispra establishment of the Joint Nuclear Research Center of EURATOM. In order to define the optimal height of the ESSOR chimney to give good diffusion results the «ORGEL Project» set up the contract No. 138-63-5 ORGC with the Geophysical and Meteorological Institute of the Osservatorio Astronomico, Milan, and the Meteorological Institute of the Technische Hochschule, Karlsruhe to study gas diffusion in the Ispra area. This report presents the expert opinion of Professor Santomauro, Milan, while the EURATOM report EUR 3167.d « Gutachten über die meteorologischen Bedingungen der Ausbreitung luftfremder Stoffe in Ispra/Italien bei den Reaktoren der EURATOM» presents the expert opinion of Professor Diem, Karlsruhe, and his collaborators.

As well the following agents of EURATOM collaborated in the study :

J. Biteau, H. Daldrup and C. Garric - ORGEL Project
G. Fontaine, C. Gandino and A. Malvicini - -Protection
H. Penkuhn - Reactor Theory and Calculation
G. Bonnet - General Studies and Radioactive Engineering.

Mr. Daldrup supplied information on the estimated activities and discharges at the exit of the ESSOR off-gas system. The Protection division gave the meteorological data registered on the meteorological tower during the last years. Mr. Gandino operated the recorders installed by Professor Diem during the period June 1st, 1963 to July 1st, 1964. Mr. Bonnet managed the contract and the coordination of the research.

G. Bonnet.

*) ESSOR = **ESS**ai **OR**gel, experimental reactor of the ORGEL series.

SUMMARY

In the first part of this Report are given the hydrologic aspects (correntometric and thermic conditions) of the Southern area of Lake Maggiore, the meteorological characteristics (weather types and their seasonal frequencies) of Northern Italy, and a summary of the main microclimatic and thermodynamic characteristics at Ispra with particular regard to the wind profile in relation to the lapse-rate and to the wind speed.

In the second part is treated the atmospheric boundary layer regarding Ispra area.

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This report is concluded by the influence of the topographic discontinuities on the radioactive airbornes diffusion and with a series of advices on the release of the effluents in the various atmospheric equilibrium conditions.

INDEX

Part One

PART ONE

A - 1. - GENERAL ANALYSIS OF GEOGRAPHIC, TOPOGRAPHIC AND HYDROLOGIC ASPECTS OF ISPRA AREA -

1.1 - Topographic and geographic aspects

Topographic and geographic aspects of the C.C.R. at Ispra have been already treated in previous publications, so it is not necessary a further description wich will be only a repetition.

It is advisable to draw the attention upon the fact that, in consideration of the particular orographic conditions of the zone, local mesometeorologic situations tending to determine atmospheric conditions having opposite effect for a ready and quick dilution of the effluents coming from stacks, may happen. This matter will anyhow be extensively developed in Part two.

1.2 - Hydrologic aspects

1.2.1. - Generalities

Within a range of 20 Km of the ORGEL reactor, there are the lakes of Comabbio (3.6 Km^2), Monate(2.5 Km^2) and Varese (15 Km^2) and a part (120 Km^2) of the Lake Maggiore, exactly the sheet of water to the south of the line connecting Pieggio (to the north of Ghiffa) and Bédero to the south of Luino). The water-course concerning the C.C.R. are the torrent "Acqua Nera" and "Novellino". The first is an effluent of the Lake Monate, wich flows into the Lake Maggiore, to the East of the Promontory of Ispra; its shallow flow is about 150 litres per second.

After showers or persisting rains it takes a torrent -like character. As to the subsoil there is a stream with a piezometric surface, declining approximately in the same direction of the surface of the field; the slope reduces gradually towards the lower part of the C.C.R. area, then it almost desappears; in this area the piezometric quota of the water stream is nearly at the same level of the field plain.

As from the ambient and climatic point-of-view, the most interesting sheet of water for the C.C.R. is the Lake Maggiore, its hydrometric characteristios will be dealt now, while in the following paragraphs the thermic and correntometric conditions of that part of the lake interesting the C.C.R. will be treated.

1.2.2. - Hydrometric conditions of the Lake Maggiore

The Lake Maggiore belongs to that category of pre-alpine lakes of glacial type. Its surface is 212 Km^2, its maximum depht 372 m between Ghiffa and Portovaltravaglia and its volume 37 Km^3. It has an oblong shape, and 65 Km is its length from Magadino to Sesto Calende, while its width varies from 2 to 4/5 Km. The average altitude above sea level is 192.87 m (hydrometric zero); the increase of the lake level in springtime may reach 1.5 m. The nature of its bottom is generally muddy, sometimes mixed with stones, and the water is comparatively rich in silicates; this is the consequence of the petrographic conditions of the feeding basin.

The average monthly hydrometric heights measured at Sesto Calende hydrometer are:

January	cm	74	July	cm	87
February	cm	36	August	cm	68
March	cm	15	September	cm	59
April	cm	43	October	cm	71
May	cm	89	November	cm	107
June	cm	113	December	cm	106

The waters of the Lake Maggiore come from hydrographic basin 6599 Km wide; 29.4% of the water comes from the river Toce (Italy), 27.7% from the river Ticino (Switzerland), 16.9% from the river Maggia (Switzerland) and the remaining 26.0% from less affluents.

The only emissary is the river Ticino (Italy), whose annual average downflow at Sesto Calende is 293.4 m^3/sec, while the monthly averages are:

January	m^3/sec	139	July	m^3/sec	408
February	"	125	August	"	305
March	"	143	September	"	311
April	"	254	October	"	325
May	"	464	November	"	333
June	"	517	December	"	197

As already mentioned, along the longitudinal axis of the lake there is a remarkable depression. The depth decreases towards the extreme North and South and towards the sides.

The depth between Bozza di Lago, to the North, and Ranco, to the South of Ispra is very low. In particular:
a) in the inlet to the North of Ispra the 5-meters bathymetric is at 200 m from the shore and the 20-m bathymetric at about 400/500 m;
b) in the inlet to the South of Ispra the 5-meters bathymetric is at 100 m from the shore and the 20- m at 400 m.

1.2.3. - Current conditions of the Lake Maggiore (Southern area)

Considering the morphologic configuration of the Lake Maggiore, there is not a real motion of the water having constant speed and direction though, to the limit, a generic direction of the current from North to South, may be seen. Neverthless, the many inlets of the coast produce secondary motions in the water. Restricting the field of researches to the sheet of water facing the areas of Ispra and Ranco, it's evident that the Promontory of Ispra produces ascensional motions in the waters coming from the North, and that those motions spread also to the inlet to the North of Ispra. Here the body of the water takes nearly a static condition , which tends to stratify thermically because of the low bottoms.

From special researches carried out on the the spot from the Italian Navy Hydrographic Institute, for the account of the then National Center for Nuclear Research of Ispra (C.N.R.N. - Ispra), it comes out that the direction of currents in the various layers between surface and 50 meters depth diverges in a fairly irregular way; nevertheless the main component, except some case, is included in the southern sector. Table A-1 contains meteorological and current speed data for various measurements (pages 5 to 11).

It's interesting to note that the pluviometric condition of the catchment-area of the Lake Maggiore has an indirect influence on the currents because the waters coming from the Ticino (Switzerland) and from the several secondary rivers flowing into the lake, cause irregular currents with whirling motions and coastal counter-currents. On the other hand the downflow variation of the Ticino (Italy), caused by the opening and closing of the gates, provokes a counter-pressure wave which spreads into the waters from the dams of the Ticino (Sesto Calende) to the parallel passing by the Fornace Buti. This wave influences the direction and the water speed in the various layers.

The average speeds obtained from every series of surveys are reported in Table A-2. Those data are also reported in the graphic of fig. A-1.

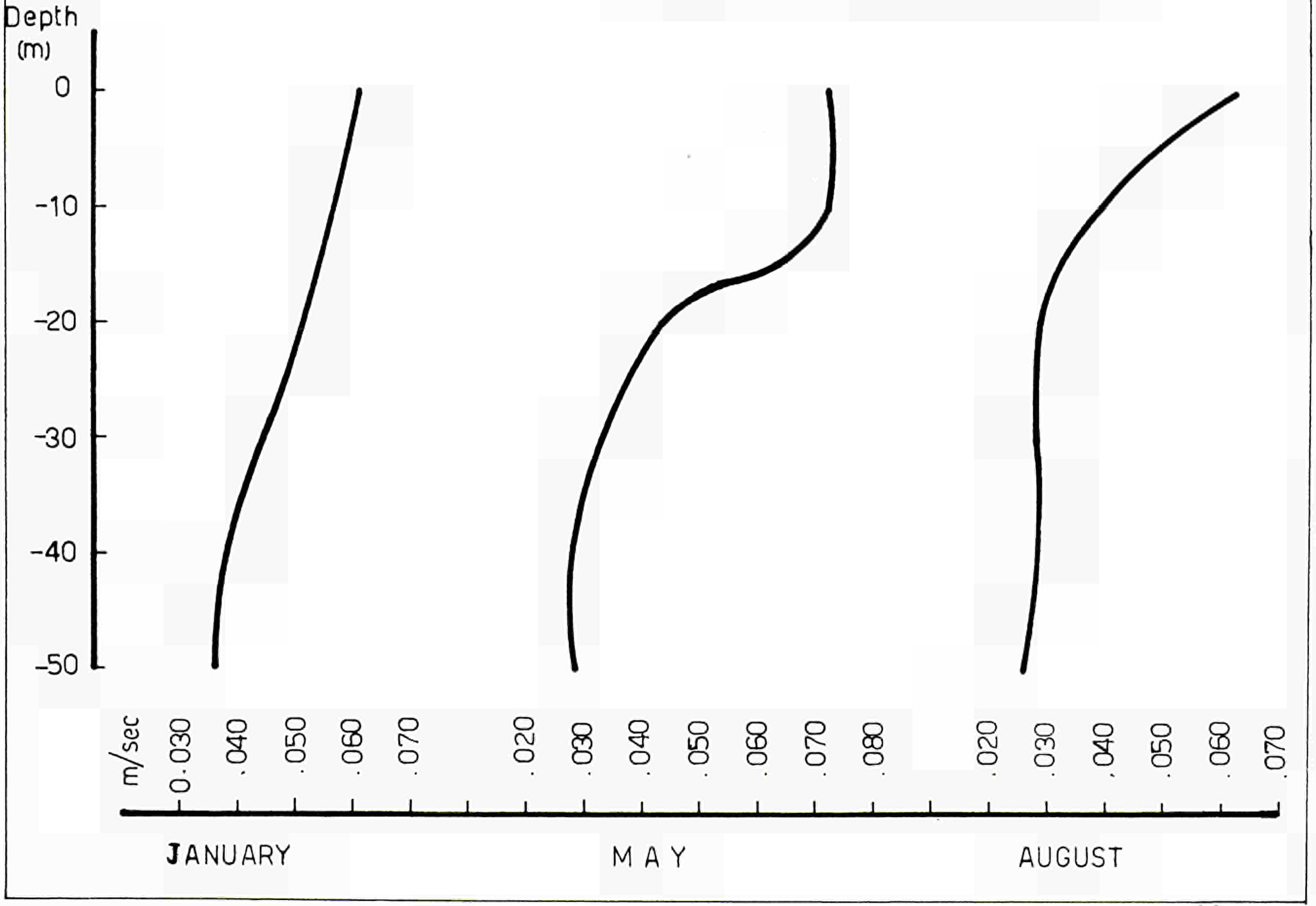
TABLE A-2 - AVERAGE SPEED OF CURRENTS IN THE LAKE MAGGIORE (m/sec)

DEPTH	JANUARY	MAY	AUGUST
0	0.061	0.072	0.062
- 10	.056	.072	.040
- 20	.051	.043	.029
- 30	.045	.034	.029
- 40	.038	.028	.029
- 50	.036	.028	.026

It is clear that speed in surface layers is higher than in the layers below and it decreases gradually towards the bottom. The values obtained from the several measurements denounce a very poor correntometric condition. The spots where currents measurements have begun are reported in the graphic of fig. A-2.

From the researches effected by the above mentioned Navy Hydrographic Institute it may be deduced that the

FIG. A-1 - CURRENT PROFILES



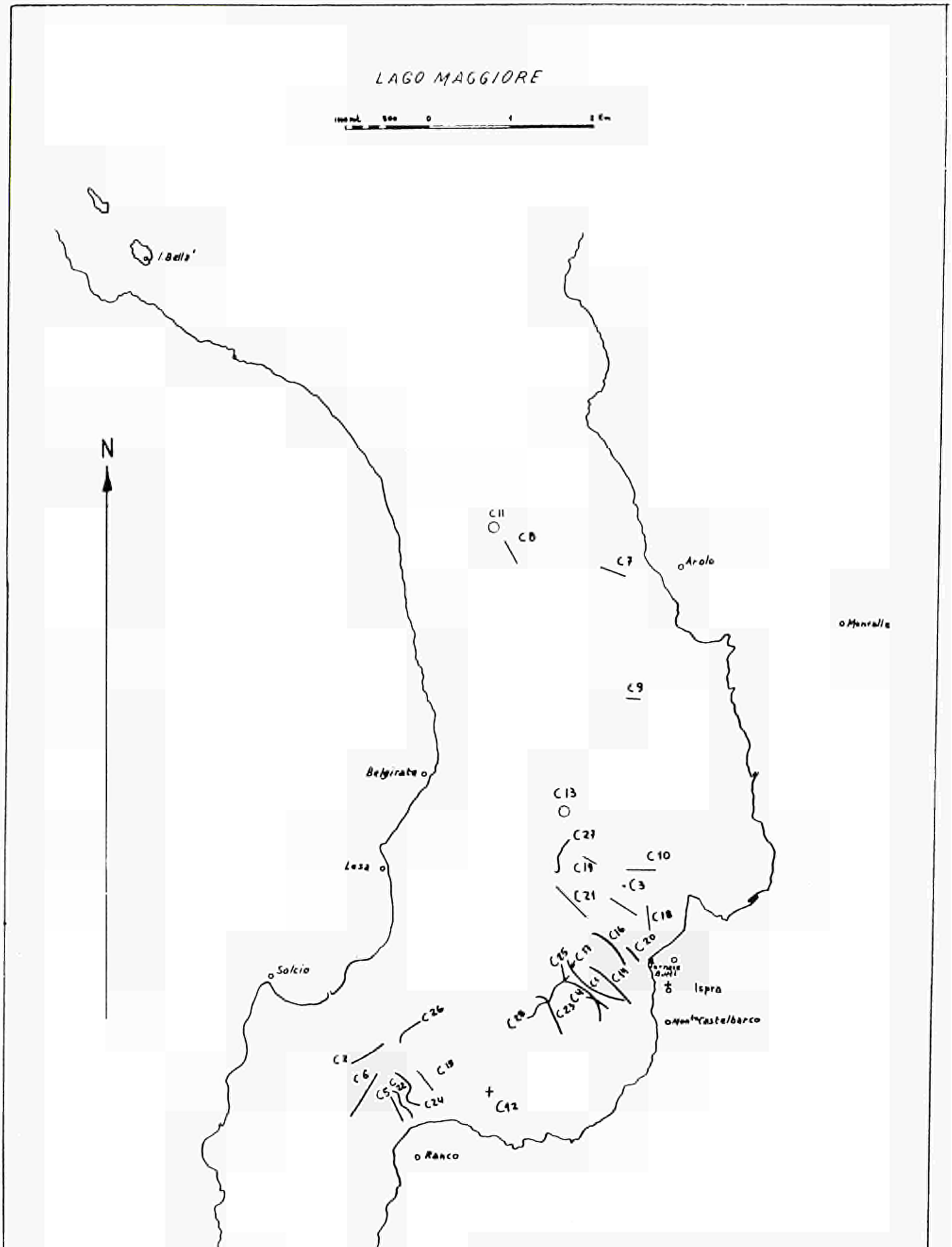


Fig. A2 Measurement places of current.

TABLE A-1 - CURRENT MEASUREMENTS OF THE LAKE MAGGIORE
(Italian Navy Hydrographic Institute-Captain M. Canò)

POSITION	C1	C2	C3	C4
DATE	1959 Jan. 12	1959 Jan. 12	1959 Jan. 13-14	1959 Jan. 13
WIND (direction	N	N	=	S
WIND (speed (m/sec)	2	3	0	4
LAKE SURFACE STATE	slight	calm	calm	slight
	CURRENT SPEED (m/sec) AND COURSE			
LEVELS:				
- 0 m	.094 S	.038 SW	.025 SW	.049 SE
- 10	.048 SW	.038 SW	.065 SSE	.054 SSE
- 20	.048 SSE	.038 SW	.064 SSE	.041 SSE
- 30	.041 SSE	.040 SW	.063 SSE	.034 SSE
- 40	.050 SE	.042 SW	.021 SSW	.028 SSE
- 50	.050 S	.046 SW	.027 SW	= =

TABLE A-1 - CURRENT MEASUREMENTS OF THE LAKE MAGGIORE
(Italian Navy Hydrographic Institute- Captain M. Canò)

POSITION	C5	C6	C7	C8
Date	1959 Jan. 14	1959 Jan. 14	1959 Jan. 15	1959 Jan. 15-16
Wind direction	N	N	N	N
Wind speed (m/sec)	4	2	5	2
Lake surface state	smooth	calm	slight	calm
	CURRENT SPEED (m/sec) AND COURSE			
LEVELS:				
0 m	.069 SW	.056 SW	.093 SSE	.035 SSE
- 10	.072 SW	.050 SW	.059 SSE	.036 SSE
- 20	.067 SW	.049 SW	.050 SSE	.031 SE
- 30	.062 SW	.052 SW	.019 SSE	.027 ESE
- 40	.064 SW	.039 SW	.015 ESE	.023 SSE
- 50	.047 SW	.032 SW	.01 ENE	.024 SSE

TABLE A-1 - CURRENT MEASUREMENTS OF THE LAKE MAGGIORE
(Italian Navy Hydrographic Institute - Captain M. Canò)

POSITION	C9	C10	C11	C12
Date	1959 Jan. 16	1959 May 24	1959 May 24	1959 May 25
Wind (direction	N	N	=	N
Wind (speed (m/sec)	7	4	0	4
Lake surface state	slight	calm	calm	slight
	CURRENT SPEED (m/sec) AND COURSE			
LEVELS:				
0 m	.082 S	.13 SW	.03 NE	= =
- 10	.083 S	.08 SW	.09 SE	= S
- 20	.071 S	.045 SW	.063 SE	= SW
- 30	.066 S	.056 SW	.041 SE	= SE
- 40	.062 S	.036 S	.039 SE	= SE
- 50	.055 S	.029 S	.033 SE	= =

TABLE A-1 - CURRENT MEASUREMENTS OF THE LAKE MAGGIORE
(Italian Navy Hydrographic Institute - Captain M. Canò)

POSITION	C13	C14	C15	C16
Date	1959 May 25	1959 May 25	1959 May 26	1959 May 26
Wind direction	N	N	N	N
Wind speed (m/sec)	3	4	2	4-5
Lake surface state	slight	calm	smooth	slight
	CURRENT SPEED (m/sec) AND COURSE			
LEVELS:				
0 m	= =	.017 S	= =	= SE
- 10	.060 S	= =	.068 SW	= SE
- 20	.052 S	= =	.045 SW	= SE
- 30	.046 S	= =	.016 W	= SE
- 40	.040 S	= =	.013 W	= NE
- 50	.023 S	= =	.009 W	= NE

TABLE A-1 - CURRENT MEASUREMENTS OF THE LAKE MAGGIORE
(Italian Navy Hydrographic Institute- Captain M. Canò)

POSITION		C17	C18	C19	C20
Date		1959 May 27	1960 Aug. 2	1960 Aug. 2	1960 Aug. 3
Wind	direction	N	NE	S	=
	speed (m/sec)	5	2	3	0
Lake surface state		smooth	calm	slight	calm
		CURRENT SPEED (m/sec) AND COURSE			
LEVELS:					
0 m		.042 S	.08 NE	.068 NE	.072 NE
- 10		.053 S	.08 NE	.083 NE	.021 SSW
- 20		.01 S	.059 NE	.037 NE	.021 SSW
- 30		.01 S	.07 NE	.04 NE	.027 SSW
- 40		.01 SE	.065 NE	.047 NE	.026 SSW
- 50		.046 WSW	.053 NE	.05 NE	.026 SSW

TABLE A-1 - CURRENT MEASUREMENTS OF THE LAKE MAGGIORE
(Italian Navy Hydrographic Institute - Captain M. Canò)

POSITION	C21	C22	C23	C24
Date	1960 Aug. 3	1960 Aug. 4	1960 Aug. 4	1960 Aug. 6
Wind direction	=	=	=	NW
Wind speed (m/sec)	0	0	0	5
Lake surface state	calm	calm	calm	slight
	CURRENT SPEED (m/sec) AND COURSE			
LEVELS:				
0 m	.042 E	.067 E	.015 SSE	.087 SW
- 10	.032 W	.005 S	.027 SE	.022 NW
- 20	.014 S	.028 SW	.022 S	.020 N
- 30	.019 SW	.009 SSW	.020 S	.027 SW
- 40	.027 SW	.011 SW	.020 S	.036 SW
- 50	.027 SW	.005 SSW	.021 SE	.025 SW

TABLE A-1 - CURRENT MEASUREMENT OF THE LAKE MAGGIORE
(Italian Navy Hydrographic Institute - Captain M. Canò)

POSITION	C25	C26	C27	C28
Date	1960 Aug. 6	1960 Aug. 7	1960 Aug. 7	1960 Aug. 8
Wind direction	NW	=	=	NW
Wind speed (m/sec)	4	0	0	4
Lake surface state	slight	calm	calm	slight
	CURRENT SPEED (m/sec) AND COURSE			
LEVELS:				
0 m	.030 NNE	.056 SE	.063 SE	.093 SW
- 10	.036 NNE	.016 SE	.032 S	.067 S
- 20	.013 NE	.032 SSW	.036 S	.037 S
- 30	.013 SSE	.024 SSW	.031 S	.037 S
- 40	.009 SSE	.019 SSW	.024 S	.037 S
- 50	.012 S	.014 S	.022 S	.028 S

body of water coming from the Ticino (Switzerland) after reaching the maximum depth of 300 m, about along the parallel crossing Asolo, assumes a forced ascensional motion spreading towards the surface by irregular and unforeseeable motions. Those motions take a whirling tendency and provoke coastal counter-currents because of the decreasing underwater plateau. The Promontory of Ranco contributes to make those motions more complex.

The coast in the tract Osteria-La Sacca receives directly the water from Ticino, which is then reflected towards the eastern coast where it tends to enter in the inlet between Monvallina and Fornace Butti, where counter-currents are established, especially in the morning and at zero and -10 m depths.

Off the Promontory of Ranco the body of water divides into two branches; one flows towards Meina and then towards the South, the other circulates in the inlet of Ispra with a whirling motion which is very difficult to analyse.

To sum up, it can be said that there is no doubt that the water coming from the Ticino and from the catchment-area flows down into the valley by irregular motions. Those motions become more regular from the joining-line Ranco-Solcio where the beginning of a well-defined motion southwards is found.

Therefore the body of water is forced to take a well-defined speed and direction even if with some whirling motion and surface counter-currents along the coast.

In fig. A-3 a generic orientation of currents in the southern area of the Lake Maggiore is reported.

1.2.4. - Thermic conditions of the Lake Maggiore (Southern area)

From the above mentioned researches carried out by the Navy Hydrographic Institute appears that in the southern area of the Lake Maggiore, and particularly in the inlet of Ispra, the water temperature at the surface is not constant for all the places. The

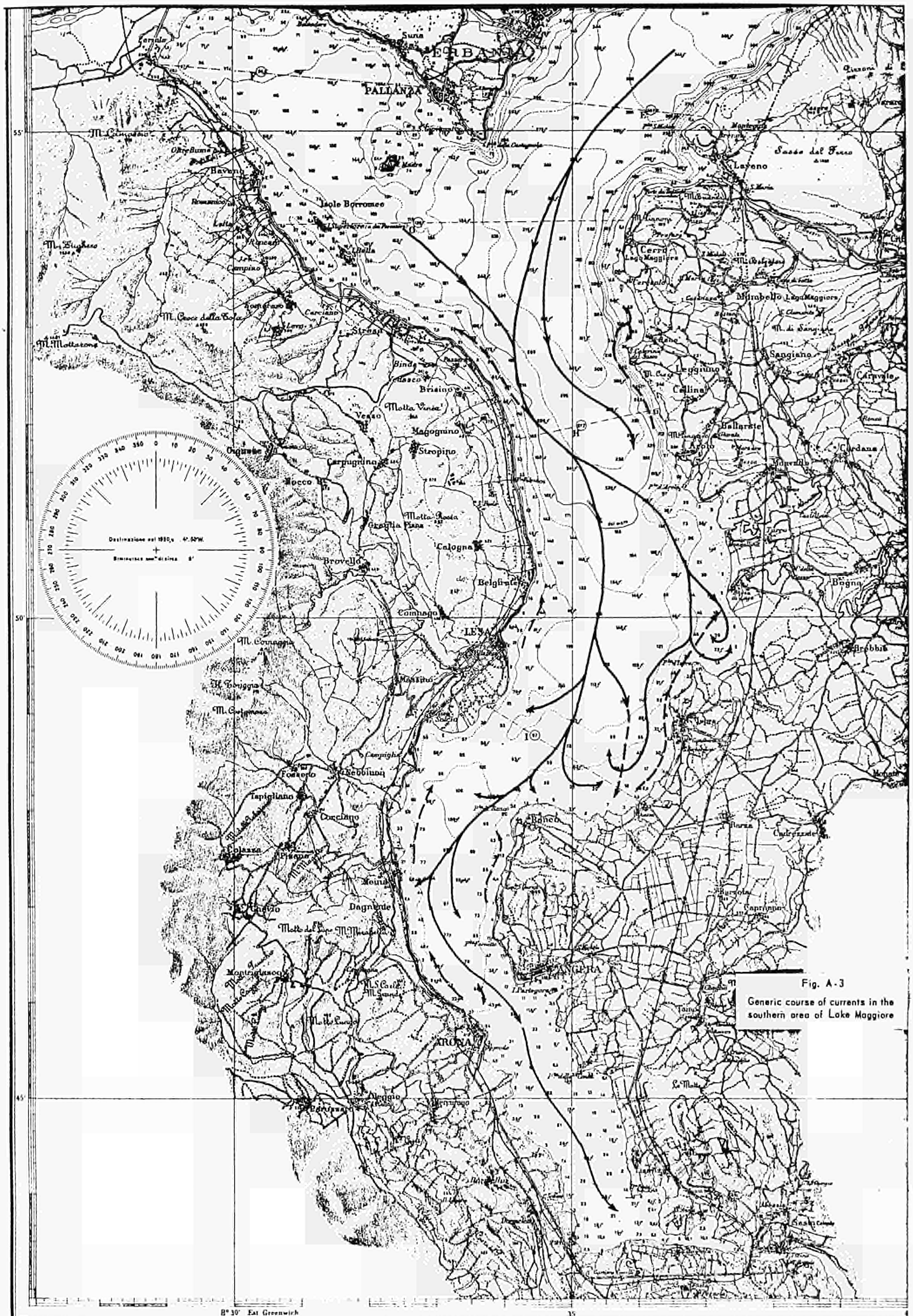


Fig. A-3
Generic course of currents in the southern area of Lake Maggiore

digressions reach the values of 2°-3° C especially in summertime. In Table A-3 (pages 14 to 23) are reported the most representative measurements carried out by the mentioned Navy Institute.

The bathythermographic curves have a regular trend; particularly during the cold season the vertical thermic gradients practically do not exist (homotermy) while during the hot season the distribution is thermocline, i.e. there is a layer of transition; it's possible to find this layer at 15 m as well as at 100/120 m depth.

The waters of the Ticino are cold both in summer and winter and flows in its bed to the maximum bottom of 300 m. Because of the decreasing depths, the water takes the slow convective motions already mentioned; reaching the surface and spreading into the inlet of Ispra it mixes with surface water and tends to a thermic equilibrium.

It must be considered that, as for the body of sea-water, only the very surface layer exchanges its warmth with the air layer immediately above.

The surface temperature is not uniform for all the lake, because the ascensional motions are irregular. Nevertheless it is possible to deduce, on the basis of all measurements taken, that at 35/40 m depth the temperature is about 6-7° C and that during the month of August reaches a maximum value of 8°C.

As the measurements have been taken in october -november and in the height of winter (January), when the snow melts (May) and in the period of the dry weather (August), the following points can be deduced:

a) in winter the thermic gradient is minimum; the temperature of water surface differs of 2-4° C from the air temperature;

b) in the period of the melting of snow there is a high negative gradient from the surface down to 40-50 m; the temperature of water surface differs of 3-4°C from the air temperature. Temperature, in the different points of the lake, is almost uniform at the surface, while in the

A-3 - THERMOMETRIC MEASUREMENTS IN THE LAKE MAGGIORE
(Italian Navy Hydrographic Institute - Captain M.Canò)

		1	2	3	4
(1)	Geogr.pos.	700 m	1100	1150	1530
(2)	Polar bearing from	275° Ispra	271° Ispra	267° Ispra	267° Ispra
(3)	Date	30.X.58	30.X.58	31.X.58	31.X.58
(4)	Time (ECT)	1520	1550	1025	1045
(5)	Bottom (m)	65	98	102	115
(6)	Lake surface	calm	calm	calm	calm
(7)	Cloudness	8/8	8/8	8/8	8/8
(8)	Air temp.(°C)	11.0	11.5	9.5	9.5
(9)	Wind (m/s)	0	0	0	0
(10)	Water temp.(°C)				
	0 m	13.0	13.0	12.5	13.0
	- 5 m	13.0	13.0	12.5	13.0
	- 10	12.9	12.9	12.5	13.0
	- 15	12.8	12.8	12.5	13.0
	- 20	11.1	11.4	10.8	11.4
	- 25	10.0	10.0	9.0	9.8
	- 30	8.9	8.9	8.1	8.7
	- 35	7.9	8.0	7.3	7.9
	- 40	7.3	7.2	6.8	7.4
	- 45	6.7	6.9	6.3	6.8
	- 50	6.4	6.5	6.1	6.7
	- 60		6.2	5.8	6.4
	- 70		6.1	5.6	6.3
	- 80		6.1	5.6	6.1
	- 90			5.6	6.1
	-100				6.1

Note - Reference points of polar bearings are the country campaniles.

A-3 - THERMOMETRIC MEASUREMENTS IN THE LAKE MAGGIORE
(Italian Navy Hydrographic Institute- Captain M.Canò)

	5	6	7	8	9
(1)	450	1050	1050	2000	2400
(2)	90°	83°	34°	36°	39°
	Lesa	Lesa	Ranco	Ranco	Ranco
(3)	31.X.58	31.X.58	31.X.58	31.X.58	31.X.58
(4)	1130	1145	1415	1500	1520
(5)	80	110	88	100	119
(6)	calm	calm	calm	calm	calm
(7)	8/8	8/8	8/8	8/8	8/8
(8)	11.5	10.0	12.0	11.5	11.0
(9)	0	0	0	0	0
(10)					
0 m	13.0	13.0	13.0	12.7	12.5
- 5 m	13.0	13.0	13.0	12.7	12.5
- 10	12.8	12.6	12.9	12.7	12.5
- 15	11.9	11.8	12.8	11.9	12.2
- 20	11.4	11.4	10.8	10.6	10.7
- 25	9.8	10.0	10.1	9.4	8.9
- 30	9.2	9.1	8.9	8.3	8.0
- 35	7.9	7.9	7.6	7.2	7.1
- 40	7.2	7.4	7.2	6.8	6.8
- 45	6.9	6.9	6.8	6.4	6.4
- 50	6.7	6.7	6.6	6.2	6.1
- 60	6.4	6.4	6.2	5.9	5.9
- 70	6.2	6.2	6.1	5.8	5.7
- 80		6.1	6.0	5.6	5.5
- 90		6.1		5.6	5.5
- 100		6.0			5.5

Note - Reference points of polar bearings are the country campaniles -

A-3 - THERMOMETRIC MEASUREMENTS IN THE LAKE MAGGIORE
(Italian Navy Hydrographic Institute- Captain M.Canò)

	10	11	12	13	14
(1)	2200	1800	1600	1600	1900
(2)	92°	69°	61°	265°	298
	Solcio	Lesa	Belgirate	Arolo	Arolo
(3)	1.XI.58	1.XI.58	1.XI.58	1.XI.58	1.XI.58
(4)	0805	0830	0845	0905	0925
(5)	130	120	160	270	290
(6)	calm	calm	calm	calm	calm
(7)	8/8	7/8	6/8	6/8	5/8
(8)	11.0	11.0	11.0	10.0	12.0
(9)	0	0	0	0	1.0
(10)					
0 m	12.5	12.5	12.8	12.8	12.5
- 5	12.5	12.5	12.8	12.8	12.5
- 10	11.7	12.5	12.7	12.7	12.5
- 15	11.1	11.9	12.5	12.2	12.5
- 20	10.6	10.8	11.1	11.1	11.1
- 25	9.6	9.2	9.4	9.2	9.4
- 30	8.9	7.8	7.8	8.3	8.1
- 35	7.3	7.0	7.0	7.3	7.4
- 40	6.9	6.7	6.8	7.0	7.0
- 45	6.5	6.4	6.7	6.7	6.7
- 50	6.3	6.2	6.4	6.4	6.4
- 60	6.0	5.9	6.2	6.2	6.0
- 70	5.9	5.7	5.9	6.0	5.9
- 80	5.7	5.6	5.8	5.9	5.7
- 90	5.6	5.6	5.8	5.9	5.7
-100	=	=	=	=	=

Note - Reference points of polar bearings are the country campaniles -

A-3 - THERMOMETRIC MEASUREMENTS IN THE LAKE MAGGIORE

(Italian Navy Hydrographic Institute- Captain M.Canò)

	15	16	17	18	19
(1)	2300	1500	1670	110	1600
(2)	274	293°	87°	258°	304°
	Reno	Ispra	Lesa	S.Caterina	Cervo
(3)	1.XI.58	10.I.59	11.I.59	11.I.59	11.I.59
(4)	0940	1023	1122	1151	1347
(5)	315	100	110	100	100
(6)	calm	calm	calm	calm	calm
(7)	6/8	3/8	0	0	0
(8)	13.5	-4.0	3.0	4.0	6.0
(9)	1.0	1.0	2.5	1.0	2.0
(10)					
0 m	12.6	7.0	7.6	7.5	7.0
- 5	12.6	7.0	7.5	7.5	7.0
- 10	12.6	7.0	7.5	7.5	7.0
- 15	12.6	7.0	7.5	7.5	7.0
- 20	11.1	7.0	7.5	7.5	7.0
- 25	9.6	7.0	7.5	7.5	7.0
- 30	8.1	7.0	7.5	7.5	7.0
- 35	7.2	7.0	7.5	7.5	7.0
- 40	6.9	6.9	7.5	7.5	7.0
- 45	6.9	6.9	7.5	7.5	7.0
- 50	6.4	6.9	7.5	7.5	7.0
- 60	6.1	6.8	7.5	7.5	7.0
- 70	5.9	6.6	7.5	7.5	6.6
- 80	5.8	5.7	7.5	7.1	6.0
- 90	5.8	5.6	6.7	6.8	5.7
- 100	5.8	=	=	=	=

Note - Reference points of polar bearings are the country campaniles -

A-3 - THERMOMETRIC MEASUREMENTS IN THE LAKE MAGGIORE

(Italian Navy Hydrographic Institute- Captain M.Canò)

	20	21	22	23	24
(1)	1600	1100	1250	1230	1200
(2)	328°	253°	40°	325°	263°
	P.S.Michele	Ispra	Ranco	Ispra	Ranco
(3)	11.I.59	12.I.59	12.I.59	13.I.59	14.I.59
(4)	1417	0953	1020	0906	0937
(5)	100	82	53	135	104
(6)	calm	calm	calm	calm	calm
(7)	0	0	0	0	0
(8)	6.0	0.0	2.0	4.0	4.0
(9)	1.0	3.0	1.0	0	2.0
(10)					
0 m	7.5	7.4	7.4	7.5	7.4
- 5	7.5	7.4	7.4	7.5	7.4
- 10	7.5	7.4	7.4	7.5	7.4
- 15	7.5	7.4	7.4	7.5	7.4
- 20	7.5	7.4	7.4	7.5	7.4
- 25	7.5	7.4	7.4	7.5	7.4
- 30	7.5	7.4	7.4	7.5	7.4
- 35	7.4	7.4	7.4	7.5	7.4
- 40	7.3	7.4	=	7.4	7.4
- 45	7.3	7.4	=	7.4	7.4
- 50	7.3	7.4	=	7.4	7.4
- 60	7.2	7.4	=	7.4	7.4
- 70	7.2	7.4	=	7.2	7.4
- 80	6.7	=	=	6.9	6.7
- 90	6.5	=	=	6.4	6.5
- 100	=	=	=	=	=

Note - Reference points of polar bearings are the country campaniles -

A-3 - THERMOMETRIC MEASUREMENTS IN THE LAKE MAGGIORE

(Italian Navy Hydrographic Institute- Captain M.Canò)

	25	26	27	28	29
(1)	2100	1400	1900	1050	1550
(2)	50°	278°	92°	352°	318°
	Belgirate	Castel-barca	Solcio	F.Brivio	Ranco
(3)	14.I.59	20.V.59	20.V.59	20.V.59	20.V.59
(4)	1433	1010	1137	1425	1710
(5)	250	110	105	98	100
(6)	calm	calm	calm	calm	calm
(7)	7/8	2/8	1/8	3/8	1/8
(8)	7.0	18.0	21.0	23.0	23.0
(9)	1.5	0.5	0	0.5	0
(10)					
0 m	7.4	16.5	16.9	18.1	18.5
- 5	7.4	16.1	15.8	17.5	17.2
- 10	7.4	14.4	15.0	13.5	16.4
- 15	7.4	11.1	10.0	12.2	11.1
- 20	7.4	9.5	8.7	10.8	9.7
- 25	7.4	9.1	8.2	10.3	9.2
- 30	7.4	8.0	7.8	10.0	8.3
- 35	7.4	7.5	7.3	9.6	8.1
- 40	7.4	7.2	6.8	8.9	7.7
- 45	7.4	6.8	6.5	8.3	7.5
- 50	7.4	6.7	6.3	8.3	7.2
- 60	7.4	6.5	6.1	8.1	7.1
- 70	6.7	6.2	6.1	7.9	7.0
- 80	6.5	6.1	6.0	7.8	6.9
- 90	6.4	6.0	6.0	=	6.9
- 100	6.3	6.0	5.8	=	6.9

Note - Reference points of polar bearings are the country campaniles -

A-3 - THERMOMETRIC MEASUREMENTS IN THE LAKE MAGGIORE

(Italian Navy Hydrographic Institute- Captain M.Canò)

	30	31	32	33	34
(1)	2000	1770	1400	1130	1530
(2)	69°	274°	90°	270°	26°
	Belgirate	Cerro	Belgirate	Ispra	Ranco
(3)	21.V.59	21.V.59	23.V.59	24.V.59	25.V.59
(4)	0930	1500	0930	1500	0845
(5)	110	200	120	100	65
(6)	slight	calm	smooth	calm	slight
(7)	8/8	7/8	8/8	5/8	8/8
(8)	17.0	18.5	17.0	19.5	16.0
(9)	4.0	1.0	1.0	0	3.0
(10)					
0 m	16.3	16.8	15.7	17.0	16.3
- 5	15.0	16.1	15.7	15.8	16.3
- 10	11.1	11.1	15.6	14.4	11.1
- 15	9.1	10.0	14.4	9.5	9.5
- 20	8.5	9.2	10.0	8.7	8.9
- 25	7.8	8.6	9.1	8.0	8.2
- 30	7.2	8.0	8.6	7.8	8.0
- 35	6.8	7.8	8.2	7.5	7.8
- 40	6.5	7.5	7.8	7.1	7.4
- 45	6.2	6.9	7.3	6.9	7.1
- 50	6.0	6.8	7.1	6.8	7.1
- 60	5.7	6.7	6.9	6.7	=
- 70	5.5	6.7	6.8	6.5	=
- 80	5.5	6.7	6.7	6.4	=
- 90	5.4	6.7	6.7	6.4	=
- 100	5.4	6.7	6.7	=	=

Note - Reference points of polar bearings are the country campaniles -

A-3 - THERMOMETRIC MEASUREMENTS IN THE LAKE MAGGIORE

(Italian Navy Hydrographic Institute- Captain M.Canò)

	35	36	37	38	39
(1)	1630	1220	1600	1300	1750
(2)	311°	300°	92°	291°	299°
	Ispra	Ispra	Lesa	F.Brivio	F.Brivio
(3)	25.V.59	26.V.59	27.V.59	2.VIII.59	4.VIII.59
(4)	1400	0845	0800	0952	0827
(5)	140	107	100	100	140
(6)	calm	smooth	calm	smooth	calm
(7)	8/8	5/8	0	0	7/8
(8)	18.5	17.5	17.0	22.3	20.5
(9)	1.0	5.0	3.0	3.0	4.0
(10)					
0 m	16.4	16.2	16.7	20.0	20.0
- 5	16.1	16.2	16.1	19.3	19.7
- 10	10.3	11.1	12.8	18.2	17.9
- 15	9.5	9.7	10.0	16.7	12.8
- 20	9.2	9.2	9.5	13.1	9.7
- 25	8.5	8.6	9.1	11.1	8.3
- 30	8.1	8.4	8.8	9.4	7.3
- 35	7.8	8.1	8.2	8.6	7.1
- 40	7.4	7.5	7.8	7.9	6.8
- 45	7.2	7.2	7.4	7.6	6.7
- 50	6.9	7.1	7.0	7.4	6.5
- 60	6.8	6.8	6.8	7.1	6.3
- 70	6.7	6.7	6.7	6.8	6.2
- 80	6.7	6.5	6.5	6.7	6.1
- 90	6.5	6.4	6.5	6.6	6.1
- 100	=	6.4	6.4	6.6	6.1

Note - Reference points of polar bearings are the country campaniles -

A-3 - THERMOMETRIC MEASUREMENTS IN THE LAKE MAGGIORE

(Italian Navy Hydrographic Institute-Captain M.Canò)

	40	41	42
(1)	1675	2120	1810
(2)	28°	299°	297°
	Ranco	Ispra (1)	Ispra (1)
(3)	4.VIII.59	4.VIII.59	4.VIII.59
(4)	1000	0821	0900
(5)	100	110	110
(6)	calm	calm	calm
(7)	2/8	8/8	8/8
(8)	26.5	22.0	23.0
(9)	0	0	0
(10)			
0 m	21.5	21.4	21.2
- 5	20.9	20.3	20.0
- 10	17.8	13.9	15.0
- 15	12.8	11.7	11.1
- 20	10.6	9.7	9.4
- 25	8.9	8.4	8.1
- 30	7.8	7.8	7.2
- 35	7.2	7.6	7.2
- 40	7.1	7.2	7.0
- 45	6.9	6.9	6.8
- 50	6.8	6.8	6.7
- 60	6.6	6.7	6.5
- 70	6.6	6.6	6.4
- 80	=	6.6	6.3
- 90	=	6.6	6.3
- 100	=	=	=

Note - Reference points of polar bearings are the country campaniles -

(1) - Monumento

A-3 - THERMOMETRIC MEASUREMENTS IN THE LAKE MAGGIORE

(Italian Navy Hydrographic Institute- Captain M.Canò)

	43	44	45
(1)	2150	1830	1600
(2)	10°	41°	329°
	Ranco	Ranco	F. Brivio
(3)	5.VIII.59	6.VIII.59	7.VIII.59
(4)	0948	0835	0912
(5)	110	110	140
(6)	calm	smooth	calm
(7)	8/8	1/8	1/8
(8)	19.0	22.5	24.5
(9)	1.0	2.0	0
(10)			
0 m	20.2	20.0	20.0
- 5	20.2	20.0	19.9
- 10	15.0	18.6	15.6
- 15	12.5	15.0	12.8
- 20	10.0	11.4	11.1
- 25	8.2	10.0	9.8
- 30	7.1	8.6	8.6
- 35	6.7	7.6	7.9
- 40	6.5	7.2	7.7
- 45	6.4	6.9	7.4
- 50	6.2	6.7	7.1
- 60	6.1	6.4	6.9
- 70	5.9	6.2	6.6
- 80	=	6.2	6.5
- 90	=	6.2	6.4
- 100	=	=	6.4

Note - Reference points of polar bearings are the country campaniles -

depths it varies during the day. Temperature becomes constant from 45 down to higher depths;

c) in the period of dry weather there is a weak gradient till 10 m depth, then a higher gradient in the layer between 10 and 30 m and finally the gradient turns again to the minimum. Therefore the maximum thermic stability is about 40 m.

We have also a complete sight of the trend of the thermic conditions in Table A-4, upon data kindly supplied by the Hydrobiologic Institute of Pallanza, and covering a whole year.

TABLE A-4 - TEMPERATURE FROM SURFACE TO 50 m DEPTH MEASURED AT MID-POINT ALONG CROSSING LINE ISPRA-LESA, FROM SEPTEMBER 1957 TO SEPTEMBER 1958 (Data kindly supplied by Hydrobiol. Italian Institute of Pallanza)

DEPTH (m)	MEAN	MAX °C	MIN	DEPTH (m)	MEAN	MAX °C	MIN
0	15.4	23.9	7.4	26	9.2	11.9	6.8
2	15.1	23.7	7.0	28	8.9	11.6	6.8
4	14.8	22.9	7.0	30	8.6	11.0	6.7
6	14.6	22.4	7.0	32	8.4	10.3	6.7
8	14.2	22.4	7.0	34	8.3	9.8	6.7
10	13.6	22.3	6.9	36	8.2	9.6	6.7
12	13.2	21.8	6.9	38	8.0	9.4	6.7
14	12.1	21.4	6.9	40	7.9	9.3	6.6
16	11.3	16.5	6.9	42	7.8	9.3	6.6
18	10.8	16.2	6.9	44	7.6	9.3	6.6
20	10.2	14.6	6.8	46	7.6	9.3	6.6
22	9.8	13.5	6.8	48	7.5	9.2	6.6
24	9.5	12.6	6.8	50	7.4	8.7	6.6

On the basis of the data of this table, fig. A-4 has been made, where is reported the annual trend of temperature at different depths and the trend of maximum and minimum temperature at different levels. It's interesting to note the isothermic regime of tke lake in winter.

1.2.5. - Interaction between the atmosphere and the Lake Maggiore

The Lake Maggiore exercises a remarkable influence

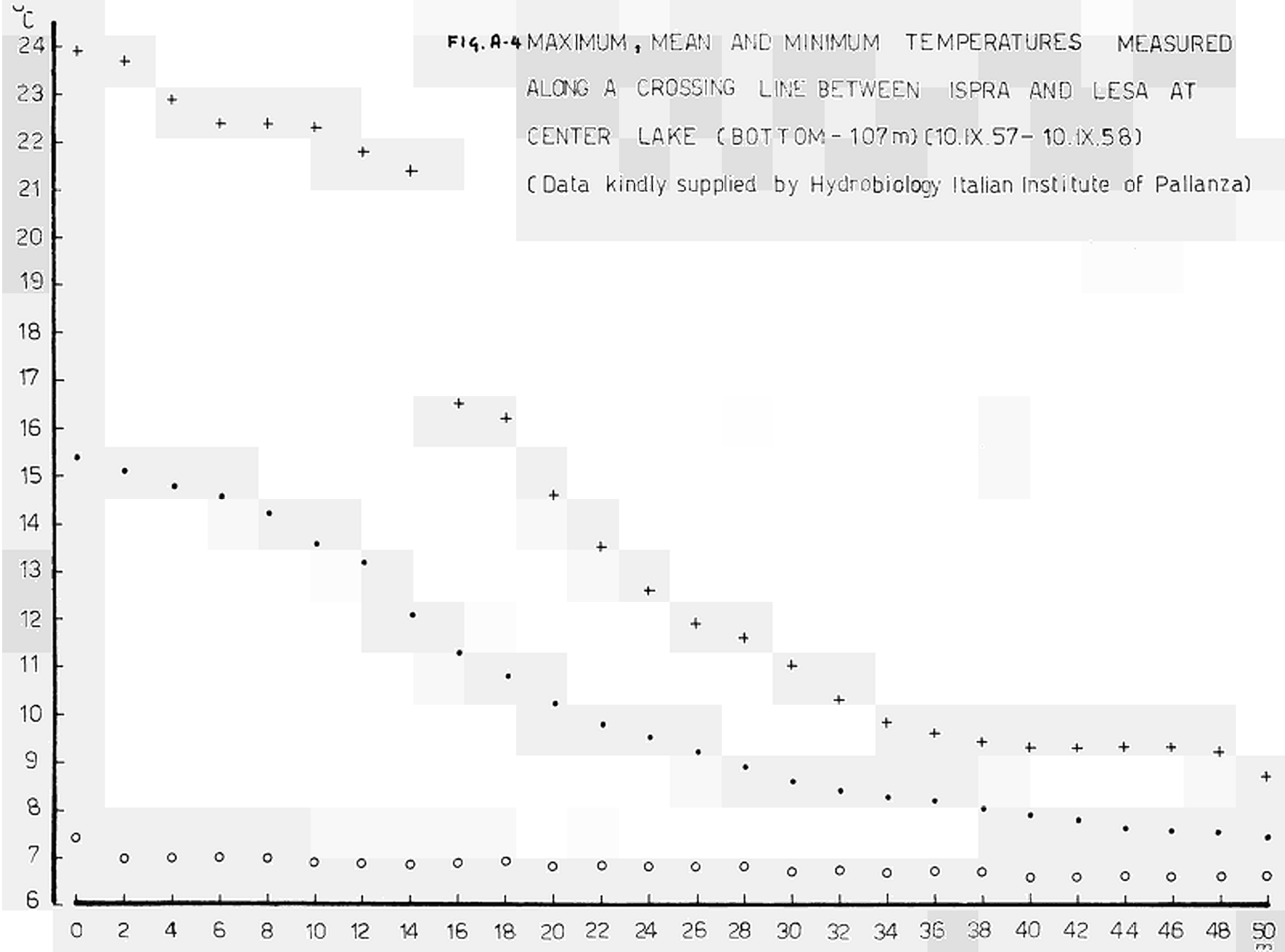


FIG. A-4 MAXIMUM, MEAN AND MINIMUM TEMPERATURES MEASURED ALONG A CROSSING LINE BETWEEN ISPRA AND LESA AT CENTER LAKE (BOTTOM - 107 m) (10.IX.57 - 10.IX.58)

(Data kindly supplied by Hydrobiology Italian Institute of Pallanza) on the climate of the entire adjacent zone (Ispra area included). It would be interesting to research the interaction between the atmosphere and the lake but it is complicated because it is impossible to separate cause and effect.

It has been noticed that the lake surface currents are closely related to the prevailing winds, and the energy useful for maintaining the current is derived from the stresses that the wind exerts on the lake surface. Indeed, any force acting on the water surface of a lake will cause the water surface to deviate from its normal position of equilibrium. As long as this force lasts, the water surface will remain in this new position. However, when this force ceases completely, the water surface tends to resume its former state of equilibrium. A periodic disturbing force provokes forced oscillations with a period corresponding to the period of the disturbing force. But these forced oscillations will not last long in a lake which is exactly tuned to certain periods. The forced progressive waves developed in the lake are rapidly damperred by reflection on the shores, and those which correspond to the dimension of the lake will be less affected.

The changes in atmospheric pressure and wind develop little oscillatory processes of water surface (level variations) in Lake Maggiore, because it has an oblong shape extending in direction north-south. It is well known that in lakes extending in this direction and having the same shape, the variations of level occur rarely and the waves rised from these oscillations cast ashore quickly.

The Hydrobiol. Italian Institute in Pallanza has also supplied the values of calories of the unitary column of water (Table A-5).

TABLE A-5 - CALORIES/cm^2 FOR UNITARY COLUMN OF WATER
(mid-point Ispra-Lesa)

DATE			CAL/cm^2	DIFFERENCE
1957	September	10	64.03	
	October	10	61.95	-2.08
	November	15	55.81	-6.14
	December	17	46.42	-9.39
1958	January	28	36.17	-9.25
	March	6	34.52	-1.65
	April	1	34.72	+0.20
	April	29	42.37	+7.65
	May	29	51.60	+9.23
	June	17	51.37	-0.23
	July	8	55.72	+3.35
	July	29	60.65	+4.93
	August	21	67.33	+6.68
	September	10	59.78	-3.30

According to the Forel method, the Lake Maggiore between March and August adsorbs 32.81 cal/cm^2, namely it adsorb totally 6.95×10^{13} calories, consequently, it gives in the atmosphere 3.28×10^{11} cal/day from August to March.

This outflow of calories from water to atmosphere determines the temperate climate of the whole area of Lake Maggiore in winter season.

A-2 - GENERAL METEOROLOGICAL FEATURES OVER NORTHERN ITALY (CENTRAL AREA)

2.1. - Generalities

The geographical area including Ispra, is very complex from a meteorological point-of-view, because it is placed among two climatic regions whose characteristics are very different: the area of the Po valley and the area of the Alps.

Altough the climatologists extend the characteristic weather types of northern Italy plain to 1000 m - countour line of the Alps, neverthless the orographic and hydrographic aspect of the analysed area don't allow to consider it rigorously belonging to the plain climate.

Generally the mountains are the most important troubling elements as regards the baric conditions and, consequently, the atmospheric circulation, especially in the lower layers, and in the Alps system, these effects are extending for several hundred kilometers both to south and north of the system itself. Another peculiarity, having static character, is the different surface pressure distribution between the plains to the north and to the south of the Alps, while at 4000 m, above the sea level, this difference disappears and the pressure field is completely levelled. This is a consequence of the temperature distribution below 4000 m-level which determines the lower layer pressure gradient.

Moreover the area is also influenced by the Adriatic and Western Mediterranean sea: the first causes the direct inflow of maritime air masses, and the second (sea exceptionally warm during the period october-march) brings about an instability effect on the air masses.

2.2. - Weather types

The types of weather are, perturbated (depression) and unperturbated (anticyclonic).

The depressions interesting the northern Italy are generally:

- **leeward depressions; the source place of these depressions is the Gulf of Genova;**
- **Mediterranean depressions;**
- **Po valley thermic depressions;**
- **Atlantic depressions.**

Following a 5-years statistic it results:

DEPRESSION TYPE	JANUARY	APRIL	JULY	OCTOBER
Leeward	24%	16%	5%	8%
Mediterranean	4	2	1	5
Po-Valley	< 1	1	9	< 1
Atlantic	1	2	1	< 1

The complement at 100 for each month is represented by no-depression type situations.

The leeward depressions of the Alps form when a cold front coming from west and north reaches the Alps. In most cases if a cyclonic center moves eastward or north-eastward crossing France, England and the North Sea, a cold front or a cold occlusion moves south-eastward crossing the Central Europe. As far as the front reaches the orographic obstacle of the Pyrenees and of the French Central Massif, generally a high-pressure wedge forms in the post-frontal cold air.

The atmospheric pressure to the south of the mountains, above the Ligurian Sea and the Po-Valley is generally constant, while to the north of those mountains it decreases strongly. The cold front crosses the Alps and the Pyrenees. A cold current wedges itself in the Western Mediterranean foregone by an active cold front; the pressure in cold air increases and the circulation intensifies near the leeward depression, above the Gulf of Genova. The Alps keep the cold front and therefore the cold air cannot overflow them. Later, when the depression center has displaced south-eastward, far from the Alps, the post-frontal air begins to channel among the mountains and appears to the ground in Northern Italy, as foehn currents.

The foehn often appears in winter on the plain only at certain levels above the surface, because the layers near the ground are formed by very cold stagnant air.

The weather type connected with the evolution of a leeward cyclon is characterized by large cloudiness and extended precipitations, especially on the Alps and Apennines. If the air masses are convectively unstable the precipitations are very persistent and strong.

After the passage of such depression south -eastward there is often a residual secondary depression or a stationary depression on the Ligurian Sea; if during these conditions a new cold front approaches the Alps, the depression deepens newly because there is already an embryonal circulation when the orographic process begins.

The above depressions are very frequent in the second part of winter and very scarce during the summer.

The Mediterranean depressions are not emphasized by orographic effects. When they reach the Northern Italian areas from the South-west, often they stop causing precipitations (also shower type) during two or three days.

One of the most important unperturbated weather type, especially in winter, happen when on the central Europe there is an anticyclone often interesting also the Northern Italy for some days and sometimes for some week. By this situation there is a thin cold air layer on the Po-Valley; along the Alps there is, almost always, a strong pressure gradient and strong winds through the Alps valley rise: the sky is clear and the temperatures are low.

Another fair weather situation is represented by the high summer pressure with almost levelled gradients persisting also for many weeks, especially when the central anticyclonic nucleus is placed on the Alps system. Consequently the air masses are almost always stable and on the central and western regions there are clear and hot days.

2.3. - Seasonal weather types

In winter prevail weak pressure gradients because the anticyclonic weather reaches its highest frequency, owing to the effect of the Alps barrier. This causes a radiative cooling of the air layers determining a thick inert cold air body lacking of inner circulation. This body of air is characterized by weak stratified inversion clouds whose base is less than 1000 m. There are almost everywhere persisting fog formation particularly from the evening to the morning. The leeward depressions forming on the Ligurian Sea carry away hot air towards the Alps above the inversion layer, causing heavy, often snowy, precipitations. The leeward depressions are followed by foehn currents flowing southward above the cold air layer. They are not found at surface unless the inversion is not vanishing by diurnal heating.

The leeward depressions forming on the Northern Italy have a lesser effect. Another frequent characteristic weather type is produced by Atlantic perturbations: stratified cloudiness, strong winds, snow storms.

In spring the leeward depressions may form on the Po-Valley mixing the cold layer and reactivating the atmospheric circulation. More often a depression flows from the Ligurian Sea to the Lombardy; it is not unfrequent that the region is interested by Atlantic fronts. These depressions can determine occasional rainfall situations which can be followed by foehn conditions determining clear sky.

The stable weather situations with poor circulation which take place in this season are less frequent than in winter. The diurnal heating is now strong enough to destroy the morning inversions. In high season the ground heating becomes more important giving a remarkable convective character to the clouds, which gives rise to thunderstorms phenomenon.

In summer prevail levelled pressure gradients; sometimes the region is interested by weak depressions. A weak area of low thermic pressure develops often on the Po-Valley in the afternoon and disappears during the night; only rarely such depression deepens and persists for several days. In these cases there is a thunderstorm activity, especially if at high levels flows cold air from the north-west. For the fore-Alps, Lombardy regions, thunderstorms, also with especially pre-frontal currents from south west, are possible.

In autumn the perturbations cross generally the Po-Valley coming from the Gulf of Genova; more rarely they form on the same valley. They are leeward,sometimes Mediterranean depressions, which cause often strong thunderstorm showers, especially when the cyclone warm sectors are formed by convectively unstable air masses. These depressions form on the Pc-Valley or on the Atlantic Ocean causing for some days showers having often a thunderstorms character. These perturbations are generally followed by cloudless days. During the periods when on the whole italian peninsula prevail east winds there are on the region levelled pressure and the weather is consequently cloudy.

2.4. - Surface winds

In winter the circulation is rather weak up to 1000 m; the winds with speed inferior to 6 Km/h have an average amount of 70% of the observations.

In the other seasons the anemologic distribution is not very different but the light winds are less frequent. In the area examined may be found channeling winds whose direction and speed-flow are function of the pressure gradient: they are weak where the pressure is higher and strong where the pressure is lower. Among these currents the best known is the foehn, which is a dry current dinamically heating coming down the slopes. The frequency of foehn is very high in the period December-May reaching a maximum in March.

2.5. - Winds aloft

As regards the thermodynamic structure of the atmospheric portion interesting the area of Ispra, the data of the radio-sounding station of Linate (Milano), kindly supplied by the Italian Air Force Meteorological Service (Roma), shall be used. This is the aerological station nearest to Ispra (70 Km as the crow flies) and the aspect of its ground is different from the ground of the C.C.R. area. Therefore, for the lowest atmospheric layers at least, the following data and the conclusions drawn from them have to be considered only as orientative.

After those previous statements, into the air layers among the ground and 1000 m level there is a great variability of the anemologic distribution. At 3000 m level the anemologic conditions are already more defined and indeed, in winter, north-west currents prevail, while in summer they come from south-west. It is possible to state, generally, that the provenance direction of the wind tends, in average, to wheel westward as the height increases.

In Table A-6 (pages 33 to 36) seasonal average frequency data (in thousandth) for five speed intervals, are reported. The direction include a 30°-sector, and the direction referred in the Table is its median.

TABLE A-6 - SEASONAL AVERAGE FREQUENCY (in thousandth) OF WINDS ALOFT

WINTER

DIRECTION	INTERVAL SPEED (KTS)				
	7-21	22-40	41-63	64-92	>92
			1500 m		
0°	54	23	=	=	=
30	18	=	=	=	=
60	27	=	=	=	=
90	65	5	=	=	=
120	56	15	1	=	=
150	28	5	=	=	=
180	28	2	=	=	=
210	38	8	=	=	=
240	85	5	=	=	=
270	62	7	=	=	=
300	55	3	1	=	=
330	47	23	1	=	=
			calms:340		
			3000 m		
0°	46	25	9	=	=
30	39	10	=	=	=
60	53	14	=	=	=
90	47	14	=	=	=
120	24	7	1	=	=
150	23	3	=	=	=
180	30	17	3	=	=
210	43	23	9	=	=
240	65	46	5	=	=
270	91	50	2	=	=
300	60	44	3	=	=
330	48	34	10	1	=
			calms: 101		

TABLE A-6 - SEASONAL AVERAGE FREQUENCY (in thousandth) OF WINDS ALOFT

SPRING

DIRECTION	INTERVAL SPEED (KTS)				
	7-21	22-40	41-63	64-92	>92
			1500 m		
0°	50	9	1	=	=
30	37	2	=	=	=
60	30	1	=	=	=
90	64	11	1	=	=
120	54	18	2	=	=
150	22	4	=	=	=
180	33	=	=	=	=
210	44	3	=	=	=
240	42	1	=	=	=
270	34	1	=	=	=
300	31	2	=	=	=
330	70	7	2	=	=
			calms: 424		
			3000 m		
0°	63	14	7	=	=
30	52	9	=	=	=
60	39	9	=	=	=
90	43	9	=	=	=
120	27	15	=	=	=
150	26	5	1	=	=
180	33	13	2	=	=
210	52	21	1	=	=
240	81	32	=	=	=
270	82	12	=	=	=
300	63	9	2	=	=
330	72	17	7	1	=
			calms: 179		

TABLE A-6 - SEASONAL AVERAGE FREQUENCY (in thousandth) OF WINDS ALOFT

SUMMER

DIRECTION	INTERVAL SPEED (KTS)				
	7-21	22-40	41-63	64-92	> 92
			1500 m		
0°	47	3	1	=	=
30	16	2	=	=	=
60	18	=	=	=	=
90	19	2	=	=	=
120	33	7	=	=	=
150	43	3	=	=	=
180	33	2	=	=	=
210	66	8	=	=	=
240	55	3	=	=	=
270	37	=	1	=	=
300	31	1	=	=	=
330	45	8	=	=	=
			calms: 514		
			3000 m		
0°	42	4	1	=	=
30	28	3	=	=	=
60	30	2	=	=	=
90	16	4	=	=	=
120	12	3	=	=	=
150	10	6	1	=	=
180	9	9	=	=	=
210	74	38	8	=	=
240	132	47	6	1	=
270	139	21	=	=	=
300	72	7	=	=	=
330	75	11	2	=	=
			calms: 187		

TABLE A-6 - SEASONAL AVERAGE FREQUENCY (in thousandth) OF WINDS ALOFT

AUTUMN

DIRECTION	INTERVAL SPEED (KTS)				
	7-21	22-40	41-63	64-92	> 92
			1500 m		
0°	43	2	=	=	=
30	24	=	=	=	=
60	28	2	=	=	=
90	81	7	2	=	=
120	45	5	2	=	=
150	21	6	=	=	=
180	23	3	=	=	=
210	26	6	=	=	=
240	51	1	=	=	=
270	45	1	=	=	=
300	33	3	=	=	=
330	32	15	1	=	=
			calms: 491		
			3000 m		
0°	53	12	3	=	=
30	65	6	=	=	=
60	51	5	1	=	=
90	47	11	=	=	=
120	38	6	1	=	=
150	23	3	=	=	=
180	28	9	=	=	=
210	51	26	2	1	=
240	85	27	=	=	=
270	84	18	1	=	=
300	45	12	=	=	=
330	49	20	6	1	1
			calms: 209		

The speeds are referred in knots and the calms include also the wind below 7 knots. Moreover the data have been calculated on two daily radio-soundings, at 00^h and 12^h (G.M.T.).

From a comparison among the wind frequencies aloft at 3000 m, to the south and to the north of the Alps system, it appears that in winter the winds coming from north and from north-east are more frequent to the north of the Alps: this is duo to the fact that the secondary leeward depression of the Po-Valley, in most cases, goes beyond 3000 m.

It is interesting also the Table A-7 including the vectorial mean direction of the wind at two levels and the prevalence index.

The prevalence index is the ratio between the vectorial mean intensity and the scalar mean velocity.

TABLE A-7 - VECTORIAL MEAN DIRECTION AND PREVALENCE INDEX OF WINDS ALOFT

	HEIGHT	MEAN VECTORIAL DIRECTION	PREVALENCE INDEX
Winter	1500 m 3000	10° 320	0.35% 0.33
Spring	1500 3000	60° 290	0.16 0.23
Summer	1500 3000	190° 260	0.32 0.58
Autumn	1500 3000	270° 260	0.23 0.63

Such ratio is equal to unit when the wind keeps always the same direction; it is zero the more numerous are the observed directions, or the more uniform is the distribution of the directions on the whole wind-rose. In practice, a 0.80 prevalence index means that there is a good prevalence, i.e., the vectorial mean direction is prevailing.

Generally an increase of the prevalence index according to the height, is noticed; this happens especially in summer, owing to the trend of currents on the western Mediterranean, that feel the effect of a semi-permanent low pressure area placed on the Eastern Mediterranean.

From the wind profile it results an increase of the speed according to the height at about 300 m above the ground and then decrease with a secondary minimum between 1000 and 1500 m. The low layers currents are less strong in winter.

2.6. - Temperature profile

In order to complete the table of meteorological features of the central part of Northern Italy, the calculation, during the usual five-years period, of the temperature profiles for the 4 main months of the year, from the ground up to 3000 m height, has been considered useful.

In Table A-8 (pages 39-40) are reported the average temperatures (in °C) and the mean lapse-rate (γ = 100 m) for every level of 200 m. The trend of temperature vs height is reported in fig. A-5 also.

From a first examination of the above Table it results that:

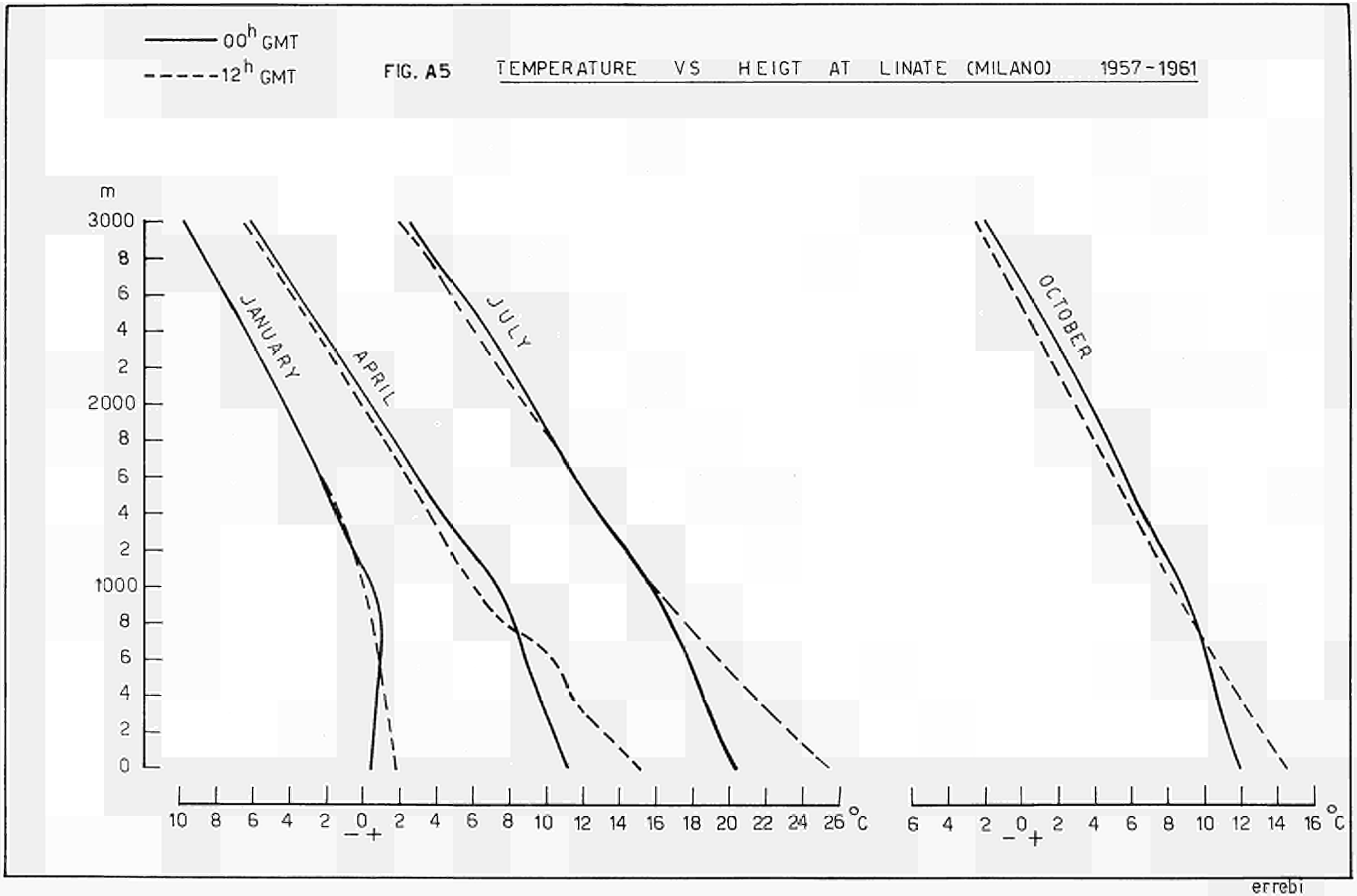
a) at low levels all the night lapse-rates are lower than the diurnal, and sometimes they change also the sign;

b) in January there are rather weak lapse-rates at about 1400 m during the day; but during the night there is the inversion layer which reaches an average of 800 m;

c) in April, July, October the value of the diurnal lapse -rates is higher at low then at high levels;

d) beyond 1500 m level, lapse-rates become almost constant.

The reason why at low levels the night lapse -rates are always inferior to the diurnal has to be



00h GMT
12h GMT
FIG. A5 TEMPERATURE VS HEIGT AT LINATE (MILANO) 1957-1961
m
3000
8
6
4
2
2000
8
6
4
2
1000
8
6
4
2
0
JANUARY
APRIL
JULY
OCTOBER
10 8 6 4 2 0 2 4 6 8 10 12 14 16 18 20 22 24 26 °C
− +
6 4 2 0 2 4 6 8 10 12 14 16 °C
− +
errebi

TABLE A-8 - AVERAGE TEMPERATURE (°C) AND MEAN LAPSE RATES UP TO 3000 m

HEIGHT	JANUARY				APRIL			
	12^h		00^h		12^h		00^h	
	t	γ	t	γ	t	γ	t	γ
Surface	1.8		0.5		15.1		11.1	
		-.15		+.05		-.90		-.35
200	1.5		0.6		13.3		10.4	
		-.15		+.05		-.95		-.35
400	1.2		0.7		11.4		9.7	
		-.15		+.05		-.95		-.40
600	0.9		0.8		9.5		8.9	
		-.20		+.05		-.90		-.35
800	0.5		0.9		7.7		8.2	
		-.25		-.25		-.80		-.50
1000	0.0		0.4		6.1		7.2	
		-.35		-.45		-.65		-.70
1200	-0.7		-0.5		4.8		5.8	
		-.30		-.45		-.60		-.70
1400	-1.3		-1.4		3.6		4.4	
		-.50		-.45		-.60		-.70
1600	-2.3		-2.3		2.4		3.0	
		-.45		-.45		-.65		-.65
1800	-3.2		-3.2		1.1		1.7	
		-.55		-.55		-.60		-.65
2000	-4.3		-4.3		-0.1		0.4	
		-.55		-.45		-.65		-.65
2200	-5.4		-5.4		-1.4		-0.9	
		-.50		-.50		-.65		-.65
2400	-6.4		-6.4		-2.7		-2.2	
		-.55		-.55		-.65		-.65
2600	-7.5		-7.5		-4.0		-3.5	
		-.60		-.60		-.65		-.65
2800	-8.7		-8.7		-5.3		-4.8	
		-.55		-.55		-.65		-.65
3000	-9.8		-9.8		-6.6		-6.1	

TABLE A-8-AVERAGE TEMPERATURE (°C) AND MEAN LAPSE RATES UP TO 3000 m

HEIGHT	JULY				OCTOBER			
	12^h		00^h		12^h		00^h	
	t	γ	t	γ	t	γ	t	γ
Surface	25.4		20.3		14.4		11.9	
		-.95		-.45		-.60		-.30
200	23.5		19.4		13.2		11.3	
		-1.00		-.40		-.65		-.30
400	21.5		18.6		11.9		10.7	
		-1.00		-.45		-.65		-.30
600	19.5		17.7		10.6		10.1	
		-1.00		-.45		-.65		-.30
800	17.5		16.8		9.3		9.5	
		-.85		-.55		-.55		-.40
1000	15.8		15.7		8.2		8.7	
		-.70		-.65		-.50		-.50
1200	14.4		14.4		7.2		7.7	
		-.70		-.70		-.50		-.50
1400	13.0		13.0		6.2		6.7	
		-.65		-.65		-.55		-.50
1600	11.7		11.7		5.1		5.7	
		-.70		-.65		-.55		-.45
1800	10.3		10.4		4.0		4.8	
		-.75		-.60		-.50		-.55
2000	8.8		9.2		3.0		3.7	
		-.70		-.65		-.55		-.55
2200	7.4		7.8		1.9		2.6	
		-.65		-.60		-.55		-.55
2400	6.1		6.6		0.8		1.5	
		-.70		-.65		-.55		-.55
2600	4.7		5.3		-0.3		0.4	
		-.45		-.70		-.55		-.55
2800	3.8		3.9		-1.4		-0.7	
		-.90		-.65		-.55		-.55
3000	1.9		2.6		-2.5		-1.8	

searched chiefly in the interdependence between lapse -rate and turbulence variations: the last is very low during the night. Then the fact that during the winter season a change in the lapse-rate sign, from negative to positive is found, is originated from the stratifying tendency of lower atmosphere. This phenomenon is very frequent in the Po-Valley, as in all the orographic depressions. During the other seasons, especially in summer, the difference between night and day lapse-rate is much more remarkable and the diurnal is higher than the night lapse-rate;this is due to the strong heating of the ground which emphasizes the turbulence processes. But all this does not exclude that also during summer -night, as during spring and autumn nights, by sky and atmospheric circulation suitable conditions, null or positive lapse-rates may occur. These lapse-rates occur chiefly after midnight and this is the reason why this peculiarity cannot appear from Table A-8 which reports the midnight soundings values. On the contrary the quasi-constancy of the lapse-rate above 1400 m is normal because this level, for the considered region, is already in the free atmosphere.

A-3 - SUMMARY OF THE MAIN MICROCLIMATIC FEATURES OF ISPRA (C.C.R)

3.1. - Generalities

This paragraph deals with the summary of the microclimatic observations contained in the "Annuario Meteorologico" of Ispra C.C.R. for the years from 1959 to 1963.

The statistical elaborations have been restricted to mean values only; other parameters and statistical researches have been left out because five years of available observations are yet scarce.

In reality also the five-years means are statistically unstable for obtaining a quantitative image of atmospheric events. However, in many cases it is necessary to have a reference scheme acting as index. Under this conditions, the arithmetic mean is also the most appropriate and noteworthy index.

Moreover, following what has been established by International Meteorological Authorities for climatic summaries, calculations of mean values over central season months (January, April, July, October) have been preferred; because they are representative from a meteorological point-of-view. This method has been employed for all climatic elements except wind magnitudes, for which seasonal means have been adopted, in that they resulte more representative. This exception is justified, first of all by the large variability in the frequency distribution, far from the gaussian, that prevents the use of arithmetic means and it suggests to stop at mean frequencies over adapted ranges; then the vectorial character of wind imposes the resolution in two scalar magnitudes, i.e., direction and velocity modulus.

The data contained in this paragraph have been observed at Ispra C.C.R. Meteorological Observatory (lat.45°48'11"N; long.8°37'36"E Gr.;height 247.5 m a.s.l.).

3.2. - <u>Insolation and radiation</u>

The mean insolation (four years) calculated from the observations is (in hours and minutes):

January	96^h 58^m
April	183 45
July	254 34
October	143 19

Now, the theoretical insolation (time-interval between sunrise and sunset) gives the following values for the above months:

January	282^h 22^m
April	406 42
July	474 40
October	338 44

then the rate between the effective and theoretical insolation, for the period examined is:

January	0.35
April	0.45
July	0.54
October	0.45

and then the <u>insolation deficit</u> is:

January	65%
April	55
July	46
October	55

This deficit is not due entirely to clouds and fog but also to position of register as regards the eventual obstacles (fig.A-6) and because the instrument is available to register only when the Sun-elevation is high enough above the horizon. This last depends principally from emulsion type of sensible registering paper.

The mean time of sunshine for each hour and for January, April, July, October, in minutes, is the following:

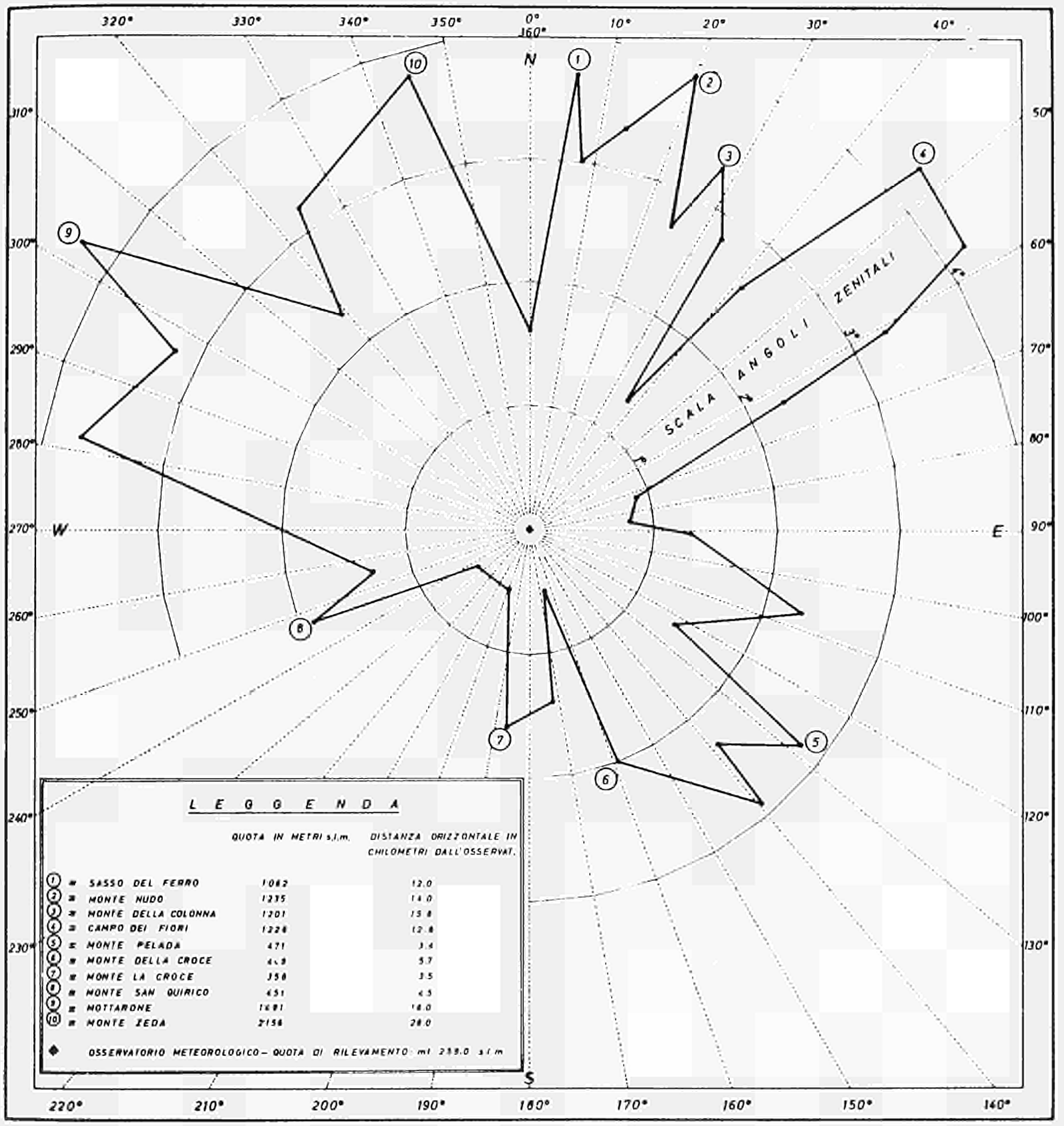


Fig. A6 - Main obstacles along the Ispra Meteorological observatory (From «G. Bollini, C. Gandino, B. Scaglianti - 5° Annuario Meteorologico - 1963 - Euratom - Ispra).

HOURS	JANUARY	APRIL	JULY	OCTOBER
5-6	=	0.2	3.8	=
6-7	=	12.5	28.0	0.2
7-8	0.5	25.7	35.4	9.9
8-9	10.4	31.9	36.5	21.0
9-10	19.2	36.0	43.0	28.0
10-11	22.1	37.8	45.7	30.7
11-12	23.9	37.1	47.1	33.1
12-13	29.2	37.1	45.5	34.2
13-14	32.0	35.7	42.6	33.2
14-15	30.4	34.6	41.3	33.4
15-16	25.2	33.9	41.0	32.3
16-17	3.2	28.6	36.2	19.2
17-18	=	15.8	33.5	0.5
18-19	=	0.6	8.0	=

The mean values of global radiation (cal/cm^2) are the following:

January	3325 cal/cm^2
April	9903
July	13729
October	6007

3.3. - Temperature

The daily means of temperature have been calculated by observers over 24 hourly values.

The mean maximum temperatures are:

January	5.57°C
April	17.33
July	26.58
October	16,93

The mean minimum temperatures are:

January	-2.25°C
April	7.08
July	16.00
October	8.07

The **mean** temperatures are:

January	1.43°C
April	12.00
July	21.08
October	11.98

The **mean amplitude** of temperature:

January	8.24°C
April	10.52
July	10.76
October	9.57

The extreme values registered for the entire period (1959, January, 1 - 1963, November, 30) are:

Absolute maximum	31.8°C
Absolute minimum	-12.0
Daily mean:	
highest value	25.8
lowest value	-6.1
Maximum amplitude:	
daily	20.2
monthly	26.6
yearly	43.8

3.4. - Degree-day

For air-conditioning designs it is interesting to know the degree-day values. It is a measure of the departure of the mean daily temperature from a given standard (18°C): one degree day for each °C of departure above the standard during one day. The mean degree days accumulated for each month are:

January	508 degree-day
February	412
March	316
April	183
May	81
June	< 1
July	0
August	0
September	32
October	187
November	331
December	469

(The december value has been calculated over 4 years only).

3.5. - Relative humidity

The mean values of relative humidity are:

January	77.1%
April	68.9
July	72.9
October	80.9

Given the orographic position of C.C.R. area and the physical constitution of ground is obvious to expect high values in relative humidity. However, as resulte from comments to various meteorological year books about Ispra, the greatest number of hours at high relative humidity (> 90%) fall in winter months.

3.6. - Rainfall

From the report "Precipitazioni atmosferiche ad Ispra (1959-1964)" by G. Bollini, the following news about the rainfall on the Ispra area, have been drawn.

The seasonal means of rainfall for the above period are:

winter	255 mm
spring	436
summer	368
autumn	641

It is clear that the wettest seasons are spring and autumn (particular feature of northern Italy) and the wettest months (rainfall > 200 mm) are april, october and november.

The mean annual height of snow is 41 cm.

Considering as wet day a day in which the rainfall(liquid precipitation or snow melted or condensation of fog) is equal or more then 0.2 mm, the mean numbers of seasonal wet-days are:

winter	24 days
spring	38
summer	30
autumn	34

Consequently the seasonal intensity of precipitation is:

winter	10.6 mm
spring	11.4
summer	12.3
autumn	19.0

The greatest intensity of autumnal rainfall is justified by the last thunderstorms and by the passage of atmospheric discontinuity zones over northern Italy.

3.7. - Wind at surface

The measurements of wind at surface have been taken at the Meteorological Observatory at m 13.5 above the ground level.

From the wind frequencies reported on the wind-rose, 16-points, it results that the most frequent winds are those from north and south sectors. Since this report has the diffusion problem as final aim it is enough to consider only these two sectors.

In the following tables are reported the seasonal frequencies (%) of these winds (½ NW, ½ NE, ... etc. indicate that the total frequency of these wind directions has been divided by 2 because half-frequency belongs to east-and west-sectors)

WINTER						
			1960	1961	1962	1963
	(½)	NW	1.4	2.4	1.8	0.8
		NNW	13.8	21.7	11.5	6.9
NORTH SECTOR		N	13.0	15.5	6.8	6.1
		NNE	18.3	4.4	15.0	12.5
	(½)	NE	1.8	0.4	3.5	4.4
			48.3	44.4	38.6	30.7
	(½)	SE	2.0	1.7	3.2	3.4
		SSE	4.9	11.1	7.7	11.2
SOUTH SECTOR		S	7.5	4.0	9.4	14.1
		SSW	6.6	3.2	8.9	11.0
	(½)	SW	4.3	0.5	3.8	2.4
			25.3	20.5	33.0	42.1
OTHER DIRECTIONS AND CALMS			26.4	35.1	28.4	25.2

SPRING						
			1960	1961	1962	1963
	(½)	NW	1.6	3.2	1.6	1.4
		NNW	22.3	25.6	11.0	13.8
NORTH SECTOR		N	5.0	6.2	10.1	13.0
		NNE	5.0	6.4	17.6	18.3
	(½)	NE	0.8	0.8	3.8	1.8
			34.7	42.2	44.1	48.3
	(½)	SE	2.6	1.4	2.6	2.0
		SSE	10.7	7.3	4.6	4.9
SOUTH SECTOR		S	6.5	8.2	8.9	7.5
		SSW	14.4	10.2	6.0	6.6
	(½)	SW	2.3	1.3	4.6	4.3
			36.5	28.4	26.7	25.3
OTHER DIRECTIONS AND CALMS			28.8	31.4	29.2	26.4

SUMMER

			1960	1961	1962	1963
NORTH SECTOR	(½)	NW	1.3	2.6	1.3	0.8
		NNW	34.9	21.7	7.9	6.9
		N	11.1	8.6	12.0	6.1
		NNE	5.4	6.6	17.9	12.5
	(½)	NE	0.6	0.6	2.2	4.3
			53.3	40.1	41.3	30.6
SOUTH SECTOR	(½)	SE	1.2	1.3	2.8	3.4
		SSE	4.6	6.9	4.4	11.2
		S	3.9	6.4	8.9	14.1
		SSW	7.8	16.7	6.9	11.0
	(½)	SW	1.2	1.6	5.8	2.4
			18.7	32.9	28.8	42.1
OTHER DIRECTIONS AND CALMS			28.0	27.0	29.9	27.3

AUTUMN

			1960	1961	1962	1963
NORTH SECTOR	(½)	NW	2.2	3.4	1.5	1.5
		NNW	33.6	25.4	6.1	13.8
		N	17.0	10.2	10.4	13.0
		NNE	4.8	4.4	21.7	18.3
	(½)	NE	0.6	0.6	6.6	1.8
			58.2	44.0	46.3	48.4
SOUTH SECTOR	(½)	SE	0.6	1.0	2.0	2.0
		SSE	5.3	8.4	5.1	4.9
		S	1.9	6.2	9.2	7.5
		SSW	4.8	11.3	5.4	6.6
	(½)	SW	0.8	1.5	2.8	4.3
			13.4	28.4	24.5	25.3
OTHER DIRECTIONS AND CALMS			28.4	27.6	29.2	26.3

Summing up the above tables it follows:

			WINTER	SPRING	SUMMER	AUTUMN
NORTH SECTOR	(½)	NW	1.6	2.0	1.5	2.2
		NNW	13.5	18.2	17.9	19.7
		N	10.3	8.6	9.4	12.6
		NNE	12.6	11.8	10.6	12.3
	(½)	NE	2.5	1.8	1.9	2.4
			40.5	42.4	41.3	49.2
SOUTH SECTOR	(½)	SE	2.6	2.1	2.2	1.4
		SSE	8.7	6.9	6.8	5.9
		S	8.7	7.8	8.4	6.2
		SSW	7.4	9.3	10.6	7.0
	(½)	SW	2.8	3.1	2.8	2.4
			30.2	29.2	30.8	22.9
OTHER DIRECTIONS AND CALMS			29.3	28.4	27.9	27.9

Whereas the figures contained in the above tables must not be considered rigorously as means but as index, given the little number of years of observation (cfr.2.1.) the <u>orientative</u> conclusion that, generally in all season the northern winds are prevailing at Meteorological Observatory of Ispra may be drawn; particularly, the most prevailing wind in absolute is the NNW. Considering also the south sector, the prevailing wind is the SSW.

Given the height and shapes of little hills round the C.C.R. area and given its extension, it is conceivable that the wind direction registered at Meteorological Observatory are the same for the C.C.R. area except some weak local deviation.

From the graphic representations of wind direction isofrequencies in terms of daily hours, contained in the

Meteorological Year-books of Ispra, it is evident that the most part of norther winds happen approximately from 9 A.N. to noon, while in afternoon are prevailing the southern winds. It is evident the persistence of breeze conditions over Ispra area (cfr.also C. Gandino - Anemologia ad Ispra - Geof. e Met. - 1962).

As regards the wind velocity distribution it is clear, from the table published in the above year-books, that light winds are about 80% in all seasons and that only northern winds attain sometimes high velocities.

3.8. - Foehn days

From particular observations on foehn days, supplied by the Meteorological Observatory of Ispra, concerning the period December 1960-November 1963, the season average number of days with foehn is:

Winter	20 days
Spring	20
Summer	5
Autumn	12

an average of about 57 days per year, equal to 16% which is a rather high percentage justified by the particular geographical position of Ispra (par. 2.4.).

A-4 - THERMODINAMIC FEATURES OF ISPRA (C.C.R. AREA)

4.1. - Generalities

The C.C.R. is supplied with a meteorological tower, 120 m high, which is equipped with remote instrument for wind-speed and temperature measurements, placed at the end of 5 m arms at 10,30,60 m levels,and 3 m and 2 m, respectively, at 90 and 120 m levels.

The wind-speeds instruments are placed at 10, 30, 60, 120 m above the ground, while the ventilated thermoresistences are placed at 10 m (reference temperature), and at 30, 60, 90, 120 m (differential temperature between these levels and 10 m).

Moreover in the Ispra area 970 m to north-north -west from the Observatory, a meteorological screen has been settled 37 m below the level of Meteorological screen of the Observatory. The simultaneous temperatures recorded in these screens allow the calculation of the temperature difference between the site of Observatory and those of C.C.R. area.

So it is not possible to speak of temperature difference on the vertical, because of the unfavorable ratio distance-height for such measurements between the two screens, those observations are all the same useful because they underline the remarkable difference existing between two sites placed in the same area.

Is is necessary to point out that, from a meteorological point-of view, especially as regards the diffusion of gaseous effluents, the winther season 1962-1963 has been very interesting because locally characterized by a prolonged anticyclonic situation; consequently the data inferred can be considered representative for the geographical area, in first approximation at least. As for the consideration dealt in the previous paraghraph 3.1., the data are treated for the whole season.

Evidently the numerical values of various meteorological parameters, included in this report, and their classification in terms of atmospheric equilibrium conditions, are susceptible of continuous modifications as the analysis is gradually extending in the future.

In the development of this paragraph also the data reported in the meteorological year-books of Ispra C.C.R. will be considered, for a table of the situation as complete as possible.

4.2. - Winds at various levels

In this report the wind measurements examined concern only 30, 60, 120 m levels.

The wind speed is referred to the average value during the last 10 minutes interval before the full hour. The lecture of diagrams has been made hourly. The recordings of these measurements have been good enough for the whole period.

The mean and maximum values of wind speed (m/s) at various levels have been the following during the whole period:

	30 m	60 m	120 m
Mean	1.7	2.1	2.9
Maximum	15.0	17.8	20.0

It has been calculated the relative frequency (%) of wind speed for having a right picture of it. The choice of wind speed intervals has been made following gas diffusion criteria; they are: from 0.1 to 2.0, 2,1 to 5.0, 5.1 to 8.0, 8.1 to 12.0 and greater than 12.0 m/s and calm (Table A-9).

TABLE A-9 - FREQUENCY (%) OF WIND SPEED AT VARIOUS LEVELS
<u>Winter 1962-63</u>

N°	INTERVAL	CENTER OF CLASS	30 m	60 m	120 m
1	calm	=	15.1	16.3	6.3
2	0.1 to 2.0 m/s	1.0	60.5	47.7	40.0
3	2.1 to 5.0	3.5	19.8	27.4	38.9
4	5.1 to 8.0	6.5	3.4	6.2	10.9
5	8.1 to 12.0	10.0	1.0	1.8	2.6
6	> 12.0	=	0.2	0.6	1.3

It is clear that, at first, the freqyency of calms increases slowly up to 60 m level and then decreases strongly at 120 m. Perhaps the anomaly of the calm frequency at 60 m level is probably due both to an uncertainty in the selection between the class 1 and the lowest values of class 2 and to a relative instrumental reliability for the low speed values. If the two classes were unified, the following frequency for wind speed $\leq$ 2.0 m/s could be obtained:

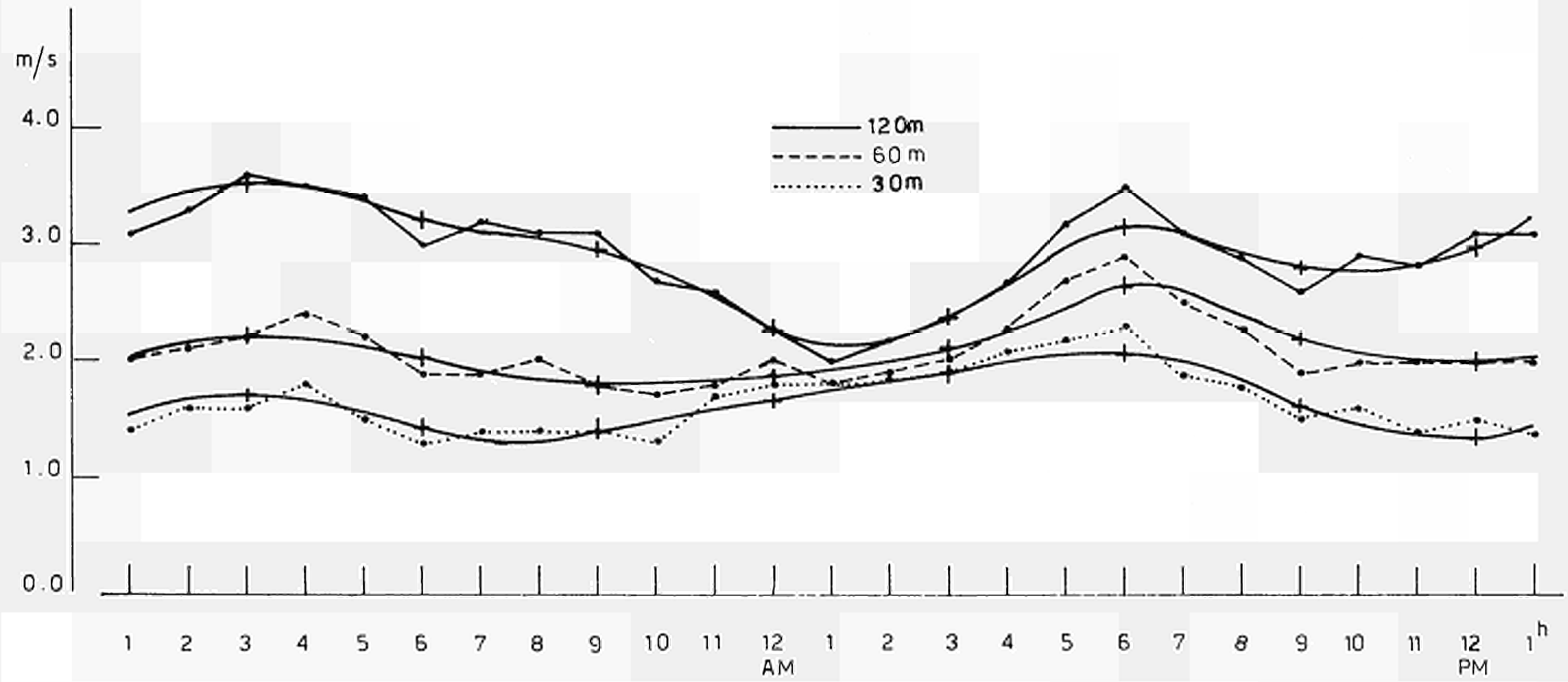
30 m	75.6%
60 m	64.0
120 m	46.3

It is interesting to point out the accord (at least in the magnitudes order) resulting, for the frequency percentages, among the different speed intervals between the anemograph placed at 60 m on the tower and that of the Observatory (the last is 16.5 m higher than the first).

From the class 3 onwards (2.1÷5.0 m/s) there is an inversion of wind speed: the frequency of velocity increases with the height.

For the outline of wind speed at Ispra, it is also interesting to analyse its average daily course at various levels (fig.A-7 and Table A-10). It is clear that in all

FIG. A-7 - MEAN WIND SPEED AT VARIOUS LEVEL - WINTER 1962-63



24-steps there is always an increase of velocity with height and that at the three levels examined there is also a well defined diurnal variation. The last one is better seen if on the same diagram (continuous lines)were plotted the mean values for 3 hours interval (Table A-11).

TABLE A-10 - WIND SPEED (m/s) AT VARIOUS LEVELS
Winter 1962-63

TIME	30 m	60 m	120 m	TIME	30 m	60 m	120 m
1 A.M.	1.4	2.0	3.1	1 P.M.	1.8	1.8	2.0
2	1.6	2.1	3.3	2	1.8	1.9	2.2
3	1.6	2.2	3.6	3	1.9	2.0	2.4
4	1.8	2.4	3.5	4	2.1	2.3	2.7
5	1.5	2.2	3.4	5	2.2	2.7	3.2
6	1.3	1.9	3.0	6	2.3	2.9	3.5
7	1.4	1.9	3.2	7	1.9	2.5	3.1
8	1.4	2.0	3.1	8	1.8	2.3	2.9
9	1.4	1.8	3.1	9	1.5	1.9	2.6
10	1.3	1.7	2.7	10	1.6	2.0	2.9
11	1.7	1.8	2.6	11	1.4	2.0	2.8
NOON	1.8	2.0	2.3	M.N.	1.5	2.0	3.1

TABLE A-11 - HOURLY MEAN OF WIND SPEED AT VARIOUS LEVELS
Winter 1962-63

TIME	30 m	60 m	120 m	TIME	30 m	60 m	120 m
3 A.M.	1.7	2.2	3.5	3 P.M.	1.9	2.1	2.4
6	1.4	2.0	3.2	6	2.1	2.7	3.2
9	1.4	1.8	3.0	9	1.6	2.1	2.8
NOON	1.7	1.9	2.3	M.N.	1.4	2.0	3.0

The shape of three smooth curves is almost equal: they exhibit two maximum and two minimum peaks in their daily course. For 30 m level the highest maximum and minimum are, respectively, at about 6 P.M. and 7-8 A.M. (the lowest are at 3 A.M. and 11 P.M.-midnight); for 60 m level the highest maximum and minimum are, respectively, at about 6-7 P.M. and 8-9 A.M. (the lowest are at 3 A.M. and 11 P.M.-midnight); the trend of these two curves is almost equal. For 120 m level the highest maximum and minimum are, respectively, at about 3-4 A.M. and 1 P.M. (the lowest are at 6 P.M. and 10 P.M.): all this follows the current theory for inland sites. The wind in the lowest layers reaches its maximum speed during the day, usually with some ill-defined peak about noon, while at heights of the order of 100 to 300 m, the reverse variation is observed: a maximum value at night and a minimum during the day (Sutton O.G. 1953).

It has been calculated, for the three levels, the frequency (%) of hourly distribution only for the first four classes of velocity intervals of Table A-9 (fig. A-8) to complete the outline of wind speed. The calm frequency lower at 30 m than at 60 m, is evidently due to local channelling effect. The values *in extenso* are reported in Table A-12 (pages 57-58).

4.3 - Differential temperature measurements

At Ispra meteorological tower are taken temperature and continuous remote measurements of differential temperature at various levels. For our purposes, only two among four differential temperature measurements have been considered; i.e. between the levels 60 and 10 m and 120 and 60 m.

FIG. **A-8** — FREQUENCY % OF DAILY DISTRIBUTION FOR VARIOUS INTERVALS OF VELOCITY FOR THREE LEVELS

WINTER 1962-63

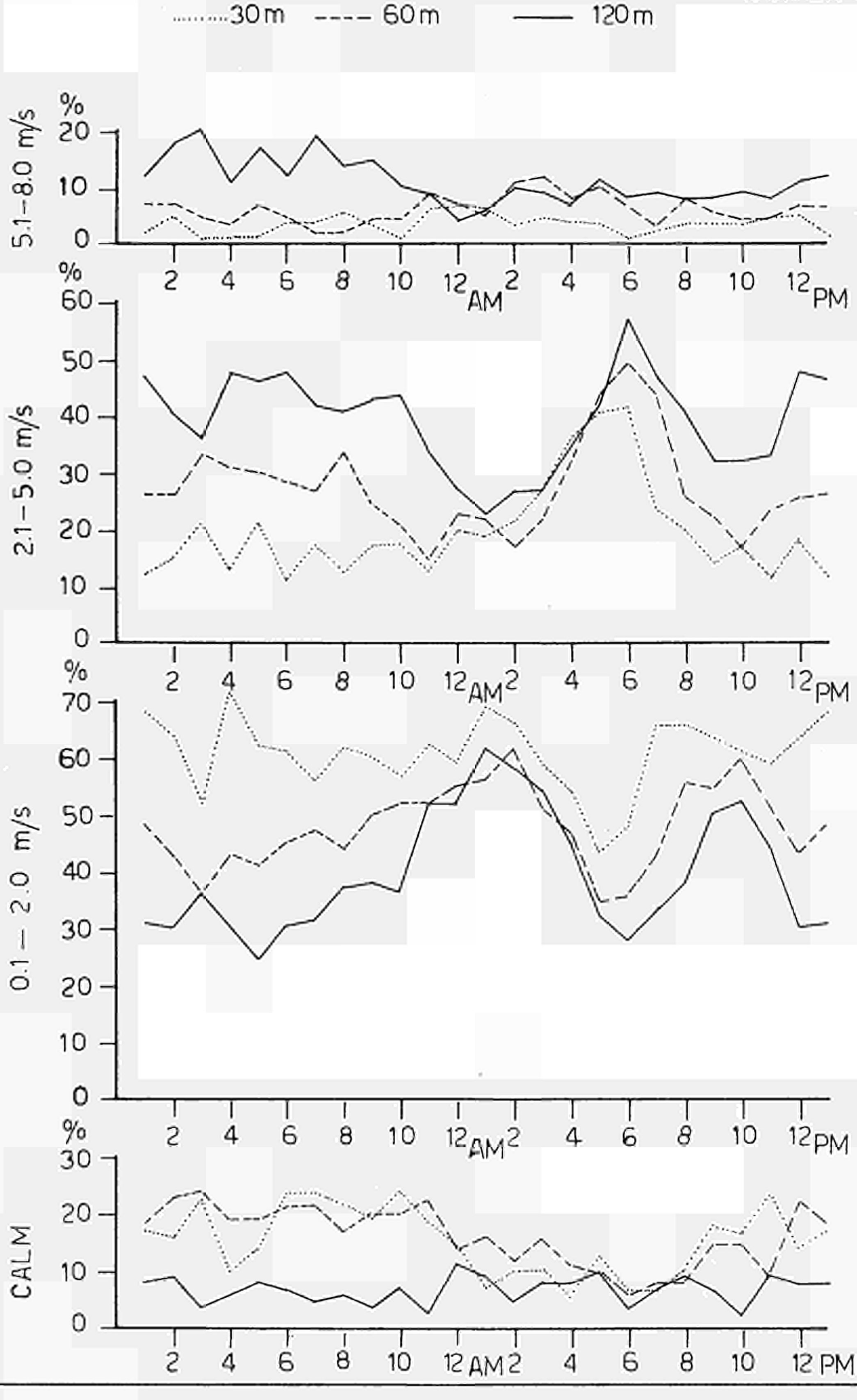


TABLE A-12 - FREQUENCY (%) OF HOURLY DISTRIBUTION OF WIND-SPEED AT VARIOUS LEVELS
Winter 1962-63

TIME	LEVELS m	WIND SPEED (m/s)					
		Calms	0.1 2.0	2.1 5.0	5.1 8.0	8.1 12.0	> 12.0
1 A.M.	30	16.7	68.2	12.2	2.2		
	60	18.0	48.3	25.9	6.7	1.1	
	120	7.8	31.1	46.7	12.2		2.2
2	30	15.6	63.4	14.4	4.4	1.1	1.1
	60	22.5	42.7	25.9	6.7	1.1	1.1
	120	8.9	30.0	40.0	16.7	2.2	2.2
3	30	22.2	52.2	21.2	1.1	3.3	
	60	23.6	36.0	32.6	4.5	2.2	1.1
	120	3.4	36.0	36.0	20.1	1.1	3.4
4	30	10.0	71.2	13.3	1.1	3.3	1.1
	60	19.1	42.7	30.4	3.4	2.2	2.2
	120	5.6	30.3	47.3	11.2	1.1	4.5
5	30	13.3	62.2	21.2	1.1	2.2	
	60	18.9	41.1	30.0	6.7	3.3	
	120	7.9	24.7	46.0	16.9	3.4	1.1
6	30	23.6	60.7	11.2	3.4	1.1	
	60	21.3	45.0	28.1	4.5		1.1
	120	6.8	30.3	47.3	12.4	1.1	1.1
7	30	23.6	56.1	16.9	3.4		
	60	21.3	47.3	27.0	2.2	2.2	
	120	4.5	31.4	41.6	19.1	3.4	
8	30	21.4	61.4	12.5	5.7		
	60	16.9	43.8	33.7	2.2	3.4	
	120	5.6	37.0	40.5	13.5	3.4	
9	30	19.3	60.3	17.0	3.4		
	60	20.0	50.0	24.4	4.4	1.2	
	120	3.3	37.8	42.3	14.4	2.2	
10	30	23.9	56.9	17.0	1.1	1.1	
	60	20.0	52.3	21.1	4.4	2.2	
	120	6.7	36.7	43.3	10.0	3.3	
11	30	18.4	62.0	12.7	5.8	1.1	
	60	22.2	52.3	14.4	8.9	2.2	
	120	2.2	52.3	33.3	7.8	3.3	1.1
NOON	30	14.8	59.1	19.3	6.8		
	60	13.5	55.0	22.5	6.7	2.3	
	120	11.1	52.3	26.7	4.4	4.4	1.1

TABLE A-12 - FREQUENCY (%) OF HOURLY DISTRIBUTION OF WIND-SPEED AT VARIOUS LEVELS
Winter 1962-63

TIME	LEVELS m	WIND SPEED (m/s)					
		Calms	0.1 2.0	2.1 5.0	5.1 8.0	8.1 12.0	>12.0
1 P.M.	30	7.0	68.6	18.6	5.8		
	60	16.0	55.7	21.6	5.6	1.1	
	120	8.9	61.1	22.2	5.6	2.2	
2	30	9.4	65.9	21.2	3.5		
	60	11.4	61.3	17.0	10.3		
	120	4.4	57.8	26.7	10.0	1.1	
3	30	10.0	58.9	26.7	4.4		
	60	15.6	51.1	22.2	11.1		
	120	7.8	54.0	27.0	9.0	2.2	
4	30	5.6	54.4	35.6	3.3	1.1	
	60	11.1	46.7	32.2	7.8	2.2	
	120	7.8	45.0	34.8	6.8	4.5	1.1
5	30	12.2	43.4	40.0	3.3	1.1	
	60	10.0	34.4	43.4	10.0	1.1	1.1
	120	10.0	32.3	42.2	11.1	3.3	1.1
6	30	6.7	47.8	41.1	1.1	2.2	1.1
	60	5.6	35.6	48.8	6.7	2.2	1.1
	120	3.3	27.8	56.7	7.8	2.2	2.2
7	30	6.7	65.5	23.4	2.2	1.1	1.1
	60	7.8	42.3	43.3	3.3	2.2	1.1
	120	6.7	33.3	46.7	8.9	3.3	1.1
8	30	10.0	65.5	20.1	3.3		1.1
	60	7.8	55.6	25.5	7.8	2.2	1.1
	120	8.9	37.8	41.1	7.8	3.3	1.1
9	30	17.9	63.3	14.4	3.3	1.1	
	60	14.4	54.4	22.3	5.6	2.2	1.1
	120	6.7	50.0	32.2	7.8	2.2	1.1
10	30	16.7	61.1	16.7	3.3	2.2	
	60	14.4	60.0	16.8	4.4	2.2	2.2
	120	2.2	52.3	32.2	8.9	1.1	3.3
11	30	23.4	58.9	12.2	4.4	1.1	
	60	17.8	51.2	23.3	4.4	2.2	1.1
	120	8.9	44.5	33.3	7.8	3.3	2.2
MIDN.	30	14.4	63.3	17.9	4.4		
	60	22.2	43.3	25.6	6.7	2.2	
	120	7.8	30.3	47.3	11.2	3.4	

Originally the temperature difference measurements were all referred to 10 m level. It has been preferred to reduce the 120-10 to 120-60 for analysing the two layers 10-60 and 60-120.

This reduction has been made because, as said formerly, the lowest atmospheric layers, for the most part of the year, especially under anticyclonic situation, are strongly influenced by the particular topography of Ispra area.

The temperature data have been taken at the full hour. Over all period analyzed (december 1962 - february 1963) have been used 1948 hours for Δ t 60-10 and 1803 hours for Δ t 120-60. The percentage of regularity for Δ t 60-10 and Δ t 120-60 has been, respectively, 90.2 and 83.5%.

4.4. - Lapse-rate frequency

The range for 10-60 m layer is from -3 to +7.0°C and for 60-120 m layer from -3 to -6.0°C. For the two layers the maximum frequency is about 0°C temperature difference.

It is interesting to observe how the two curves take a quasi-Gaussian shape whose median axis is lightly displaced on the left of 0-axis. Of course also the shapes of two curves representing the cumulative frequency is regular enough.

Following the Sutton stability classification where

a) $\partial T/\partial z \leq$ - 1°C/100 m lapse (L)

b) $0 \geq \partial T/\partial z >$ - 1°C/100 m neutral (from small lapse to light inversion) (N)

c) $0 < \partial T/\partial z <$ 2°C/100 m moderate inversion (MI)

d) $\partial T/\partial z \geq$ 2°C/100 m strong inversion (SI)

it results the following frequencies in winter 1962/63:

STABILITY CONDITIONS	LEVEL DIFFERENCIES	
	60-10 m	120-60 m
Lapse or instability	33.4%	22.1%
Isothermal	34.7	55.2
Moderate inversion	19.1	13.6
Strong inversion	12.8	9.1

From the above table it is clear that in the first layer (10-60) the conditions of inversion (moderate and strong) have almost the same weight as the instability and isothermal conditions; in the second layer (60-120) the isothermal conditions are prevailing and the other are nearly equal. This means that the lower atmospheric layers of the area have a poor diluition power.

As already mentioned in paragraph 4.1., the existence of a second meteorological screen at the C.C.R. Mechanics Works has permitted the evaluation, though rather generally, of the temperature difference between the C.C.R. and the meteorological Observatory sites.

The daily thermic means of the two stations and not their hourly values have been used to eliminate quick oscillations which could have brought to deductions not always in conformity with the reality, because of the actual little functioning period of the two survey sites.

In this case too, has been preferred to examine the two main stations and divide the frequencies only into three intervals, i.e. positive, null and negative differencies between the Observatory and the Mechanics Works. To the null differencies has been applied the value of a mean error of ±0.2°C. The Charlier rule (algebraic addition of extreme values of the series divided by 20) for establishing frequency intervals could not be applied because it would have resulted intervals of the order of 0.3°C bringing to a discontinuous distribution of the frequencies, due to the little number of observations available.

Therefore the percentage frequencies are:

DIFFERENCIES	WINTER	SUMMER
Positive	68.9	54.9
Null	20.6	34.8
Negative	10.5	10.3

The above differencies can be interpreted as a poor vertical mixing of air in the low part of the C.C.R. area

As regards the hourly mean trend of those differencies, the graphics published in the Ispra Meteorological Year-books can be consulted.

4.5. - Daily variation of lapse-rate

In fig. A-9 is reported the daily variation course of the temperature difference between 60 and 10 m and between 120 and 60 m levels (Table A-13). Analysing the curve relative to Δ t 60-10 it is possible to observe its regular course through the whole day. The lapse-rate changes its sign between 9 and 10 A.M. and between 5 and 6 P.M. The maximum depletion of positive Δ t is about 2 A.M. The largest mean amplitude is 2.3°C.

The curve relative to Δ t 120-60 has also a regular course through the whole day but its amplitude is 1.4°C, that is lower than Δt 60-10 curve. The analysis of this curve is very interesting from the diffusion point-of -view. Between 2 and 7 A.M. take place the greatest positive values of Δ t; a long isothermal period until noon, then a weak negative lapse-rate period between 1 and 5 P.M. and again an isothermal interval from 6 P.M. to 1 A.M.

From the trend of two curves it is clear that in the morning and in the afternoon it is possible to determine the condition of fumigation or at the most

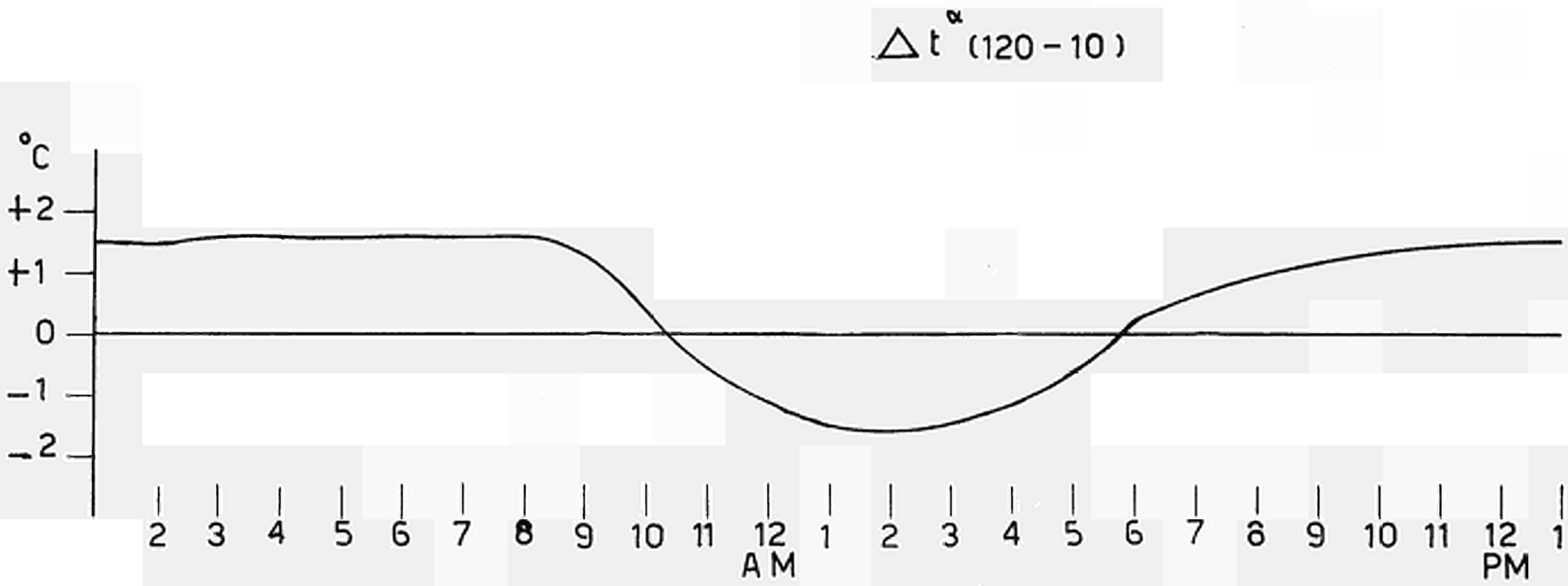


FIG. A. 9 - DAYLY VARIATION OF Δ t (from (Gandino)

TABLE A-13 - DAILY VARIATION OF 10 m LEVEL TEMPERATURE AND Δt AT 60 AND 120 m

Winter 1962-63

HOUR	t_{10}	Δt (60-10)	Δt (120-60)
1 A.M.	-2.0	+0.6	+0.4
2	-2.2	+0.3	+0.9
3	-2.5	+0.7	+0.7
4	-2.4	+0.5	+0.8
5	-2.7	+0.6	+0.7
6	-3.0	+0.5	+0.7
7	-2.9	+0.6	+0.8
8	-3.1	+0.5	+0.6
9	-2.6	+0.4	+0.2
10	-1.3	-0.5	-0.1
11	+0.3	-1.2	-0.1
NOON	+1.4	-1.4	0.0
1 P.M.	+2.2	-1.4	-0.2
2	+2.7	-1.4	-0.5
3	+2.9	-1.2	-0.2
4	+2.6	-0.9	-0.2
5	+1.5	-0.3	-0.4
6	+0.5	+0.1	-0.2
7	-0.4	+0.4	-0.1
8	-0.7	+0.7	0.0
9	-1.4	+0.8	-0.1
10	-1.7	+0.9	-0.1
11	-1.9	+0.7	+0.1
MIDNIGHT	-2.1	+0.8	+0.1

of pseudo-fumigation. This is better seen in fig. A.12 which represents the average thermic structure during winter 1962-63 for the first 120 m atmosphere at Ispra. The dashed isothermes are referred to inversion area. From the analysis of this graph it appears that in the interval between 2 and 4 P.M. there is possibility of atmospheric exchange among lower and upper layers.

4.6. - Lapse-rate in terms of wind speed

Then it is interesting to analyse the course of temperature difference frequency in the 120-60 m layer in terms of wind speed. In this paragraph too, as previously, the temperature difference for wind speed at 60 and 120 m have been considered. In Table A-14 are reported the frequency values.

For the "lapse" and "inversion" (moderate and strong inversion) conditions, the highest frequency is obtained in the class interval 0.1-2.0 m/s, considering the wind speed at 60 m; for the wind velocity at 120 m the highest frequency is obtained in the class interval 2.1-5.0 m/s. For the "neutral" condition, the highest frequency is obtained for both levels, in the 0.1-2.0 m/s class interval.

4.7. - Wind profile

The p-index has been calculated only between 30-60 m and 60-120 m levels following the usual formula $u/u_o = (z/z_o)^p$. Only positive values and $\neq 0$ of p have been considered.

4.7.1. - p-index frequency

The p-index frequency has been accepted for four class intervals (Table A-15).

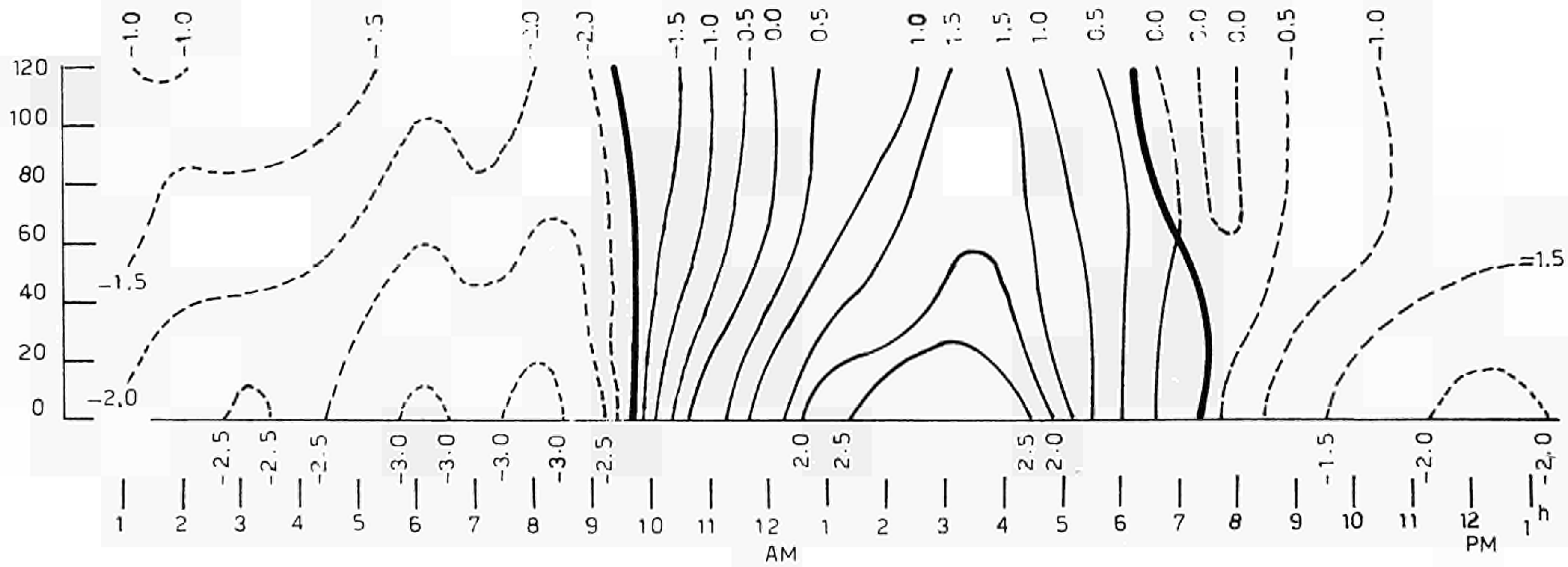


FIG. A-10 – AVERAGE THERMIC STRUCTURE

TABLE A-14 - Δ t FREQUENCY (%) BETWEEN 120 AND 60 m IN TERMS OF WIND SPEED INTERVAL CLASSES AT 60 AND 120 m LEVELS
Winter 1962-63

	LAPSE	NEUTRAL	INVERSION	
			Moderate	Strong
		60 m		
Calm	2.4	8.4	2.1	2.0
0.1 to 2.0 m/s	10.0	24.8	6.9	4.6
2.1 to 5.0	7.0	15.6	4.2	2.0
5.1 to 8.0	1.8	4.5	0.4	0.5
8.1 to 12.0	0.8	1.5	=	=
> 12.0	0.1	0.4	=	=
		120 m		
Calm	1.4	2.9	0.9	0.2
0.1 to 2.0 m/s	7.8	26.6	4.0	2.8
2.1 to 5.0	8.4	19.7	6.2	3.8
5.1 to 8.0	1.8	6.3	1.9	1.7
8.1 to 12.0	0.7	2.0	=	0.2
> 12.0	0.1	0.6	=	=

TABLE A-15 - p-INDEX FREQUENCY (%)
Winter 1962-63

CLASS INTERVAL	30-60 m	60-120 m
from 0.01 to 0.40	42.5	43.7
0.41 0.70	26.3	22.1
0.71 1.00	14.4	13.5
> 1.00	16.8	20.7

It is evident that the highest frequencies have been found in the first class interval for both layers.

4.7.2. - <u>p-index daily trend</u>

Fig. A-13 and A-14 show the p-index daily trend while the numerical values are reported in Table A-16 and A-17.

The broken lines represent the hourly trend of p while the continuous lines represent the 3-hourly mean trend. It is clear that the course of curves is regular enough, and in general terms may be said that the value of p increases after the sunset and decreases after the sunrise; therefore the two curves (30-60 and 60-120) are both of diurnal type. Particularly, the curve 30-60 (fig.A-11) presents a maximum value about midnight and a minimum value about 2 P.M.; the average curve 60-120 (fig.A-12) is also of diurnal type with a maximum value about 6 A.M. and a minimum value about 4 P.M.

Another peculiarity of these curves is that the decrease of p in the morning is steeper than the increase in the afternoon; evidently this pattern is related to the diurnal lapse-rate and turbulence changes.

The values of p are almost always highest at 60-120 m than at 30-60 m layer, except in afternoon (between 3 and 7) when this last is higher.

It has been calulated the correlation index for p values for the layers 30-60 and 60-120; it is +0.856 and the regression lines have a good alignment.

4.7.3. - <u>p-index in terms of wind speed</u>

Figures A-13 and A-14 show how the mean values of p-index (dashed lines) vary with wind speed at 30 m and 60 m.

The mean values of p show a general decrease by the increase of wind speed up to about 6 m/s, and then they remain relatively constant.

Since the p-index trend, in terms of u_o, resembles an hyperbole, have been calculated the coefficients by the method of least squares and the following equations have been obtained:

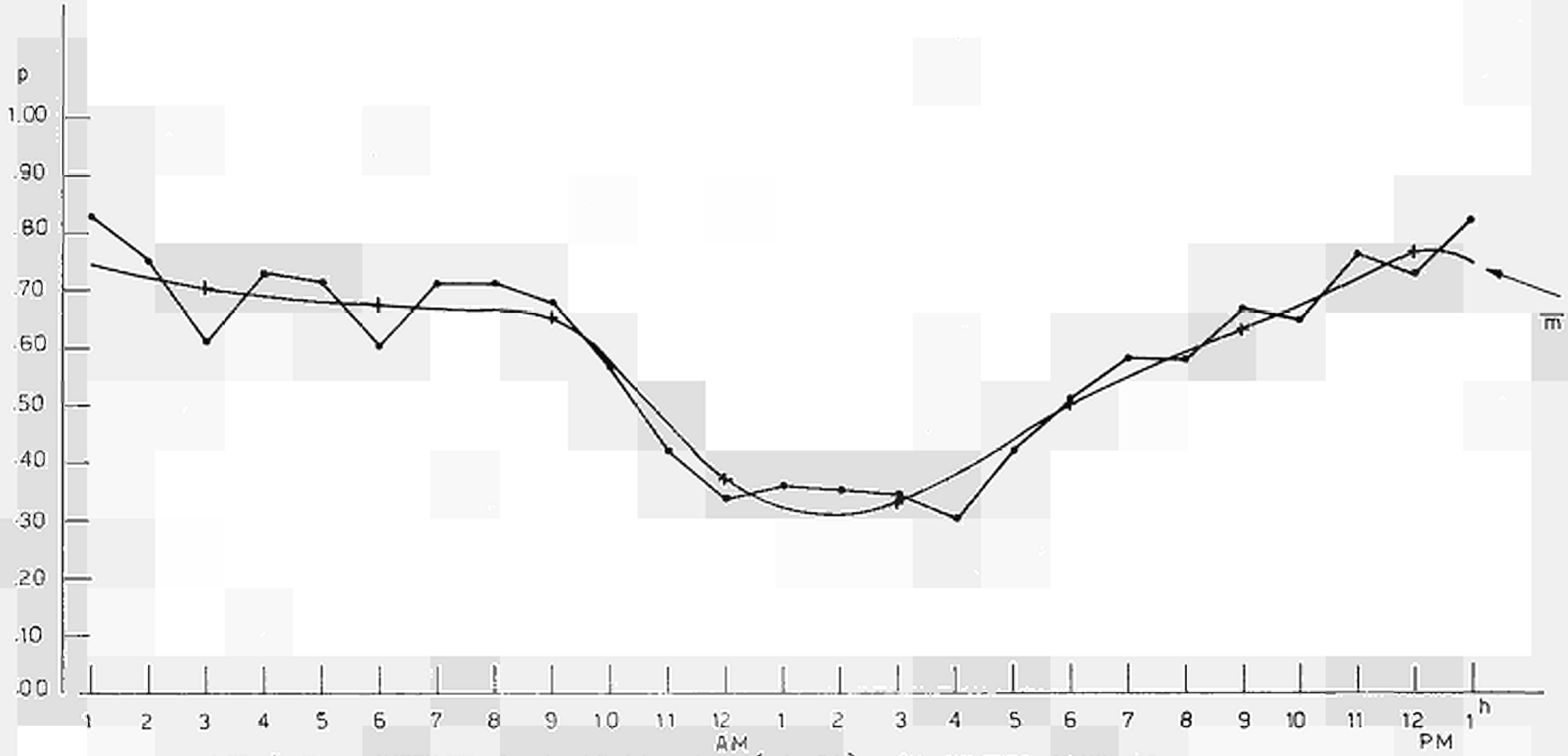


FIG. A-11 – AVERAGE DAILY COURSE OF p (30-60) IN WINTER 1962-63

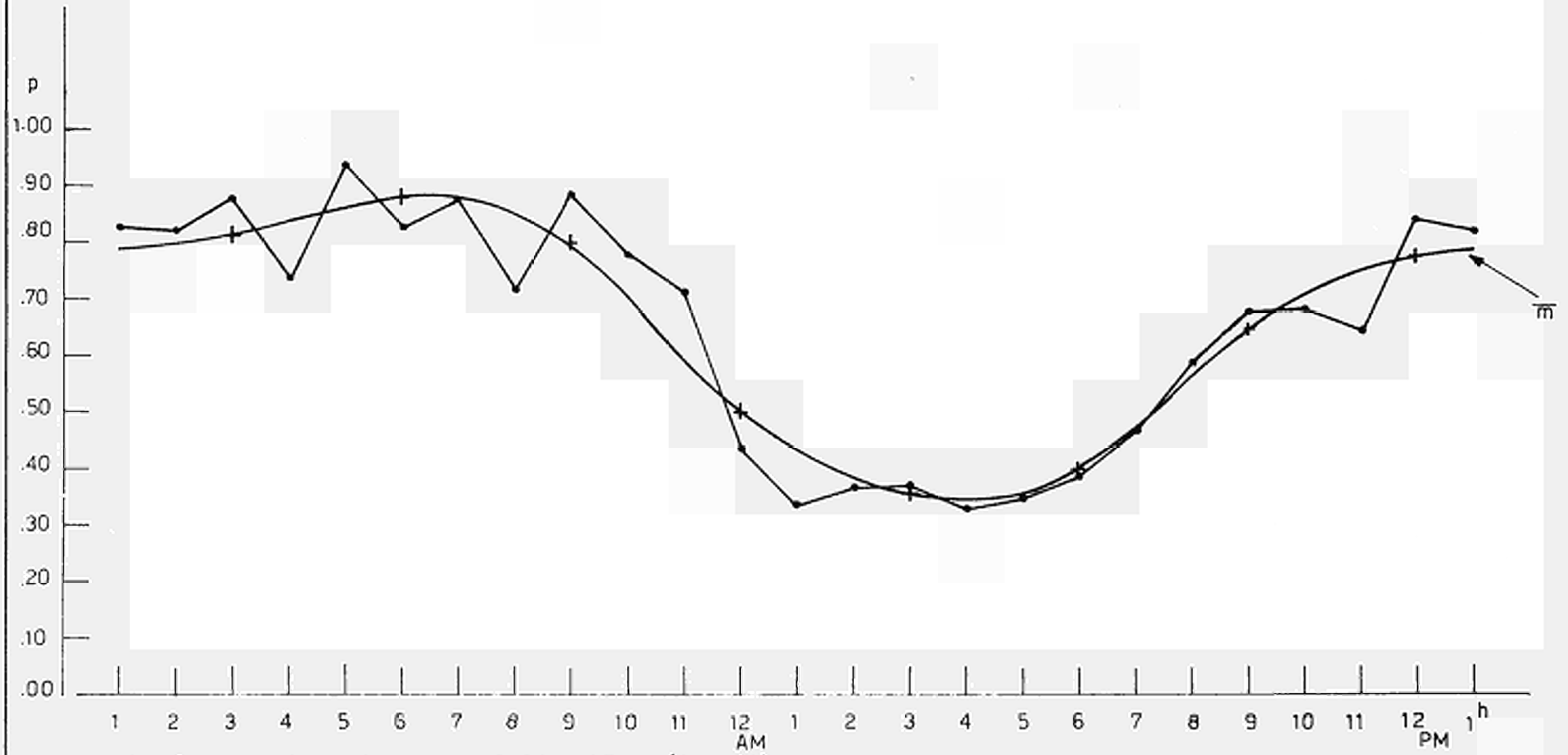


FIG. A-12- AVERAGE DAILY COURSE OF p (60-120) IN WINTER 1962-63

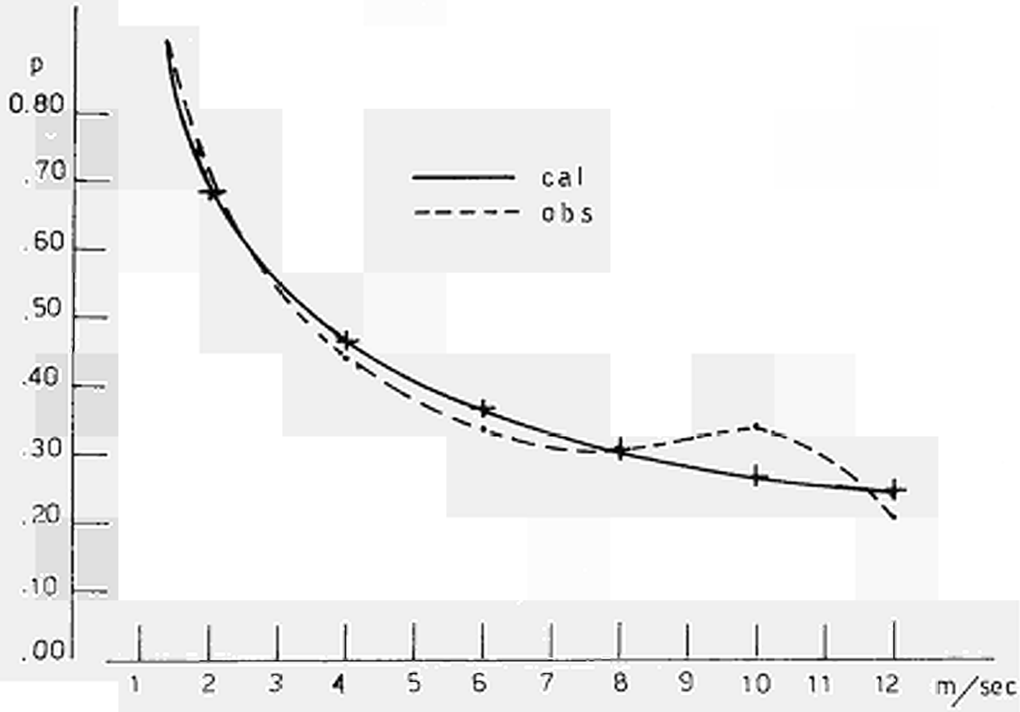


FIG. A.13 – "p" Vs "u" – (30–60 m)

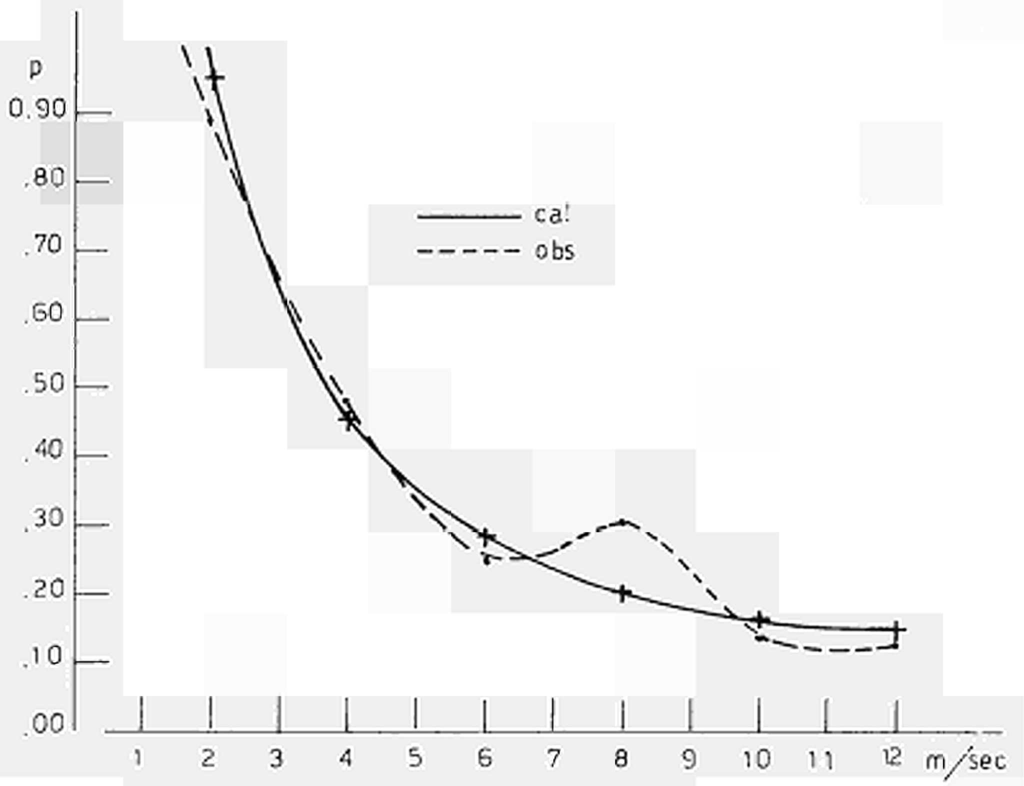


FIG. A.14 – "p" Vs "u" – (60–120m)

TABLE A-16 - p-INDEX DAILY COURSE
Winter 1962-63

HOUR	30-60	60-120	HOUR	30-60	60-120
1 A.M.	0.83	0.83	1 P.M.	0.36	0.34
2	0.75	0.82	2	0.35	0.37
3	0.61	0.88	3	0.34	0.37
4	0.73	0.74	4	0.30	0.33
5	0.71	0.94	5	0.42	0.35
6	0.60	0.83	6	0.51	0.39
7	0.71	0.88	7	0.58	0.47
8	0.71	0.72	8	0.58	0.59
9	0.68	0.89	9	0.67	0.68
10	0.57	0.78	10	0.65	0.69
11	0.42	0.71	11	0.76	0.65
NOON	0.34	0.44	MIDNIG.	0.58	0.65

TABLE A-17 - 3 HOURLY COURSE OF p-INDEX
Winter 1962-63

TIME	30-60	60-120	TIME	30-60	60-120
3 A.M.	0.70	0.81	3 P.M.	0.33	0.36
6	0.67	0.88	6	0.50	0.40
9	0.65	0.80	9	0.63	0.65
NOON	0.37	0.50	MIDNIG.	0.77	0.78

for 30-60 m $\quad y = 14.9\ x^{-0.5794}$

for 60-120 m $\quad y = 268.4\ x^{-1.0677}$

The values observed and calculated (continuous curve in fig. A-15 and A-16) are reported in Table A-18.

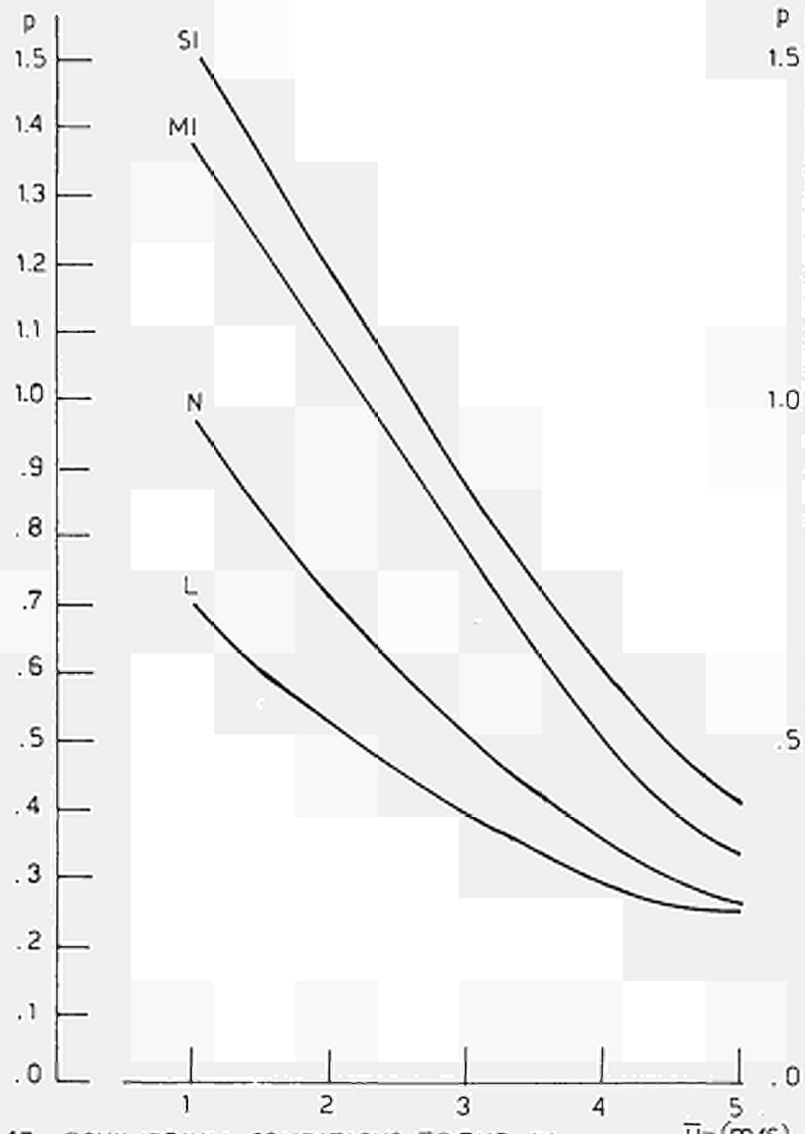


FIG. A.15 – EQUILIBRIUM CONDITIONS TREND IN TERMS OF p AND ū

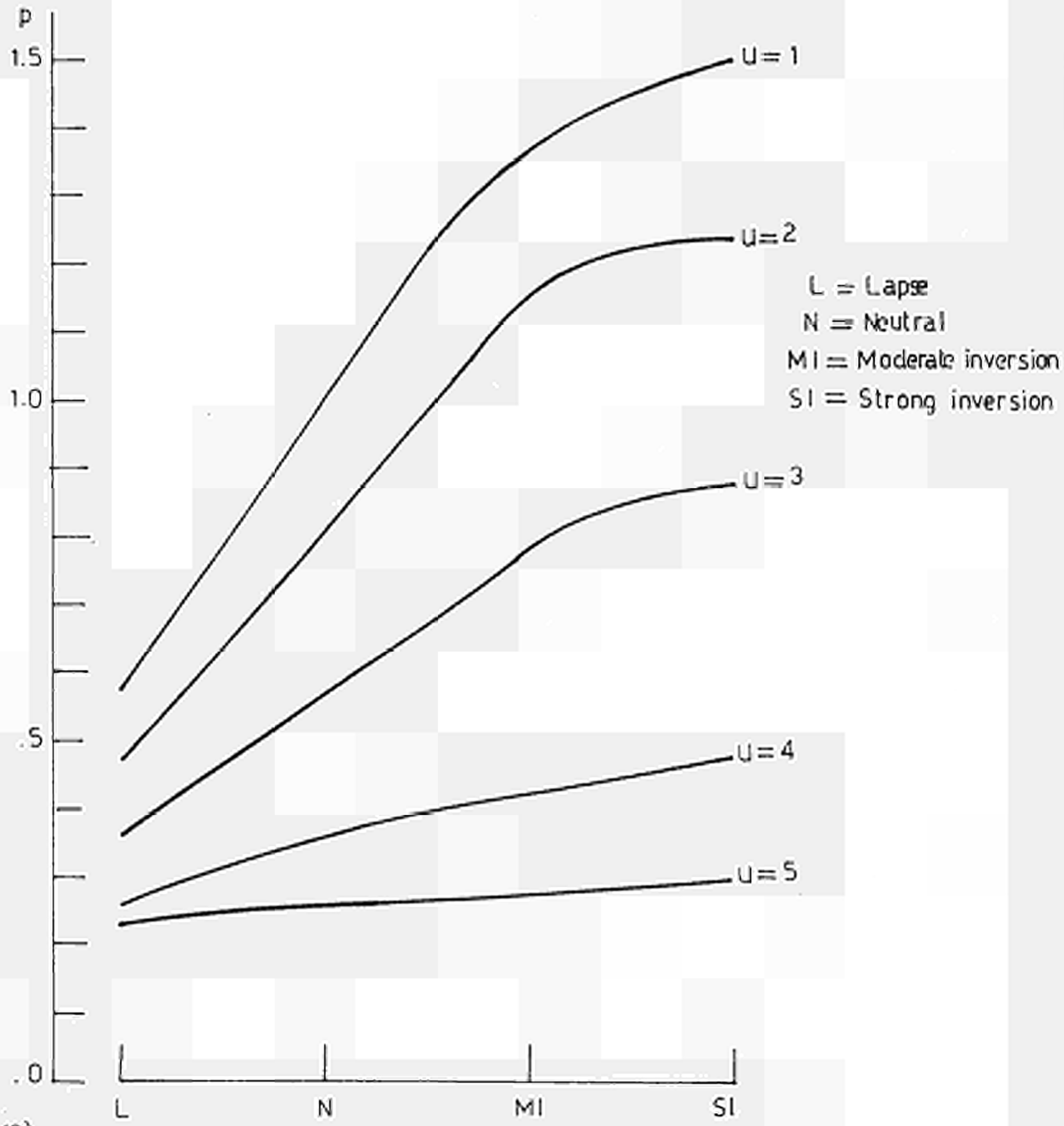


FIG. A.16 – WIND-SPEED TREND IN TERMS OF p AND EQUILIBRIUM CONDITIONS

TABLE A-18 - OBSERVED AND CALCULATED VALUES OF p-INDEX IN TERMS OF U
Winter 1962-63

U_o	30 - 60			60 - 120		
	O	C	O-C	O	C	O-C
2	0.71	0.69	+0.02	0.89	0.94	-0.05
4	0.44	0.46	-0.02	0.48	0.45	+0.03
6	0.34	0.37	-0.03	0.25	0.29	-0.04
8	0.31	0.31	0.00	0.31	0.21	+0.10
10	0.34	0.27	+0.07	0.14	0.17	-0.03
12	0.21	0.24	-0.03	0.13	0.14	-0.01

4.7.4. - Variation of p-index in terms of lapse-rate for the layer 60-120 m

Only the layer 60-120 m have been considered to calculate the variation of p-index in terms of lapse -rate; that because this layer is less troubled by orographic irregularities of the below ground.

Following the Sutton stability classification the mean values of p, in terms of atmospheric stability in winter 1962-63 at Ispra, are:

Lapse-rate	p	0.42
Isothermal or small lapse	p	0.62
Moderate inversion	p	1.02
Strong inversion	p	1.06

Actually it is appropriate this qualitative classification, based on a large numerical lapse-rate interval, rather than the quantitative because the data available are yet too few to permit this last type of analysis.

4.7.5. - Variation of p-index in terms of lapse-rate and wind speed for the layer 60-120 m

From data available the mean values of p-index in terms of lapse-rate and wind speed, only for the layer 60-120 m above the ground, have also been calculated. (Table A-19)

TABLE A-19 - p-INDEX IN TERMS OF WIND SPEED AND EQUILIBRIUM CONDITIONS
Winter 1962-63

EQUILIBRIUM CONDITIONS	WIND SPEED (m/s)					
	1	2	3	4	5	6
Lapse	0.56	0.59	0.41	0.26	0.25	0.21
Isothermal or small lapse	0.97	0.71	0.50	0.36	0.26	0.22
Moderate inversion	1.38	1.17	0.80	0.42	0.22	0.23
Strong inversion	1.49	1.18	0.87	0.49	0.16	0.22

Although the available data are few the course of p-index is good enough. For practical and orientative purposes two families of curves have been drawn: the first (fig. A-17) is the lapse-rate classification in terms of p-index and wind-speed classes; the second (fig. A-18) is the wind-speed curves in terms of p-index and lapse-rate classification.

From the fig. A-17 it is clear that all the curves tend to group as soon as the wind speed increases; while in fig. A-18 it is evident that the curves become flat just as the atmospheric equilibrium conditions from lapse-rate turn gradually into strong inversion.

From data available it is possible to conclude, in first approximation, that for wind-speed up to 5-6 m/s the discharge of effluents has to be controlled according to the actual meteorological conditions.

PART TWO

B-1 - ATMOSPHERIC BOUNDARY LAYER

1.1. - Boundary layer

In micrometeorological researches, especially in the case of the diffusion of gaseous effluents, it is necessary to know the mean thickness of the atmospheric boundary layer for the sites examined, on the purpose to establish, at least in an indicative way, the atmospheric tickness where the heat turbulent exchange with the ground below take place. This determination is the more interesting the more accentuated is the orographic variety of the ground itself.

For an area like Ispra, where the character of the ground has not a well defined scheme, this research would have a great importance, at least to have an idea of the geometry and of the dynamics of the air thickness that a gaseous radioactive cloud or puff might have to cross before reaching the free atmosphere.

As far as the atmospheric boundary layer thickness is concerned, two points-of-view are known. The first, proposed by Sutton, takes into consideration a surface boundary layer whose thickness reaches 50-100 m and where the wind structure is determined by the surface nature and by the temperature lapse-rate, and a region of transition (500-1000 m) between the surface boundary layer and the free atmosphere, where the wind structure is influenced by the surface friction, the density gradient and the Coriolis force. Those two layers determine the planetary boundary layer. The second point-of-view, proposed by Laiktham, considers a boundary layer that is supposed to reach also 1800m(Pavlovsk case),depending on the thermic influence of the active surface below, chiefly based, therefore, on the solar radiation flux variations. On the active surface there is a boundary under-layer where considerable lapse-rates of the meteorological elements are remarked.

As a matter of fact, the under-layer and the boundary layer thickness depend, first of all, on the character and aspect of the ground and on the density gradient variation which are comparatively remarkable especially at mean and low latitudes and on irregular grounds. Therefore the difference between the two definition is formal more than substantial.

The yearly mean ratio between the boundary under -layer and the boundary layer thickness is generally included from 1 to 10-12; this ratio falls down to 5 in January, 8 in April and July and 10 in October, in an open ground without obstacles. Though those figures are chiefly orientative, it is clear that the meteorologic tower of Ispra can be sufficient for the determination of the boundary under-layer, duly considering the parameter defining the roughness of the ground below.

For the determination of a boundary layer it is necessary at least the use of a captive balloon having the possibility to reach 800 m and permitting the following procedure, already experimented by the Author with summer radio-soundings at Linate, which can be considered an orientative datum for the Ispra area.

Taking into consideration the boundary layer of thermic nature, its thickness is function of the mean thermic diffusion degree and of the variations nature in the solar radiation flux, which can be considered as periodic oscillations. In other words, the boundary thermic layer thickness H depends on the thermic diffusion degree α^2 , and on the oscillation period τ The ratio between the layer thickness and those two variables is

$$H \sim \alpha \sqrt{\tau}$$

One of the method to determine the thermic boundary layer thickness is to consider the attenuation of temperature oscillation at different levels.

Considering the orographic configuration of the Po-Valley and of the meteorological situation characterized by persisting stability conditions, the summer period, when those conditions are restricted to the lowest layers and, for the most part, during the sunrise, has been chosen for the determinations.

The thermic fields of summer periods 1960-63 have been examined up to 3000 m above the ground level (station height: 104 m a.s.l.) and the temperature oscillations between 12 (GMT) and 00 (GMT) and those between 12 (GMT) and 12 (GMT) of the previous day.

The data have been taken at 200 m difference height, except the first, beyond the surface, taken at 100 m. A further division of the interval has not been considered necessary because, dealing with data taken from sounding-balloon ascensions, it has been preferred to remain as near as possible to the fixed isobaric surfaces and to the characteristic points.

From the analysis of the trend of the two curves it is possible to deduce that up to 600 m height the variation is rather steep (more remarkable, obviously, the 12 h variation): beyond those heights, oscillations become fairly constant.

Now, applying the thermic diffusion concept, it results that the thermic diffusion for a 600 m boundary thermic layer is:

$$4.17 \times 10^{\circ} m^2 \ sec^{-1} \qquad (\tau = 86400 \ sec)$$

As the thermic molecular air diffusion is:

$$\sim 2 \times 10^{-5} m^2 sec^{-1}$$

it results that in the boundary layer the heating transport take place following whirling and not molecular motions.

As already said, the atmospheric boundary layer has also its own dynamic nature determined by the inferior layer of the air current on the ground surface.

Considering the aim of the research and the fact that it is led with the elements of one station, only the wind speeds have been considered because the direction is essential only for researches on a large scale.

The most remarkable oscillations take place in both cases, at 600 m layer.

Summing up: the atmospheric boundary layer, both termic and dynamic, of the Linate area may be considered at 600 m, i.e. when the lapse-rate begins to become constant and the wind gradient is near zero (calculated only for 12 (GMT)).

1.2. - Incidence of buildings on the under-boundary layer

It is well-known that the C.C.R. area at Ispra is divided into different sectors having each its own function. The two more interesting sectore for this report are those indicated by the numbers I and VI on the C.C.R. planimetry, which are respectively the reactors and the hot materials sectors. Those two areas are placed near the little hills round the eastern part of the C.C.R.

The thermic stability layer forming more frequently and persistently in winter than in the other seasons, may present in those two sectors, a certain mixing due to the effect of the drainage currents which can happen during the night and sometimes also during the morning. But given the vertical dimension of the obstacles and, above all, their slope (not very accentuated), those currents, on the whole, are not supposed to be very remarkable. But they are supposed to be able to influence the boundary under-layer, where instability conditions may happen, while the boundary layer immediately above would remain untouched.

But the Center is now developing and therefore susceptible of new buildings which will facilitate even more the turbulence of the under-layer. However this event is not favourable from the diffusion point-of-view, because the existence of a turbulent layer under a less turbulent or laminar layer could easily bring to the fumigation phenomenon.

Of course this speech is valid only for an eventual uncontrolled waste of the reactor building and not for the stack release.

However, in the future development plan of the Center it is not advisable to increase the number of buildings on the hills to the north, east and south because there would be great difficulties also owing to forced uncontrolled wastes of the reactor stack.

B-2 - ACTIVE GASEOUS EFFLUENTS

Here below are reported the news supplied by the Ispra C.C.R. pertinent to the reactor operations and the quantity (c/sec) of radionuclide emitted by the reactor stack.

2.1. - Gaseous wastes

During reactor operation active gaseous effluents are continuously or discontinuously released chiefly from the following installation of the ESSOR plant:

- organic circuits
- D_2O circuits
- exhausting system of the airspace around the reactor
- fuel handling installations.

These activities cause a certain ground level concentration which, generally, must be lower than the maximum tolerable limits. Because this ground contamination will be calculated in the hazards analysis, the activities are given in detail in the following paragraphs.

2.2. - Gaseous activities of the organic circuits

The radioactivity in the organic circuits and the off-gas system has been calculated in the document ad hoc for the different kinds of reactor operation.

The experiences of Atomics International with the OMRE show that no iodines will enter the off-gas system; they are retained by the degasifying system.

Only H3, C14 and the noble gases are present. In the tables below always the activities before and behind the adsorption columns of the off-gas system are given. The adsorption columns are filled with charcoal which is delaying the Kripton - and Xenon - isotopes with 7 and 28 days.

Two kinds of activities have to be respected, "peak" and "saturation". The "peak" activity is the one directly after an element failure. This activity is slowly changing over to the "saturation" activity. With the existing layout of the purification and degasifying system the saturation activity for the noble gases is reached nearly 1 day after the failure. The activity flow is given in Table B-1.

TABLE B-1 - OPERATION WITH ONE FUEL ROD DEFECT

	BEFORE THE ADSORPTION COLUMN		AFTER THE ADSORPTION COLUMN (stack inlet)	
	Peak (c/sec)	Saturation (c/sec)	Peak (c/sec)	Saturation (c/sec)
Kr 85	3.1 (-6)	4.65 (-11)	3.1 (-6)	4.65 (-11)
Kr 85 m	1.54 (-5)	3.5 (- 6)	=	=
Kr 87	1.54 (-5)	8. (- 6)	=	=
Kr 88	3.3 (-5)	1.08 (- 5)	=	=
Kr 89	5.7 (-6)	5.6 (- 6)	=	=
Xe 133 m	6.4 (-6)	1.54 (- 7)	1.35 (-9)	3.2 (-11)
Xe 133	5.73 (-4)	6.1 (- 6)	1.52 (-5)	1.6 (- 7)
Xe 135 m	3.1 (-5)	2.6 (- 5)	=	=
Xe 135	1.68 (-4)	2.2 (- 5)	=	=
Xe 137	8.5 (-6)	8.1 (- 6)	=	=
Xe 138	1.6 (-5)	1.33 (- 5)	=	=

2.2.1 - Normal operation

During normal operation only the radionuclids H_3 and C_{14} are escaping via the off-gas system into the stack.

2.2.2. - Destructive test with one Orgel-element (exceptional operation)

It is assumed in this case that the halogens and noble gases of 10% of one Orgel-element are released into the coolant.

The activity flow in the off-gas system is listed in Table B-2.

TABLE B-2 - DESTRUCTIVE TEST WITH ONE ORGEL-ELEMENT

	BEFORE THE ADSORPTION COLUMN		AFTER THE ADSORPTION COLUMN (stack inlet)	
	Peak (c/sec)	Saturation (c/sec)	Peak (c/sec)	Saturation (c/sec)
Kr 85	1.15 (-3)	1.64 (-8)	1.15 (-3)	1.64 (-8)
Xe 133 m	2.1 (-2)	5.1 (-4)	4.4 (-6)	1.07 (-7)
Xe 133	8.7 (-1)	9.16 (-3)	2.3 (-2)	2.43 (-4)

2.2.3. - <u>Melting of an Orgel-element without pressure tube rupture</u>

Correspondingly to the philosophy used for the layout of the shielding of the differente loops, it is assumed that 100% of the halogenes and noble gases and 10% of the solid products are released into the corresponding organic circuit.

The activity flow in the off-gas system is given in Table B-3 for the two following kinds of operation:

a) purification of the coolant during 24 h and there after distillation of the coolant into the storage tank;

b) decay of the coolant activity during 10 hours and thereafter distillation into the storage tank.

The columns two and four of Table B-3 show the activity flow in the off-gas system for operation a) at the beginning and at the end of the purification, while the column 3 shows the activity for operation b) at the beginning of the distillation.

TABLE B-3 - MELTING OF AN ORGEL-ELEMENT WITHOUT PRESSURE TUBE RUPTURE (Behind the adsorption column)

	0^h		10^h		24^h	
Kr 85	1.2	(-2)	2.2	(-4)	6.5	(- 8)
Xe 135 m	4.5	(-5)	7.5	(-7)	1.8	(-10)
Xe 133	2.25	(-1)	4.45	(-3)	1.15	(- 6)

2.2.4 - Melting of an Orgel-element after rupture of a pressure tube

In most cases melting of an element will be originated by pressure tube rupture. The fission gases (100% noble gases, 50% iodines), are collected in the condensor, from where they have to be evacuated via the off-gas system.

To avoid boiling of the D_2O in the condenser the gas of the condenser is not completely evacuated. When a vacuum of 0.15 Kg/cm^2 is reached the condenser is filled with N_2 and evacuated again. Both operation will be repeated three times. The first evacuation can be done in approximately 2½ days. Without respecting the time necessary for filling the condenser with N_2 most of the activity can be released in 5½ days. The activity flow at the beginning (0.1 d) and at the end (2.5 d) of the first evacuation are listed in Table B-4.

TABLE B-4 - MELTING OF AN ORGEL-ELEMENT AFTER RUPTURE OF A PRESSURE TUBE (Behind the adsorption column)

	0.1 d	2y d
Kr 85 m	3.55 (-5)	=
Kr 85	3.44 (-4)	2.6 (- 5)
Kr 88	1.57 (-6)	=
Xe 133 m	1.9 (-9)	1.25(-10)
Xe 133	4.05 (-4)	2.65(- 5)

B.3 - ATMOSPHERIC DIFFUSION

3.1. - Generalities

In this paragraph are treated all the subjects pertinent to the atmospheric diffusion of the already mentioned radionuclides.

First of all the more suitable height of the reactor stack will be treated, then the values of the radioactive decay will be shown for each radionuclide, afterwards tables will show the atmospheric concentrations values for each operation treated in the paragraph B.2, besides a description of how the dispersion trajectory is modified by the presence of topographic discontinuity will follow, and finally a theoretic discussion on the shear of the wind direction.

3.2. - Stack height

It is well-known that a well designed stack is a safe and easy way to dispose of waste gases and vapors; but it is also well-known that the atmosphere capacity to disperse and diffuse effluent materials varies widely according to the weather conditions.

Usually when it is considered the problem of atmospheric dilution of stack gases it must also be considered(1) the mechanical eddies generated by terrain and structures in the immediate vicinity of the stack, (2) the buoyancy and jet effects associated with the stack gas emission and (3) the diffusion of polluents through natural turbulence in the atmosphere.

The three points-of-view are functions, partially or fully, of wind direction, of wind speed, of mechanical and thermic turbulence and of wind-shear.

Now these meteorological conditions in Ispra area are not excellent, as seen, for a quick dilution of effluents, especially during the winter season:

high frequency of calm and light winds, and low frequency of lapse conditions in the atmospheric equilibrium.

For this reason, it is our opinion that the emission of gases from stack must be of the jet type; it is well-known that this type carries the gases above the stack top and so the effective stack height is higher than the construction stack height; in other words, the height of rise of the effluent above stack top depends upon the effectiveness of atmospheric turbulence in dissipating the vertical momentum of the stack gases.

The flow rate of stack is expected to be 152.000 m^3/h at conditionned ambient temperature (18°C).

In fig. B-1 it has been drawn a curve in terms of various diameter length and respectively stack velocities for a flow rate of 152.000 m^3/h.

Actually there are fifteen techniques at least for the effective stack height calculations. Among these various techniques they have been selected the Davidson-Bryant's and Bosanquet's ones because these methods don't take into account of the atmospheric equilibrium conditions and therefore they are one another comparable.

It is current opinion that the Davidson-Bryant's technique is the preferable because is the simplest to apply and the most conservative because the values it gives are lower than the real values, at least for low wind velocities.

The Davidson-Bryant formula is:

$$\Delta h = d \left(\frac{V_s}{U}\right)^{1.4} \left(1 + \frac{\Delta T}{T}\right)$$

The Bosanquet formula when the density of the effluent is less than the atmosphere at the point

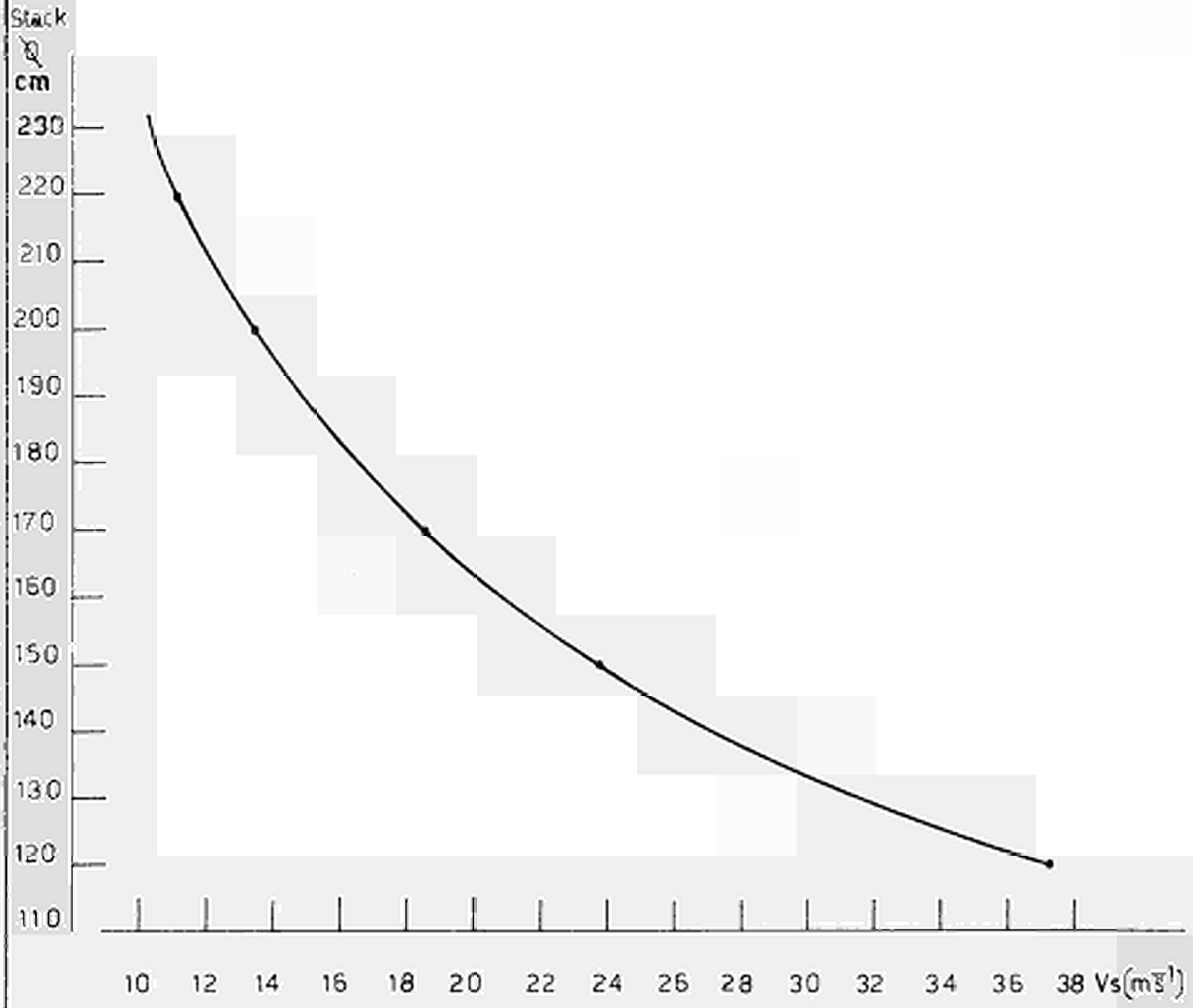


FIG. B-1 - FLOW RATE OF STACK 152000 $m^3 h^{-1}$

of emission, is

$$\Delta h = AU \left\{ f_I (X) + f_{II} (X_o) - \frac{0.615 X_o^{\frac{1}{2}}}{\left[(\frac{V_s}{U})^2 + 0.57 \right]^{\frac{1}{2}}} \right\}$$

where:

A is a parameter with the dimension of time,

d is the inside diameter of stack,

Δ h is the computed rise of plume center line above the stack,

T is the ambient air temperature, °K,

Δ T is the temperature excess of effluent gas over ambient air, °K,

U is the mean horizontal wind speed,

V_s is the mean stack effluent velocity

X and X_o are non dimensionable variables.

(For A, X and X_o formulas see Moses, Strom and Carson, 1964)

At values of Δh calculated with the Bosanquet formula it has been applied the Stümke empirical factor of correction equal to 0.75. It has not been applied the correction factors to the Davidson-Bryant values of Δ h because these are very different from an Author (Moses and Strom) to another one (Stümke) while the correction factor for Bosanquet formula has always the same numerical value.

The values of stack velocity in terms of d inside stack diameter (°), for a flow rate of 152.000 m^3/h are the following:

d (m)	V_s (m/s)
1.90	14.7
2.10	12.1
2.30	10.2

The temperature of effluent gas is considered to

(°) - The values of inside stack diameter have been supplied by Euratom C.C.R. - Ispra.

be nearly 18°C. For the values 0°C and 20°C of ambient temperature and for different wind-speed (1, 2, 3, 4, 5, 8 and 12 m/s) the following Table B-5 is obtained:

TABLE B-5 - RISE OF PLUME (in m) ABOVE THE STACK FOR THE INSIDE STACK DIAMETER 1.90, 2.10 AND 2.30 m

U m/s	T = 0°C						T = 20°C					
	1.90		2.10		2.30		1.90		2.10		2.30	
	DB	Bo	DB	Bo	DB	Bo	DB	Bo	DB	Bo	DB	Bo
1	88	91	77	84	65	75	82	83	72	76	60	69
2	33	42	29	38	25	34	31	28	22	29	22	29
3	19	26	17	23	14	21	18	34	15	4	13	4
4	13	18	11	16	9	15	11	-4	10	-3	8	-3
5	9	14	8	12	6	11	9	-7	8	-6	6	-5
8	4	2	3	2	3	2	4	-12	3	-11	3	-9
12	2	-2	2	-2	2	-2	2	-17	2	-15	2	-13

N.B. - DB = Values calculated by Davidson-Bryant formula
Bo = Values calculated by Bosanquet formula

reproducing the course of rise of the plume above the stack in terms of inside stack diameter and of wind speed. From this table it is clear that for wind speed above 5 m/s and for reasonable values of V_s it does not exist a problem for ambient temperature; as well as when the wind speed is above 8 m/s the effective and the construction heights of stack pratically coincide. In the fig. B-2 are reported the values of ΔH (m) in terms of wind speed (ambient temperature = 0°C) and for two inside stack diameters (1.90 and 2.30 m).

In the Table B-6 are included the values of effective heights for the same parameter of Table B-1.

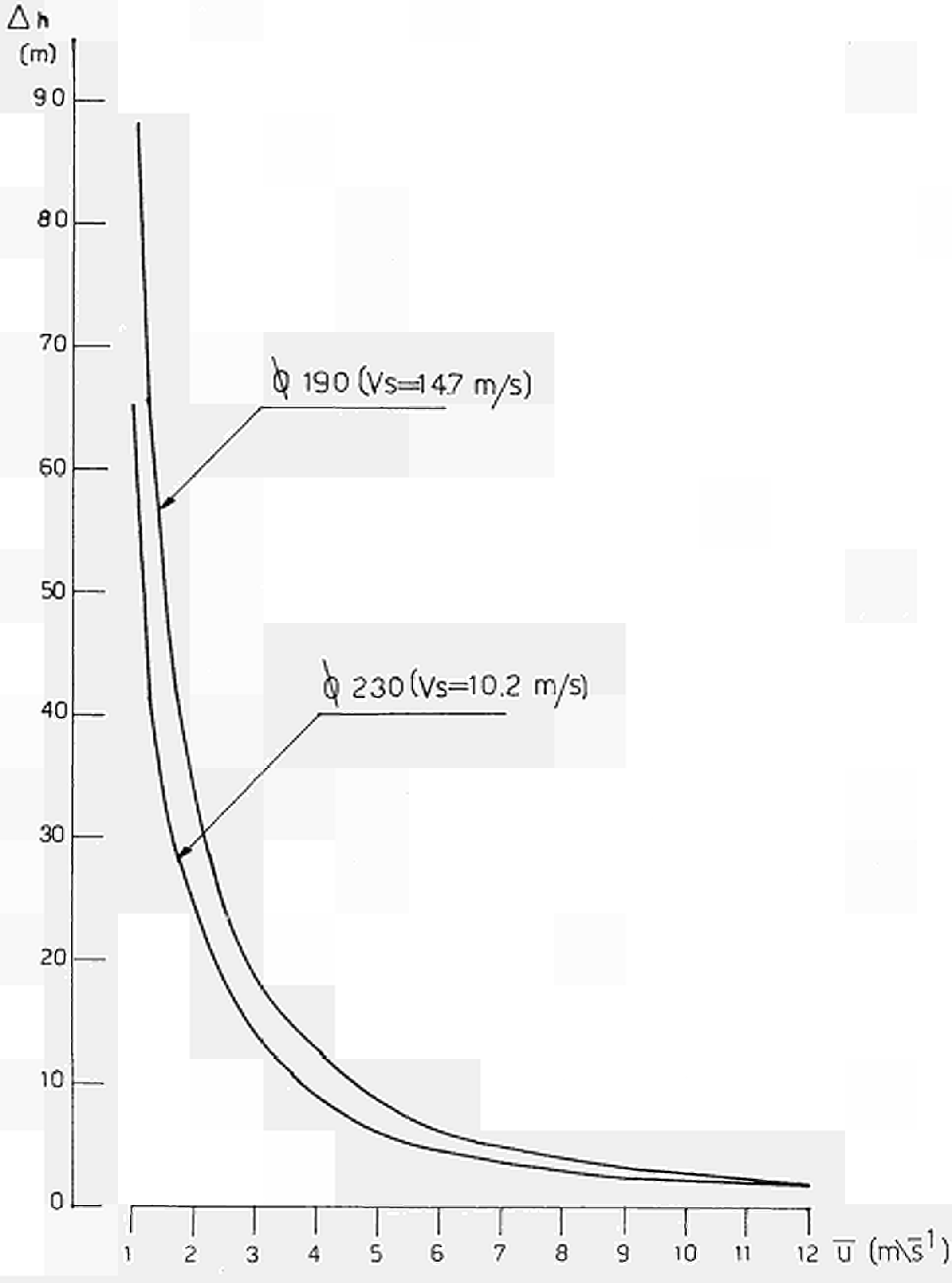


FIG. B-2 - TREND OF PLUME RISE FOR STACK DIAMETER 190 AND 230 cm IN TERMS OF Vs AND u (t = 0°C / t = 20°C)

TABLE B-6 - EFFECTIVE HEIGHT(in m) FOR CONSTRUCTION HEIGHT = 90 m

U m/s	T = 0°C						T = 20°C					
	1.90		2.10		2.30		1.90		2.10		2.30	
	DB	Bo	DB	Bo	DB	Bo	DB	Bo	DB	Bo	DB	Bo
1	178	181	167	174	155	165	172	173	162	166	150	159
2	123	132	119	128	115	124	121	118	112	119	112	119
3	109	116	107	113	104	111	108	93	105	94	103	94
4	103	108	101	106	99	105	101	86	100	87	98	87
5	99	104	98	102	96	101	99	83	98	84	96	85
8	94	92	93	92	93	92	94	78	93	79	93	81
12	92	88	92	88	92	88	92	73	92	75	92	77

DB = following Davidson - Bryant
Bo = following Bosanquet

Now if it is considered that the construction height of stack was 90 m, in winter 1962-63 the effective height would have coincided with the construction height, for 3.9% (wind speed $\gtrsim$ 8.1 m/s at 120 m).

At these velocities the problem of diffusion, in terms of wind-speed, is almost negligible, but it must not be forgetten that for 38.9% (wind speed from to 2.1 to 5.0 m/s at 120 m) the difference between the effective and the construction height is rather low.

3.3. - Radioactive decay values

The λ (sec^{-1}) values, calculated for the half-lives by the Trilinear Chart of Nuclides of the USAEC, are the following:

Kr 85 m	4.3 (-5)
Kr 85	2.1 (-9)
Kr 87	1.5 (-4)
Kr 88	6.9 (-5)

Kr 89	3.6 (-3)
Xe 133 m	3.5 (-6)
Xe 133	1.5 (-6)
Xe 135 m	7.3 (-4)
Xe 135	2.1 (-5)
Xe 137	3.0 (-3)
Xe 138	6.9 (-4)

3.4. - Concentration values

3.4.1. - Criteria used in the calculation of concentration

For the calculation of the concentration values it has been considered suitable to adopt the Gifford atmospheric model because, for the moment, it gives the most reliable values basing its coefficients on the practically experiment.

Of course the values calculated with the formulae in use (the Gifford's included) cannot be taken literally, in that they are based on the presupposition that the ground surface is smooth and homogeneous and that the micro and mesometeorological conditions are constant. In reality, lacking the first, the second condition has very little possibility to happen.

If, at Ispra, the ground surface is not smooth nor homogeneous in the physical and mechanical structure and the baric field is levelled, the trend of meteorological conditions (atmospheric equilibrium and wind) feels in a very accentuated way, foreseeable only after many years experience and local research, the topographic and orographic panorama. This point will be more widely treated in the conclusive paragraph.

The Gifford formula for Gaussian plume is:

$$\bar{\chi} = \frac{Q}{\pi \sigma_y \sigma_z \bar{u}} \exp\left[-\frac{1}{2}\left(\frac{y^2}{\sigma_y^2} + \frac{h^2}{\sigma_z^2}\right)\right]$$

where

$\bar{\chi}$ = concentration at ground (curie m^{-3})

Q = source intensity (curie sec^{-1})

$\bar{u}$ = wind speed ($m\ sec^{-1}$)

y = cross-wind distance as measured from the central line

h = height of release above ground level (m)

σ_y, σ_z = dispersion coefficients (m^2)

In the case of fumigation the formula used is:

$$\chi_F = \frac{Q}{(2\pi)^{1/2} \sigma_y \bar{u} H}$$

where the values for neutral concentration are given to σ_y , and H is the height (in m) above the ground of the inversion base.

To both the formulae have been brought the corrections for the radioactive decay, i.e.

$$\chi = \bar{\chi} \exp(-\lambda \frac{x_0}{u})$$

where λ is the constant of radioactive decay (sec^{-1}) (par. 3.3.) and x_0 is the leeward radial distance.

3.4.2. - <u>Meteorological parameters</u>

Four cases of atmospheric equilibrium have been considered:

- lapse
- neutral (D)
- moderate inversion (E)
- strong inversion (F)

The letters in brackets following the different equilibrium conditions correspond to the well-known category established by Pasquill. In this report the two categories (A and B) have not been considered in that rarely the atmospheric equilibrium at Ispra may reach such an excessive degree of instability.

The values of the vertical and horizontal dispersion coefficients, σ_y and σ_z , are respectively those calculated by Gifford and reported, for each equilibrium degree, in the families of curves in figures B-3 and B-4 and in the Table B-7.

The wind mean velocity is 2 m/s except for the case of fumigation where has been preferred the value of 1 m/s.

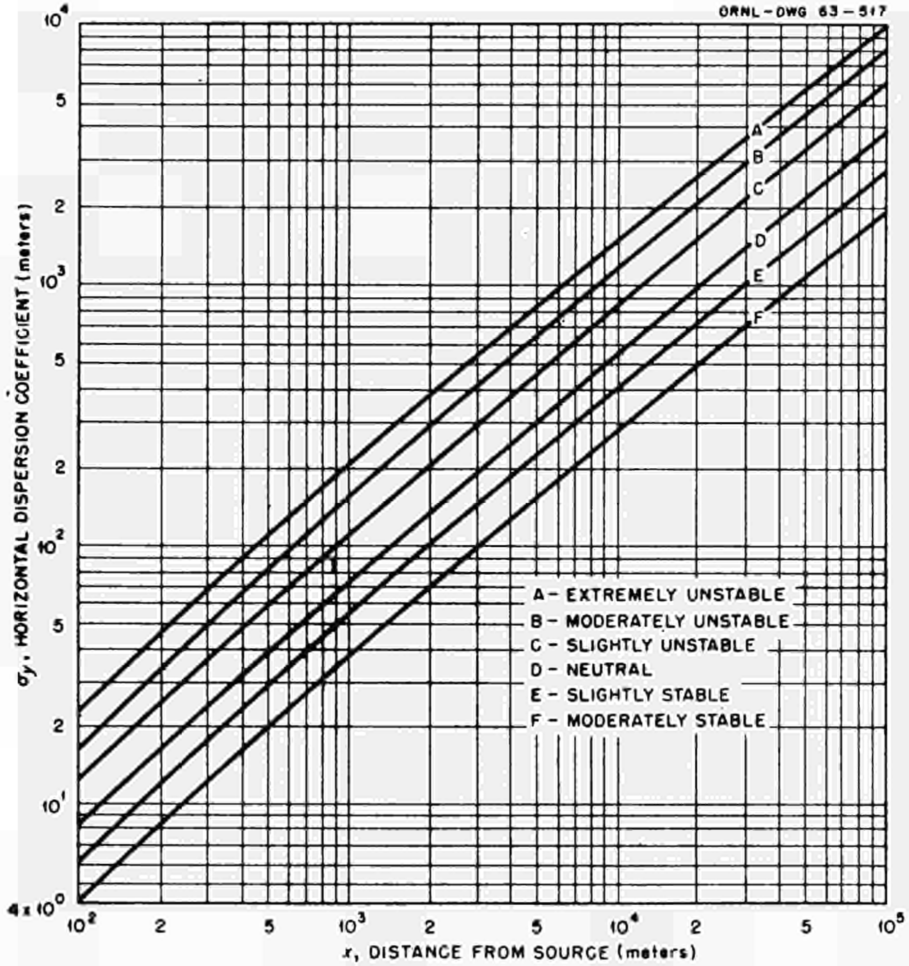


FIGURE B-3

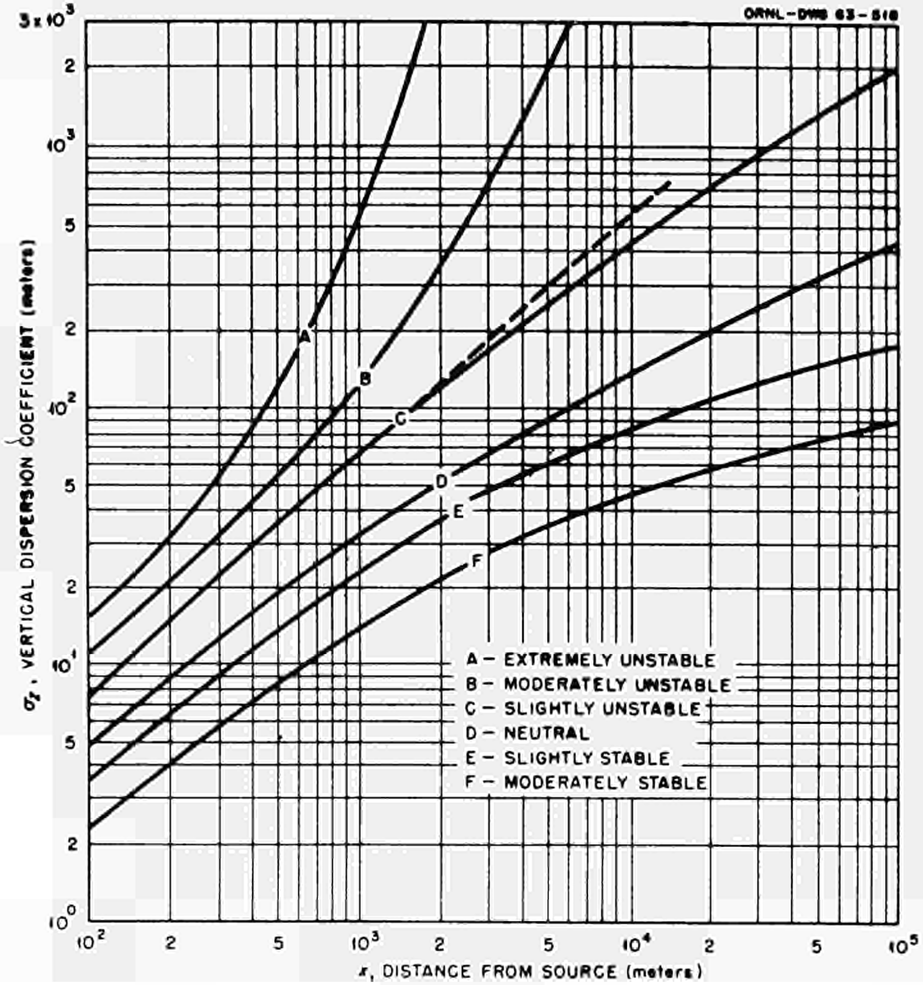


FIGURE B.4

TABLE B-7 - NUMERICAL VALUES OF Y AND DISPERSION COEFFICIENTS

X_o	LARGE LAPSE			ISOTHERMAL OR SMALL LAPSE		
	y	σ_y	σ_z	y	σ_y	σ_z
(Km)	(m)	(m^2)	(m^2)	(m)	(m^2)	(m^2)
0.5	1.8(2)	6.0(1)	3.6(1)	1.2(2)	3.9(1)	1.9 (1)
0.6	2.1	7.0	4.3	1.4	4.6	2.2
0.7	2.4	8.1	4.9	1.6	5.3	2.5
0.8	2.8	9.2	5.5	1.8	6.0	2.7
0.9	3.0	1.0(2)	6.0	2.0	6.7	3.0
1.0	3.8	1.25	6.9	2.2	7.3	3.3
2.0	6.3	2.1	1.3(2)	4.2	1.4(2)	5.1
3.0	9.0	3.0	1.8	6.0	2.0	6.7
4.0	1.1(3)	3.8	2.3	7.8	2.6	8.1
5.0	1.4	4.6	2.5	9.3	3.1	9.1
6.0	1.7	5.5	2.9	1.1(3)	3.7	1.03(2)
7.0	1.9	6.3	3.3	1.26	4.2	1.1
8.0	2.1	7.0	3.6	1.4	4.7	1.2
9.0	2.3	7.8	4.0	1.5	5.2	1.3
10.0	2.7	8.6	4.3	1.7	5.7	1.4
20.0	4.8	1.6(3)	6.2	3.0	9.9	2.0

X_o	MODERATE INVERSION			STRONG INVERSION		
	y	σ_y	σ_z	y	σ_y	σ_z
(Km)	(m)	(m^2)	(m^2)	(m)	(m^2)	(m^2)
0.5	8.7(1)	2.9(1)	1.4(1)	6.0(1)	2.0(1)	8.8(0)
0.6	1.1(2)	3.5	1.6	6.9	2.3	9.8
0.7	1.2	4.0	1.8	8.4	2.8	1.1(1)
0.8	1.4	4.5	1.9	9.6	3.2	1.2
0.9	1.5	5.0	2.2	1.0(2)	3.5	1.3
1.0	1.7	5.6	2.4	1.17	3.9	1.45
2.0	3.2	1.05(2)	3.8	2.3	7.6	2.2
3.0	4.8	1.6	4.8	3.0	1.0(2)	2.8
4.0	5.7	1.9	5.5	4.2	1.4	3.3
5.0	6.9	2.3	6.0	4.8	1.6	3.6
6.0	8.1	2.7	6.6	5.4	1.8	3.8
7.0	9.0	3.0	7.0	6.3	2.1	4.0
8.0	1.0(3)	3.4	7.5	7.2	2.4	4.2
9.0	1.1	3.7	8.0	7.8	2.6	4.4
10.0	1.2	4.1	8.5	8.4	2.8	4.7
20.0	2.2	7.3	1.2(2)	1.5(3)	5.0	5.8

NOTE - The figures in clams must be considered the exponents of 10 -

The height of the inversion on the ground (H) is 150 and 200 m, except for some particular operations (melting of an Orgel element without rupture and after rupture of a pressure tube) where the height of the inversion on the ground has been valued at 30 m.

3.4.3. - Release height

For each diffusion calculation have been considered two effective release heights: 100 and 150 m, except for the fumigation.

3.4.4. - Diffusion tables

In appendix of this report a suitable number of tables include the values of the concentrations.
It must be pointed out that, contrary to the greatest part of Hazard Reports, concentrations have been calculated up to a maximum distance of 20 Km from the stack. This limit has been imposed by the orographic conditions of the area where the reactor stack is placed and the adjacent area.

In fact, unless it is question of air currents of a certain importance for which the diffusion calculation has no more a practical meaning, it is very unlikely, if not impossible, that weak winds might keep a certain constancy in direction, intensity and structure in the atmospheric boundary layer, when it is well-known that those currents feel very much the aspect of the ground below. This is also the reason why it has not been considered suitable to enrich this report with data concerning both the geometry and the dosage calculation of radioactive clouds and puffs, in that a few moments after their settlement they are deformed by the thermic and dynamic field of the area.

But there is another reason that makes useless a deepening and an extension of diffusion preliminary calculations, i.e. the effect of wind direction shear on the diffusion itself. In fact, also on a flat ground, a cloud or a puff (which have the idealized shape of an ellipse on two main axis, whose dimensions vary continually) is deformed in the upper part turning to the right and in the lower part turning to the left. This effect is caused by the systematic turning of wind with height that will translate the different horizontal slices relative to each other without causing appreciable enhanced dilution unless the mixing is fairly vigorous. The consequencies on concentration, due to this deformation,are very clear and don't need any explanation.

Now, in calculations, it is necessary to suppose that the systematic turning of the wind with height is constant. If this approximation is possible in a flat ground, it is not possible in a ground orographically non-homogeneous in that many factors modify the wind -shear in the atmospheric boundary layer.

3.4.5. - Influence of topographic discontinuities on the diffusion

In the previous paragraph have already been pointed out the orographic and meteorological reasons limiting the validity of the concentrations values calculated.

The location of Ispra, also as regards the hydrography of the region, must not be forgotten. The C.C.R. is placed among three lakes very near it: one large from one side, two smaller from the other side. The influence of the Lake Maggiore has already been treated in chapter A.1; but the influence of the smaller lakes must not be disregarded because, generally, they determine, especially during the summer, an unfavourable situation due to the active evaporation that brings a lot of humidity in the low layers, particularly in absence of wind. But, apart from those considerations, the incidence of the ground aspect on clouds or on radioactive puffs behaviour is remarkable. In fact it is not necessary to use special experience (in that they are data already obtained for other similar sites) to make sure that clouds or puffs flowing in the direction of the solid surface will act very differently from those flowing towards the lakes. In the first case clouds and puffs have the precise tendency to follow the topography.

To obtain a rather exact panorama of the situation under different forms of atmospheric equilibrium (the three equilibrium states would be enough) it is necessary to increase the number of stations monitoring (one for every 30° sector at the most), if they don't already exist, also in the area of the circular crown near the C.C.R. In that case, for the calculation of the dispersion, the current averages method could be used. As it is well-known, this method has, also according to Gifford himself, two remarkable advantage:

1) - it relates the actual turbulent wind fluctuations directly to the dispersion, without introducing an intermediate hypotesis. As a result, there does not seem to be any a priory restriction to particular scales of dispersion time or distance or to particular meteorological conditions. This point will, of course, have to be verified by suitable studies.

2) - it is well adopted to the continuous monitoring of atmospheric dispersive capacity at a reactor site and would appear, at least from the reactor hazards stand point, to solve the problem of processing large amounts of wind fluctuation data in connection with reactor-site meteorological program.

CONCLUSIONS

1. - The area where is placed the Euratom Research Communitary Center at Ispra is not, from the point-of-view of the natural dilution of radioactive effluents, the more suitable considering the low percentage average of daily hours when the atmosphere interesting that area has an effective dilution power.

The Ispra C.C.R. is rather far from the Po-Valley properly said, but it is not far enough to be interested by a different meteorological situation. Because the region has the same position as regards the secondary circulation of the atmosphere (formed by cyclonic and anticyclonic systems) of the Po-Valley. In fact the boundary line between two different meteorological situations crosses the ridge of the Alps system. Consequently the same incidence of cyclonic or anicyclonic situations, in order of magnitude, is equal both for Ispra and for the Po-Valley.

Nevertheless, because of the different topographic aspect, when the atmospheric pressure distribution at ground is levelled, or very nearly, in Ispra area take place local phenomena of topographic nature that, considered under the meso-meteorological, and no more meteorological, aspect, cause situations typical and characteristic.These last can also be contrary to an efficacious dilution of radioactive effluents.

Consequently, it would be useful that the Meteorological Service of the C.C.R. might have a larger credit, in order to spread, and at the same time to deepen, its range of action and to formulate a dynamic climatology of the area.

2. - The atmospheric boundary under-layer of the Ispra area (C.C.R.) has not a constant thickness, also in levelled atmospheric pressure conditions, owing to the non-homogeneity of the ground. In fact it is enough

to compare the temperature data, sometimes strongly different, between the Meteorological Observatory and the Mechanics Works,to have an idea of the irregular distribution of the thermic field. And it is very probable that, installing another meteorological screen in other sectors (i.e. V or VII sector) completely different temperatures from the first two would be found. Moreover, the presence ot little hills to the east of the reactors area, compromises even more the stability of the boundary under-layer, when it is stable. But this, for some emergency operations, could be a protection for the center itself.

3. - It would be useful for the C.C.R. Meteorological Service to be in teletype connexion with the Meteorological Bureau af Air Force of the Malpensa Airport and with the Meteorological Observatory of Locarno-Monti to dispose of forecasts both of meteorological and mesometeorological character relative to the next conditions of atmospheric equilibrium and for the evolution of the dynamic field, at least up to 1500 m height.

4. - It is suitable that temperature and humidity soundings are carried out by means of captive-balloons within the first 500-1000 m at least during characteristic meteorological situations. And it would also be suitable to encourage the researches on the turbulence in the low layers following the usual methods (smokes, pilot-balloons, small parachutes, and so on), and to increase the number of monitoring places in the most representative sites of the C.C.R. and outside this area.

5. - However all those researches must not be devoted only to the microclimatology of the area but also to the mesoclimatology for doing a correlation between them, without forgetting the radioactive gas

diffusion, which is the main question.

6. - It is not advisable to place new buildings on the hills to the east of the reactors area because they would be too near to the stacks wastes. Because, in conditions of unstable or neutral atmospheric equilibrium, without wind or with wind coming from the western sector (with intensity favourable to an high concentration) the impact of the effluents patterns could be unfavourable to the people living in those buildings.

7. - As regards the construction-height of stack, 80 m, above the ground are enough, if the exit diameter is 2.10 m.

8. - As for the controlled wastes, in relation to the atmospheric equilibrium states, shown by continuous measurements at the Meteorological Tower, it is advisable that:

a) in instability conditions: to release at spaced intervals; because if the instability is weak or moderate, the puff fells to the ground increasing the level of radioactivity in the air of the Center; if the instability is strong it is necessary that the cloud or the puff, vhen in the free atmosphere, may have the time to reach a sufficient dilution;

b) in neutral conditions: to release at spaced intervals; because it is not possible to know, for lack of suitable measurements, the layer reached by those conditions and, chiefly, what there is above it;

c) in stability conditions: if the stability layer spreads over all the area and the upper base of the layer is lower than the stack effective height the release may be continuous; if the stability layer has a limited horizontal range, the release must be made with caution; if the stability layer includes the effective height of the stack, it is advisable not to release.

d) in fumigation conditions: every release must be avoided.

A P P E N D I X

DIFFUSION TABLES

KRIPTON 85
OPERATION WITH ONE FUEL ROD DEFECT
u = 2 m/s

DISTANCE	PEAK CONCENTRATION (c/m^3)			
Km	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	4.8 (-12)	6.4 (-16)	1.0 (-20)	2.6 (-39)
1.0	2.1 (-11)	2.1 (-12)	6.2 (-14)	1.9 (-19)
2.0	1.3	1.0 (-11)	4.1 (-12)	1.0 (-14)
3.0	7.8 (-12)	1.3	7.3	3.0 (-13)
4.0	5.1	1.1	9.0	1.1 (-12)
5.0	4.0	9.8 (-12)	8.9	1.9
6.0	2.9	8.1	8.8	2.3
7.0	2.3	7.2	8.5	2.6
8.0	1.9	6.0	8.0	2.9
9.0	1.5	5.5	7.6	3.3
10.0	1.3	4.6	7.1	3.9
20.0	4.9 (-13)	2.2	4.0	3.8
		h = 150		
0.5	3.9 (-14)	1.9 (-23)	1.4 (-34)	=
1.0	5.3 (-12)	6.7 (-15)	1.2 (-18)	1.7 (-31)
2.0	9.3	9.1 (-13)	5.4 (-14)	2.6 (-20)
3.0	6.5	3.2 (-12)	4.9 (-13)	1.0 (-16)
4.0	4.6	4.2	1.1 (-12)	3.5 (-15)
5.0	3.6	4.4	1.6	1.5 (-14)
6.0	2.7	4.6	2.1	3.0
7.0	2.1	4.7	2.4	5.2
8.0	1.8	4.1	2.6	8.3
9.0	1.5	4.0	2.9	1.3 (-13)
10.0	1.3	3.5	3.0	2.3
20.0	4.8 (-13)	1.9	2.6	6.0

KRIPTON 85

OPERATION WITH ONE FUEL ROD DEFECT

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	7.2 (-17)	9.6 (-21)	1.5 (-25)	3.8 (-44)
1.0	3.1 (-16)	3.1 (-17)	9.4 (-19)	2.9 (-24)
2.0	2.0	1.5 (-16)	6.1 (-17)	1.6 (-19)
3.0	1.2	1.9	1.1 (-16)	4.5 (-18)
4.0	7.7 (-17)	1.6	1.4	1.6 (-17)
5.0	5.9	1.5	1.3	2.7
6.0	4.4	1.2	1.3	3.4
7.0	3.4	1.1	1.3	3.9
8.0	2.8	9.0 (-17)	1.2	4.3
9.0	2.3	8.2	1.1	4.9
10.0	1.9	6.9	1.1	5.8
20.0	7.4 (-18)	3.3	6.0 (-17)	5.7
		h = 150		
0.5	5.8 (-19)	2.9 (-28)	2.2 (-39)	=
1.0	7.9 (-17)	1.0 (-19)	1.8 (-23)	2.5 (-36)
2.0	1.4 (-16)	1.4 (-17)	8.1 (-19)	3.9 (-25)
3.0	9.7 (-17)	4.7	7.3 (-18)	1.5 (-21)
4.0	6.8	6.3	1.7 (-17)	5.2 (-20)
5.0	5.4	6.9	2.4	2.2 (-19)
6.0	4.1	7.0	3.1	4.5
7.0	3.2	7.1	3.5	7.8
8.0	2.7	6.2	3.9	1.2 (-18)
9.0	2.2	5.9	4.3	1.9
10.0	1.9	5.2	4.5	3.5
20.0	7.2 (-18)	2.5	3.9	9.0

KRIPTON 85 m
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)
u = 2 m/s

DISTANCE Km	PEAK CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	2.4 (-11)	3.2 (-15)	5.0 (-20)	1.3 (-38)
1.0	1.0 (-10)	1.0 (-11)	3.0 (-13)	9.4 (-19)
2.0	6.4 (-11)	4.9	1.9 (-11)	5.0 (-14)
3.0	3.6	6.1	3.4	1.4 (-12)
4.0	2.3	5.2	4.1	4.9
5.0	1.8	4.6	4.0	8.1
6.0	1.3	3.8	3.8	9.9
7.0	9.7 (-12)	3.3	3.6	1.1 (-11)
8.0	7.9	2.7	3.3	1.2
9.0	6.3	2.4	3.1	1.3
10.0	5.2	2.1	2.8	1.6
20.0	1.6	8.8 (-12)	1.3	1.2
		h = 150		
0.5	1.9 (-13)	9.6 (-23)	7.1 (-34)	=
1.0	2.6 (-11)	3.2 (-14)	5.9 (-18)	8.1 (-31)
2.0	4.4	4.4 (-12)	2.6 (-13)	1.2 (-19)
3.0	3.0	1.5 (-11)	2.3 (-12)	4.8 (-16)
4.0	2.1	2.0	5.2	1.6 (-14)
5.0	1.6	2.2	7.0	6.5
6.0	1.2	2.3	9.1	1.3 (-13)
7.0	9.1 (-12)	2.2	1.0 (-11)	2.2
8.0	7.5	1.9	1.1	3.5
9.0	6.0	1.8	1.2	5.3
10.0	5.0	1.5	1.2	9.2
20.0	1.6	7.5 (-12)	8.3 (-12)	1.9 (-12)

KRIPTON 85 m
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	5.4 (-12)	7.2 (-16)	1.1 (-20)	2.9 (-39)
1.0	2.3 (-11)	2.3 (-12)	6.9 (-14)	2.1 (-19)
2.0	1.5	1.1 (-11)	4.4 (-12)	1.1 (-14)
3.0	8.3 (-12)	1.4	7.8	3.2 (-13)
4.0	5.3	1.2	9.4	1.1 (-12)
5.0	4.0	1.1	9.0	1.8
6.0	2.9	8.6 (-12)	8.7	2.2
7.0	2.2	7.6	8.2	2.5
8.0	1.8	6.2	7.6	2.7
9.0	1.4	5.6	7.1	3.0
10.0	1.2	4.6	6.5	3.6
20.0	3.6 (-13)	2.0	2.9	2.8
		h = 150		
0.5	4.3 (-14)	1.2 (-23)	1.6 (-34)	=
1.0	5.9 (-12)	7.4 (-15)	1.3 (-18)	1.8 (-31)
2.0	1.0 (-11)	1.0 (-12)	5.8 (-14)	2.8 (-20)
3.0	6.8 (-12)	3.4	5.2 (-13)	1.1 (-16)
4.0	4.7	4.6	1.2 (-12)	3.6 (-15)
5.0	3.6	5.0	1.6	1.5 (-14)
6.0	2.7	5.3	2.1	3.0
7.0	2.1	4.9	2.3	5.0
8.0	1.7	4.3	2.5	7.9
9.0	1.4	4.1	2.7	1.2 (-13)
10.0	1.1	3.5	2.7	2.1
20.0	3.5 (-13)	1.7	1.9	4.4

KRIPTON 87
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	PEAK CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	2.3 (-11)	2.1 (-15)	4.8 (-20)	1.2 (-38)
1.0	9.5	9.9 (-12)	2.9 (-13)	8.9 (-19)
2.0	5.7	4.6 (-11)	1.7 (-11)	4.5 (-14)
3.0	3.1	5.6	2.9	1.2 (-12)
4.0	1.9	4.6	3.3	4.0
5.0	1.4	4.1	3.0	6.2
6.0	9.2 (-12)	3.2	2.8	7.2
7.0	6.7	2.8	2.5	7.6
8.0	5.1	2.2	2.2	7.8
9.0	3.9	1.9	1.9	8.2
10.0	3.0	1.6	1.7	9.1
20.0	5.4 (-13)	5.2 (-12)	4.4 (-12)	4.3
		h = 150		
0.5	1.9 (-13)	9.5 (-23)	6.9 (-34)	=
1.0	2.4 (-11)	2.2 (-14)	5.6 (-18)	7.7 (-31)
2.0	4.0	4.2 (-12)	2.3 (-13)	1.1 (-19)
3.0	2.6	1.4 (-11)	1.9 (-12)	4.1 (-16)
4.0	1.7	1.8	4.2	1.3 (-14)
5.0	1.2	1.9	5.4	5.0
6.0	8.6 (-12)	1.9	6.6	9.4
7.0	6.3	1.8	7.0	1.5 (-13)
8.0	4.9	1.5	7.1	2.3
9.0	3.7	1.4	7.3	3.3
10.0	2.9	1.2	7.0	5.4
20.0	5.4 (-13)	4.4 (-12)	2.9	6.7

KRIPTON 87
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	1.2 (-11)	1.6 (-15)	2.5 (-20)	6.4 (-39)
1.0	4.9	5.1 (-12)	1.5 (-13)	4.6 (-19)
2.0	3.0	2.4 (-11)	9.0 (-12)	2.3 (-14)
3.0	1.6	2.9	1.5 (-11)	6.2 (-13)
4.0	9.8 (-12)	2.4	1.7	2.1 (-12)
5.0	7.0	2.1	1.6	3.2
6.0	4.8	1.7	1.4	3.7
7.0	3.5	1.4	1.3	3.9
8.0	2.7	1.1	1.1	4.1
9.0	2.0	1.0	1.0	4.3
10.0	1.6	8.2 (-12)	8.6 (-12)	4.8
20.0	2.8 (-13)	2.7	2.3	2.2
		h = 150		
0.5	9.6 (-14)	4.9 (-23)	3.6 (-34)	=
1.0	1.3 (-11)	1.7 (-14)	2.9 (-18)	4.0 (-31)
2.0	2.1	2.2 (-12)	1.2 (-13)	5.7 (-20)
3.0	1.3	7.2	1.0 (-12)	2.1 (-16)
4.0	8.7 (-12)	9.4	2.2	6.7 (-15)
5.0	6.4	9.9	2.8	2.6 (-14)
6.0	4.5	9.9	3.4	4.9
7.0	3.3	9.3	3.6	7.9
8.0	2.5	7.9	3.7	1.2 (-13)
9.0	1.9	7.2	3.8	1.7
10.0	1.5	6.2	3.6	2.8
20.0	2.8 (-13)	2.2	1.5	3.5

KRIPTON 88
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	PEAK CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		<u>h = 100</u>		
0.5	5.0 (-11)	6.8 (-15)	1.1 (-19)	2.7 (-38)
1.0	2.1 (-10)	2.2 (-11)	6.4 (-13)	2.0 (-18)
2.0	1.3	1.0 (-10)	4.0 (-11)	1.0 (-13)
3.0	7.5 (-11)	1.3	7.0	2.9 (-12)
4.0	4.8	1.1	8.4	1.0 (-11)
5.0	3.5	9.6 (-11)	8.0	1.6
6.0	2.5	7.7	7.6	2.0
7.0	1.9	6.8	7.1	2.2
8.0	1.5	5.6	6.4	2.3
9.0	1.2	5.0	6.0	2.5
10.0	9.8 (-12)	4.1	5.3	2.9
20.0	2.6	1.7	2.1	2.1
		<u>h = 150</u>		
0.5	4.1 (-13)	2.0 (-22)	1.5 (-33)	=
1.0	5.5 (-11)	7.0 (-14)	1.2 (-17)	1.7 (-30)
2.0	9.2	9.4 (-12)	5.3 (-13)	2.6 (-19)
3.0	6.2	3.2 (-11)	4.7 (-12)	9.9 (-16)
4.0	4.2	4.2	1.1 (-11)	3.2 (-14)
5.0	3.2	4.5	1.4	1.3 (-13)
6.0	2.3	4.7	1.8	2.6
7.0	1.8	4.4	2.0	4.3
8.0	1.5	3.8	2.1	6.7
9.0	1.2	3.6	2.2	1.0 (-12)
10.0	9.5 (-12)	3.1	2.2	1.7
20.0	2.6	1.4	1.4	3.2

KRIPTON 88
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION (c/m^3) LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	1.6 (-11)	2.2 (-15)	3.5 (-20)	8.8 (-39)
1.0	6.9	7.1 (-12)	2.1 (-13)	6.5 (-19)
2.0	4.4	3.4 (-11)	1.3 (-11)	3.4 (-14)
3.0	2.5	4.2	2.3	9.4 (-13)
4.0	1.6	3.5	2.7	3.3 (-12)
5.0	1.2	3.1	2.6	5.3
6.0	8.3 (-12)	2.5	2.5	6.4
7.0	6.2	2.2	2.3	7.1
8.0	5.0	1.8	2.1	7.6
9.0	3.9	1.6	1.9	8.3
10.0	3.2	1.4	1.7	9.6
20.0	8.6 (-13)	5.4 (-12)	7.0 (-12)	6.7
		h = 150		
0.5	1.3 (-13)	6.7 (-23)	4.9 (-34)	=
1.0	1.8 (-11)	2.2 (-14)	4.1 (-18)	5.6 (-31)
2.0	3.0	3.1 (-12)	1.7 (-13)	8.4 (-20)
3.0	2.0	1.0 (-11)	1.5 (-12)	3.2 (-16)
4.0	1.4	1.4	3.5	1.1 (-14)
5.0	1.1	1.5	4.6	4.3
6.0	7.7 (-12)	1.6	5.9	8.4
7.0	5.9	1.5	6.5	1.4 (-13)
8.0	4.7	1.3	6.9	2.2
9.0	3.8	1.2	7.3	3.3
10.0	3.1	1.0	7.4	5.7
20.0	8.4 (-13)	4.6 (-12)	4.5	1.0 (-12)

KRIPTON 89
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	PEAK CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	3.6 (-12)	7.5 (-16)	7.6 (-21)	1.9 (-39)
1.0	6.2	1.6 (-12)	1.9 (-14)	5.9 (-20)
2.0	6.8 (-13)	3.0	2.0 (-13)	5.3 (-16)
3.0	6.5 (-14)	1.6	6.1 (-14)	2.5 (-15)
4.0	7.1 (-15)	5.5 (-13)	1.2	1.5
5.0	9.0 (-16)	2.0	2.0 (-15)	4.1 (-16)
6.0	1.1	6.7 (-14)	3.3 (-16)	8.5 (-17)
7.0	1.4 (-17)	2.4	5.3 (-17)	1.6
8.0	1.9 (-18)	8.2 (-15)	8.2 (-18)	2.9 (-18)
9.0	2.6 (-19)	3.0	1.3	5.5 (-19)
10.0	3.6 (-20)	1.0	2.0 (-19)	1.1
20.0	2.1 (-28)	6.1 (-20)	1.7 (-27)	1.6 (-27)
		h = 150		
0.5	2.9 (-14)	2.3 (-23)	1.1 (-34)	=
1.0	1.6 (-12)	5.0 (-15)	3.7 (-19)	5.1 (-32)
2.0	4.7 (-13)	2.8 (-13)	2.7 (-15)	1.3 (-21)
3.0	5.4 (-14)	3.9	4.0	8.6 (-19)
4.0	6.3 (-15)	2.7	1.6	4.8 (-18)
5.0	8.1 (-16)	9.5 (-14)	3.6 (-16)	3.3
6.0	1.0	3.6	7.8 (-17)	1.1
7.0	1.4 (-17)	1.6	1.5	3.2 (-19)
8.0	1.8 (-18)	5.7 (-15)	2.7 (-18)	8.5 (-20)
9.0	2.5 (-19)	2.2	4.9 (-19)	2.2
10.0	3.5 (-20)	7.9 (-16)	8.4 (-20)	6.4 (-21)
20.0	2.1 (-28)	5.3 (-20)	1.1 (-27)	2.6 (-28)

KRIPTON 89
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION (c/m3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	3.5 (-12)	7.4 (-16)	7.4 (-21)	1.9 (-39)
1.0	6.1	1.5 (-12)	1.9 (-14)	5.8 (-20)
2.0	6.6 (-13)	3.0	2.0 (-13)	5.2 (-16)
3.0	6.4 (-14)	1.5	6.0 (-14)	2.4 (-15)
4.0	6.9 (-15)	5.4 (-13)	1.2	1.5
5.0	8.8 (-16)	2.0	2.0 (-15)	4.0 (-16)
6.0	1.1	6.6 (-14)	3.2 (-16)	8.3 (-17)
7.0	1.4 (-17)	2.2	5.2 (-17)	1.6
8.0	1.9 (-18)	8.2 (-15)	8.0 (-18)	2.9 (-18)
9.0	2.6 (-19)	3.0	1.3	5.4 (-19)
10.0	3.6 (-20)	1.0 (-16)	1.9 (-19)	1.1
20.0	2.1 (-28)	6.1 (-20)	1.7 (-27)	1.6 (-27)
		h = 150		
0.5	2.8 (-14)	2.2 (-23)	1.1 (-34)	=
1.0	1.6 (-12)	4.9 (-15)	3.6 (-19)	5.0 (-32)
2.0	4.6 (-13)	2.7 (-13)	2.6 (-15)	1.3 (-21)
3.0	5.3 (-14)	3.8	4.0	8.4 (-19)
4.0	6.2 (-15)	2.1	1.6	4.7 (-18)
5.0	8.0 (-16)	9.3 (-14)	3.5 (-16)	3.2
6.0	1.0	3.5	7.7 (-17)	1.1
7.0	1.3 (-17)	1.6	1.4	3.2 (-19)
8.0	1.8 (-18)	5.6 (-15)	2.6 (-18)	8.4 (-20)
9.0	2.5 (-19)	2.2	4.8 (-19)	2.1
10.0	3.5 (-20)	7.8 (-16)	8.2 (-20)	6.3 (-21)
20.0	2.0 (-28)	5.2 (-20)	1.1 (-27)	2.5 (-28)

XENON 133 m
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	PEAK CONCENTRATION(c/m3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	9.9 (-12)	1.2 (-15)	2.1 (-20)	5.3 (-39)
1.0	4.2 (-11)	4.2 (-12)	1.3 (-13)	4.0 (-19)
2.0	2.8	2.1 (-11)	8.4 (-12)	2.2 (-14)
3.0	1.6	2.6	1.5 (-11)	6.1 (-13)
4.0	1.1	2.2	1.9	2.2 (-12)
5.0	8.1 (-12)	2.0	1.8	3.7
6.0	6.0	1.7	1.8	4.6
7.0	4.6	1.5	1.7	5.3
8.0	3.8	1.2	1.6	5.9
9.0	3.1	1.1	1.6	6.6
10.0	2.6	9.4 (-12)	1.4	7.9
20.0	9.8 (-13)	4.5	7.9 (-12)	7.7
		h = 150		
0.5	8.0 (-14)	4.0 (-23)	3.0 (-34)	=
1.0	1.1 (-11)	1.4 (-14)	2.5 (-18)	3.4 (-31)
2.0	1.9	1.9 (-12)	1.1 (-13)	5.3 (-20)
3.0	1.3	6.5	1.0 (-12)	2.1 (-16)
4.0	9.4 (-12)	8.7	2.3	7.1 (-15)
5.0	7.3	9.5	3.2	3.0 (-14)
6.0	5.5	9.9	4.3	6.1
7.0	4.4	9.6	4.8	1.1 (-13)
8.0	3.7	8.5	5.3	1.7
9.0	3.0	8.1	5.8	2.6
10.0	2.5	7.2	6.1	4.7
20.0	9.6 (-13)	3.8	5.1	1.2 (-12)

XENON 133 m
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION (c/m3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	2.4 (-19)	3.2 (-17)	5.0 (-22)	1.3 (-40)
1.0	1.0 (-12)	1.0 (-13)	3.1 (-15)	9.6 (-21)
2.0	6.7 (-13)	5.0	2.0 (-13)	5.2 (-16)
3.0	3.9	6.3	3.6	1.5 (-14)
4.0	2.5	5.4	4.5	5.3
5.0	2.0	4.9	4.4	8.9
6.0	1.4	4.0	4.3	1.1 (-13)
7.0	1.1	3.6	4.2	1.3
8.0	9.2 (-14)	3.0	3.9	1.4
9.0	7.5	2.7	3.7	1.6
10.0	6.3	2.3	3.5	1.9
20.0	2.4	1.1	1.9	1.8
		h = 150		
0.5	1.9 (-15)	9.7 (-25)	7.1 (-36)	=
1.0	2.6 (-13)	3.3 (-16)	6.0 (-20)	8.3 (-33)
2.0	4.6	4.5 (-14)	2.7 (-15)	1.3 (-21)
3.0	3.2	1.6 (-13)	2.4 (-14)	5.1 (-18)
4.0	2.3	2.1	5.6	1.7 (-16)
5.0	1.8	2.3	7.7	7.2
6.0	1.3	2.4	1.0 (-13)	1.5 (-15)
7.0	1.1	2.3	1.2	2.5
8.0	8.8 (-14)	2.0	1.3	4.1
9.0	7.2	1.9	1.4	6.3
10.0	6.1	1.7	1.5	1.1 (-14)
20.0	2.3	9.2 (-14)	1.2	2.9

XENON 133 m
OPERATION WITH ONE FUEL ROD DEFECT
(After the adsorption column stack inlet)

u = 2 m/s

DISTANCE Km	PEAK CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	2.1 (-15)	2.8 (-19)	4.4 (-24)	1.1 (-42)
1.0	8.9	9.0 (-16)	2.7 (-17)	8.4 (-23)
2.0	5.8	4.4 (-15)	1.8 (-15)	4.5 (-18)
3.0	3.4	5.5	3.2	1.3 (-16)
4.0	2.2	4.7	3.9	4.7
5.0	1.7	4.3	3.8	7.8
6.0	1.3	3.5	3.8	9.7
7.0	9.8 (-16)	3.1	3.6	1.1 (-15)
8.0	8.1	2.6	3.4	1.2
9.0	6.6	2.3	3.3	1.4
10.0	5.6	2.0	3.0	1.7
20.0	2.1	9.4 (-16)	1.7	1.6
		h = 150		
0.5	1.7 (-17)	8.4 (-27)	6.2 (-38)	=
1.0	2.3 (-15)	2.9 (-18)	5.3 (-22)	7.3 (-25)
2.0	4.0	4.0 (-16)	2.3 (-17)	1.1 (-23)
3.0	2.8	1.4 (-15)	2.1 (-16)	4.5 (-20)
4.0	2.0	1.8	5.0	1.5 (-18)
5.0	1.5	2.0	6.8	6.3
6.0	1.2	2.1	9.0	1.3 (-17)
7.0	9.2 (-16)	2.0	1.0 (-15)	2.2
8.0	7.7	1.8	1.1	3.6
9.0	6.3	1.7	1.2	5.5
10.0	5.4	1.5	1.3	9.9
20.0	2.0	8.0 (-16)	1.1	2.5 (-16)

XENON 133 m
OPERATION WITH ONE FUEL ROD DEFECT
(After the adsorption column stackinlet)

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	5.0 (-17)	6.6 (-21)	1.0 (-25)	2.6 (-44)
1.0	2.1 (-16)	2.2 (-17)	6.4 (-19)	2.0 (-24)
2.0	1.4	1.0 (-16)	4.2 (-17)	1.1 (-19)
3.0	8.0 (-17)	1.3	7.5	3.1 (-18)
4.0	5.3	1.1	9.3	1.2 (-17)
5.0	4.1	1.0	9.1	1.9
6.0	3.0	8.4 (-17)	9.0	2.3
7.0	2.3	7.4	8.6	2.6
8.0	1.9	6.2	8.1	2.9
9.0	1.6	5.6	7.8	3.3
10.0	1.3	4.8	7.2	4.0
20.0	4.9 (-18)	2.2	4.0	3.8
		h = 150		
0.5	4.0 (-19)	2.0 (-28)	1.5 (-39)	=
1.0	5.5 (-17)	6.9 (-20)	1.2 (-23)	1.7 (-36)
2.0	9.6	9.4 (-18)	5.5 (-19)	2.7 (-25)
3.0	6.6	3.2 (-17)	5.0 (-18)	1.1 (-21)
4.0	4.7	4.3	1.2 (-14)	3.6 (-20)
5.0	3.7	4.8	1.6	1.5 (-19)
6.0	2.8	5.4	2.1	3.0
7.0	2.2	4.8	2.4	5.3
8.0	1.8	4.2	2.7	8.5
9.0	1.5	4.0	2.9	1.3 (-18)
10.0	1.3	3.6	3.0	2.3
20.0	4.8 (-18)	1.9	2.6	6.0

XENON 133
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	PEAK CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	8.9 (-10)	1.2 (-13)	1.9 (-18)	4.7 (-37)
1.0	3.8 (- 9)	3.8 (-10)	1.1 (-11)	3.6 (-17)
2.0	2.5	1.9 (- 9)	7.5 (-10)	1.9 (-12)
3.0	1.4	2.3	1.3 (- 9)	5.5 (-11)
4.0	9.5 (-10)	2.0	1.7	2.0 (-10)
5.0	7.3	1.8	1.6	3.3
6.0	5.4	1.5	1.6	4.2
7.0	4.2	1.3	1.6	4.7
8.0	3.5	1.1	1.5	5.3
9.0	2.8	1.0	1.4	6.0
10.0	2.4	8.5 (-10)	1.3	7.1
20.0	8.9 (-11)	4.0	7.2 (-10)	7.0
		h = 150		
0.5	7.2 (-12)	3.6 (-21)	2.7 (-41)	=
1.0	9.8 (-10)	1.2 (-12)	2.2 (-16)	3.1 (-29)
2.0	1.7 (- 9)	1.7 (-10)	9.9 (-12)	4.8 (-18)
3.0	1.2	5.8	9.0 (-11)	1.9 (-14)
4.0	8.4 (-10)	7.8	2.1 (-10)	6.4 (-13)
5.0	6.6	8.6	2.9	2.7 (-12)
6.0	5.0	9.2	3.8	5.5
7.0	3.9	8.7	4.3	9.5
8.0	3.3	7.6	4.8	1.5 (-11)
9.0	2.7	7.3	5.3	2.4
10.0	2.3	6.4	5.5	4.2
20.0	8.8 (-11)	3.4	4.7	1.1 (-10)

XENON 133
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	9.5 (-12)	1.3 (-15)	2.0 (-20)	5.0 (-39)
1.0	4.0 (-11)	4.1 (-12)	1.2 (-13)	3.8 (-19)
2.0	2.6	2.0 (-11)	8.0 (-12)	2.1 (-14)
3.0	1.5	2.5	1.4 (-11)	5.9 (-13)
4.0	1.0	2.1	1.8	2.1 (-12)
5.0	7.8 (-12)	1.9	1.7	3.5
6.0	5.7	1.6	1.7	4.4
7.0	4.4	1.4	1.7	5.0
8.0	3.7	1.2	1.6	5.6
9.0	3.0	1.1	1.5	6.4
10.0	2.5	9.0 (-12)	1.4	7.6
20.0	9.5 (-13)	4.3	7.7 (-12)	7.5
		h = 150		
0.5	7.6 (-14)	3.8 (-23)	2.8 (-34)	=
1.0	1.0 (-11)	1.3 (-14)	2.4 (-18)	3.3 (-31)
2.0	1.8	1.8 (-12)	1.1 (-13)	5.1 (-20)
3.0	1.3	6.2	1.0 (-12)	5.0 (-16)
4.0	9.0 (-12)	8.3	2.2 (-12)	6.8 (-15)
5.0	7.0	9.1	3.1	2.9 (-14)
6.0	5.3	9.9	4.1	5.8
7.0	4.2	9.2	4.6	1.0 (-13)
8.0	3.5	8.1	5.1	1.6
9.0	2.9	7.7	5.6	2.5
10.0	2.4	6.9	5.8	4.5
20.0	9.4 (-13)	3.7	5.0	1.2 (-12)

XENON 133
OPERATION WITH ONE FUEL ROD DEFECT
(After the adsorption column)

u = 2 m/s

DISTANCE Km	PEAK CONCENTRATION (c/m3)			
	LAPSE	NEUTRAL	MODER. INV.	STRONG INV.
		h = 100		
0.5	2.4 (-11)	3.1 (-15)	5.0 (-20)	1.3 (-38)
1.0	1.0 (-10)	1.0 (-11)	3.1 (-13)	9.5 (-19)
2.0	6.6 (-11)	4.9	2.0 (-11)	5.1 (-14)
3.0	3.8	6.2	3.6	1.5 (-12)
4.0	2.5	5.3	4.4	5.3
5.0	1.9	4.8	4.4	8.8
6.0	1.4	3.9	4.3	1.1 (-11)
7.0	1.1	3.5	4.1	1.3
8.0	9.2 (-12)	2.9	3.9	1.4
9.0	7.5	2.7	3.7	1.6
10.0	6.3	2.2	3.4	1.9
20.0	2.4	1.1	1.9	1.9
		h = 150		
0.5	1.9 (-13)	9.5 (-23)	7.0 (-34)	=
1.0	2.6 (-11)	3.3 (-14)	5.9 (-18)	8.2 (-31)
2.0	4.5	4.5 (-12)	2.6 (-13)	1.3 (-19)
3.0	3.2	1.5 (-11)	2.4 (-12)	5.1 (-16)
4.0	2.2	2.1	5.6	1.7 (-14)
5.0	1.7	2.3	7.7	7.1
6.0	1.3	2.6	1.0 (-11)	1.5 (-13)
7.0	1.0	2.3	1.2	2.5
8.0	8.7 (-12)	2.0	1.3	4.1
9.0	7.2	1.9	1.4	6.3
10.0	6.1	1.7	1.5	1.1 (-12)
20.0	2.3	9.1 (-12)	1.2	2.9

XENON 133
OPERATION WITH ONE FUEL ROD DEFECT
(After the adsorption column)

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	2.5 (-13)	3.3 (-17)	5.2 (-22)	1.3 (-40)
1.0	1.1 (-12)	1.1 (-13)	3.2 (-15)	1.0 (-20)
2.0	6.9 (-13)	5.2	2.1 (-13)	5.4 (-16)
3.0	4.0	6.5	3.8	1.5 (-14)
4.0	2.6	5.6	4.7	5.6
5.0	2.0	5.1	4.6	9.3
6.0	1.5	4.2	4.5	1.2 (-13)
7.0	1.2	3.7	4.3	1.3
8.0	9.7 (-14)	3.1	4.1	1.5
9.0	7.9	2.8	3.9	1.2
10.0	6.7	2.3	3.6	2.0
20.0	2.5	1.1	2.0	2.0
		h = 150		
0.5	2.0 (-15)	1.0 (-24)	7.4 (-36)	=
1.0	2.7 (-13)	3.4 (-16)	6.2 (-20)	8.6 (-33)
2.0	4.8	4.7 (-14)	2.8 (-15)	1.3 (-21)
3.0	3.3	1.6 (-13)	2.5 (-14)	5.3 (-18)
4.0	2.3	2.2	5.9	1.8 (-16)
5.0	1.8	2.4	8.1	7.5
6.0	1.4	2.5	1.1 (-13)	1.5 (-15)
7.0	1.1	2.4	1.2	2.7
8.0	9.2 (-14)	2.1	1.3	4.3
9.0	7.6	2.0	1.5	6.6
10.0	6.4	1.8	1.5	1.2 (-14)
20.0	2.5	9.6 (-14)	1.3	3.1

XENON 135 m
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	PEAK CONCENTRATION (c/m3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	4.0 (-11)	5.9 (-15)	8.4 (-20)	2.1 (-38)
1.0	1.4 (-10)	1.7 (-11)	4.3 (-13)	1.3 (-18)
2.0	6.5 (-11)	7.0	2.0 (-11)	5.0 (-14)
3.0	2.6	7.4	2.5	1.0 (-12)
4.0	1.2	5.3	2.1	2.5
5.0	6.4 (-12)	4.0	1.4	2.9
6.0	3.3	2.7	9.8 (-12)	2.5
7.0	1.8	2.0	6.6	2.0
8.0	1.0	1.4	4.3	1.6
9.0	5.7 (-13)	1.1	2.9	1.2
10.0	3.4	7.4 (-12)	1.8	1.0
20.0	3.3 (-15)	5.7 (-13)	2.7 (-14)	2.6 (-14)
		h = 150		
0.5	3.2 (-13)	1.8 (-22)	1.2 (-33)	=
1.0	3.7 (-11)	5.6 (-14)	8.4 (-18)	1.2 (-30)
2.0	4.5 (-11)	6.3 (-12)	2.6 (-13)	1.2 (-19)
3.0	2.2	1.8 (-11)	1.6 (-12)	3.5 (-16)
4.0	1.6	2.0	2.7	8.1 (-15)
5.0	5.8 (-12)	1.9	2.5	2.3 (-14)
6.0	3.0	1.4	2.3	3.3
7.0	1.7	1.3	1.8	4.0
8.0	9.7 (-13)	9.6 (-12)	1.4	4.5
9.0	5.5	7.6	1.1	4.8
10.0	3.3	5.6	7.8 (-13)	6.0
20.0	3.3 (-15)	4.9 (-13)	1.7 (-14)	4.1 (-15)

XENON 135 m
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	3.4 (-11)	4.9 (-15)	7.1 (-20)	1.8 (-38)
1.0	1.2 (-10)	1.5 (-11)	3.6 (-13)	1.1 (-18)
2.0	5.4 (-11)	5.9	1.6 (-11)	4.2 (-14)
3.0	2.2	6.2	2.1	8.4 (-13)
4.0	1.0	4.4	1.8	2.1 (-12)
5.0	5.4 (-12)	3.3	1.2	2.4
6.0	2.7	2.2	8.2 (-12)	2.1
7.0	1.5	1.7	5.5	1.7
8.0	8.5 (-13)	1.2	3.6	1.3
9.0	4.8	8.8 (-12)	2.4	1.0
10.0	2.8	6.2	1.5	8.5 (-13)
20.0	2.8 (-15)	4.8 (-13)	2.3 (-14)	2.2 (-14)
		h = 150		
0.5	2.7 (-13)	1.5 (-22)	1.0 (-33)	=
1.0	3.1 (-11)	4.6 (-14)	7.0 (-18)	9.7 (-31)
2.0	3.8	5.2 (-12)	2.2 (-13)	1.0 (-19)
3.0	1.8	1.5 (-11)	1.4 (-12)	2.9 (-16)
4.0	8.9 (-12)	1.7	2.2	6.8 (-15)
5.0	4.8	1.6	2.1	2.0 (-14)
6.0	2.5	1.2	2.0	2.8
7.0	1.4	1.1	1.5	3.4
8.0	8.1 (-13)	8.1 (-12)	1.2	3.8
9.0	4.6	6.4	9.0 (-13)	4.1
10.0	2.7	2.7	6.5	5.0
20.0	2.7 (-15)	4.1 (-13)	1.5 (-14)	3.4 (-15)

XENON 135
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	PEAK CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	2.6 (-10)	3.5 (-14)	5.5 (-19)	1.4 (-37)
1.0	1.1 (- 9)	1.2 (-10)	3.3 (-12)	1.0 (-17)
2.0	7.1 (-10)	5.4	2.2 (-10)	5.5 (-13)
3.0	4.1	6.7	3.8	1.6 (-11)
4.0	2.7	5.8	4.7	5.6
5.0	2.0	5.2	4.6	9.3
6.0	1.5	4.2	4.5	1.1 (-10)
7.0	1.1	3.7	4.3	1.3
8.0	9.4 (-11)	3.1	4.0	1.4
9.0	7.6	2.8	3.8	1.6
10.0	6.3	2.3	3.5	1.9
20.0	2.2	1.1	1.7	1.7
		h = 150		
0.5	2.1 (-12)	1.0 (-21)	7.7 (-33)	=
1.0	2.8 (-10)	3.6 (-13)	6.5 (-17)	8.9 (-30)
2.0	4.9	4.9 (-11)	2.8 (-12)	1.4 (-18)
3.0	3.4	1.7 (-10)	2.6 (-11)	5.4 (-15)
4.0	2.4	2.2	6.0	1.8 (-13)
5.0	1.8	2.4	8.1	7.5
6.0	1.4	2.6	1.1 (-10)	1.5 (-12)
7.0	1.1	2.4	1.2	2.6
8.0	8.9 (-11)	2.1	1.3	4.1
9.0	7.3	2.0	1.4	6.4
10.0	6.1	1.8	1.5	1.1 (-11)
20.0	2.1	9.2 (-11)	1.1	2.6

XENON 135
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION(c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	3.4 (-11)	4.5 (-15)	7.1 (-20)	1.8 (-38)
1.0	1.4 (-10)	1.5 (-11)	4.4 (-13)	1.4 (-18)
2.0	9.3 (-11)	7.1	2.8 (-11)	7.3 (-14)
3.0	5.4	8.9	5.0	2.1 (-12)
4.0	3.5	7.6	6.1	7.4
5.0	2.7	6.8	6.0	1.2 (-11)
6.0	1.9	5.5	5.8	1.5
7.0	1.5	5.0	5.6	1.7
8.0	1.2	4.1	5.2	1.9
9.0	9.9 (-12)	3.7	4.9	2.1
10.0	8.3	3.1	4.5	2.5
20.0	2.8	1.4	2.3	2.2
		h = 150		
0.5	2.7 (-13)	1.4 (-22)	1.0 (-33)	=
1.0	3.7 (-11)	4.7 (-14)	8.5 (-18)	1.2 (-30)
2.0	6.4	6.4 (-12)	3.7 (-13)	1.8 (-19)
3.0	4.4	2.2 (-11)	3.3 (-12)	7.1 (-16)
4.0	3.1	2.9	7.8	2.4 (-14)
5.0	2.4	3.2	1.1 (-11)	9.8
6.0	1.8	3.5	1.4	2.0 (-13)
7.0	1.4	3.2	1.6	3.4
8.0	1.2	2.8	1.7	5.4
9.0	9.5 (-12)	2.7	1.9	8.3
10.0	8.0	2.3	1.9	1.5 (-12)
20.0	2.8	1.2	1.5	3.5

XENON 137
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	PEAK CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	6.2 (-12)	1.2 (-15)	1.3 (-20)	3.3 (-39)
1.0	1.2 (-11)	2.7 (-12)	3.8 (-14)	1.2 (-19)
2.0	1.8 (-12)	6.1	5.6 (-13)	1.4 (-15)
3.0	2.4 (-13)	3.7	2.2	9.1
4.0	3.5 (-14)	1.5	6.1 (-14)	7.4
5.0	6.0 (-15)	6.3 (-13)	1.4	2.7
6.0	9.9 (-16)	2.5	3.0 (-15)	7.6 (-16)
7.0	1.7	1.0	6.4 (-16)	1.9
8.0	3.2 (-17)	4.1 (-14)	1.3	4.8 (-17)
9.0	5.8 (-18)	1.7	2.9 (-17)	1.2
10.0	1.1	7.0 (-15)	5.9 (-18)	3.3 (-18)
20.0	1.3 (-25)	1.8 (-18)	1.0 (-24)	9.9 (-25)
		h = 150		
0.5	5.0 (-14)	3.7 (-23)	1.9 (-34)	=
1.0	3.2 (-12)	8.6 (-15)	7.4 (-19)	1.0 (-31)
2.0	1.3	5.7 (-13)	7.3 (-15)	3.5 (-21)
3.0	2.0 (-13)	9.1	1.5 (-14)	3.1 (-18)
4.0	3.1 (-14)	5.7	7.8 (-15)	2.4 (-17)
5.0	5.4 (-15)	2.9	2.4	2.2
6.0	9.2 (-16)	1.3	7.1 (-16)	1.0
7.0	1.6	6.7 (-14)	1.8	3.9 (-18)
8.0	3.0 (-17)	2.8	4.4 (-17)	1.4
9.0	5.5 (-18)	1.3	1.1	4.8 (-19)
10.0	1.1	4.3 (-15)	2.5 (-18)	1.9
20.0	1.2 (-25)	1.6 (-18)	6.6 (-25)	1.5 (-25)

XENON 137
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION (c/m 3)			
	LAPSE	NEUTRAL	MODER. INV.	STRONG INV.
		h = 100		
0.5	6.0 (-12)	1.2 (-15)	1.2 (-20)	3.2 (-39)
1.0	1.2 (-11)	2.6 (-12)	3.6 (-14)	1.3 (-19)
2.0	1.7 (-12)	5.9	5.3 (-13)	1.4 (-15)
3.0	2.3 (-13)	3.5	2.1	8.7
4.0	3.3 (-14)	1.4	5.9 (-14)	7.0
5.0	5.7 (-15)	6.1 (-13)	1.3	2.6
6.0	9.4 (-16)	2.3	2.8 (-15)	7.3 (-16)
7.0	1.6	9.9 (-14)	6.1 (-16)	1.9
8.0	3.0 (-17)	3.9	1.3	4.6 (-17)
9.0	5.5 (-18)	1.7	2.7 (-17)	1.2
10.0	1.0	6.7 (-15)	5.7 (-18)	3.1 (-18)
20.0	1.2 (-25)	1.8 (-19)	9.7 (-25)	9.4 (-25)
		h = 150		
0.5	4.8 (-14)	3.5 (-23)	1.8 (-34)	=
1.0	3.1 (-12)	8.2 (-15)	7.0 (-19)	9.7 (-32)
2.0	1.2	5.3 (-13)	7.0 (-15)	3.5 (-21)
3.0	1.9 (-13)	8.7	1.4 (-14)	2.3 (-18)
4.0	3.0 (-14)	5.5	7.4 (-15)	2.3 (-17)
5.0	5.2 (-15)	2.9	2.3	2.1
6.0	8.7 (-16)	1.4 (-14)	6.7 (-16)	9.6 (-18)
7.0	1.5	6.4	1.7	3.7
8.0	2.9 (-17)	2.7	4.2 (-17)	1.3
9.0	5.3 (-18)	1.2	1.0	4.6 (-19)
10.0	1.0	5.0 (-15)	2.4 (-18)	1.8
20.0	1.2 (-25)	1.5 (-19)	6.3 (-25)	1.5 (-25)

XENON 138
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	PEAK CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	2.1 (-11)	3.0 (-15)	4.4 (-20)	1.1 (-38)
1.0	7.5	9.0 (-12)	2.3 (-13)	7.1 (-19)
2.0	3.5	3.7 (-11)	1.1 (-11)	2.7 (-14)
3.0	1.4	3.9	1.3	5.5 (-13)
4.0	6.7 (-12)	2.8	1.1	1.4 (-12)
5.0	3.6	2.1	8.2 (-12)	1.7
6.0	1.9	1.5	5.7	1.5
7.0	1.0	1.1	3.9	1.2
8.0	6.1 (-13)	7.7 (-12)	2.6	9.4 (-13)
9.0	3.5	5.9	1.8	7.5
10.0	2.1	4.2	1.2	6.4
20.0	2.6 (-15)	3.6 (-13)	2.1 (-14)	2.0 (-14)
		h = 150		
0.5	1.7 (-13)	9.2 (-23)	6.2 (-34)	=
1.0	1.9 (-11)	2.9 (-14)	4.4 (-18)	6.1 (-31)
2.0	2.4	3.3 (-12)	1.4 (-13)	6.7 (-20)
3.0	1.2	9.7	8.9	1.9 (-16)
4.0	5.9 (-12)	1.1 (-11)	1.5 (-12)	4.5 (-15)
5.0	3.3	1.0	1.4	1.3 (-14)
6.0	1.8	7.9 (-12)	1.4	1.9
7.0	9.9 (-13)	7.3	1.1	2.4
8.0	5.9	5.4	8.6 (-13)	2.7
9.0	3.4	4.3	6.6	3.0
10.0	2.1	3.2	4.9	3.8
20.0	2.5 (-15)	3.1 (-13)	1.3 (-20)	3.1 (-20)

XENON 138
OPERATION WITH ONE FUEL ROD DEFECT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	1.7 (-11)	2.5 (-15)	3.7 (-20)	9.2 (-39)
1.0	6.2	7.5 (-12)	1.9 (-13)	5.9 (-19)
2.0	2.9	3.1 (-11)	8.8 (-12)	2.2 (-14)
3.0	1.2	3.2	1.1 (-11)	4.6 (-13)
4.0	5.5 (-12)	2.3	9.8 (-12)	1.2 (-12)
5.0	3.0	1.8	6.8	1.4
6.0	1.6	1.2	4.8	1.2
7.0	8.7 (-13)	9.3 (-12)	3.2	9.9 (-13)
8.0	5.1	6.5	2.2	7.8
9.0	2.9	4.9	1.5	6.3
10.0	1.8	3.5	9.6 (-13)	5.3
20.0	2.1 (-15)	2.9 (-13)	1.7 (-14)	1.7 (-14)
		h = 150		
0.5	1.4 (-13)	7.7 (-23)	5.2 (-34)	=
1.0	1.6 (-11)	2.4 (-14)	3.7 (-18)	5.1 (-31)
2.0	2.0	2.7 (-12)	1.2 (-13)	5.5 (-20)
3.0	9.8 (-12)	8.1	7.4	1.6 (-16)
4.0	4.9	9.1	1.2 (-12)	3.8 (-15)
5.0	2.7	8.4	1.2	1.1 (-14)
6.0	1.5	6.5	1.1	1.6
7.0	8.2 (-13)	6.0	9.1 (-13)	2.0
8.0	4.9	4.5	7.1	2.3
9.0	2.8	3.6	5.5	2.5
10.0	1.7	2.7	4.1	3.1
20.0	2.1 (-15)	2.5 (-13)	1.1 (-14)	2.6 (-15)

KRIPTON 85
DESTRUCTIVE TEST WITH ONE ORGEL ELEMENT

u = 2 m/s

DISTANCE Km	PEAK CONCENTRATION (c/m³)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	1.8 (- 9)	1.4 (-13)	3.8 (-18)	9.5 (-37)
1.0	7.6	7.7 (-10)	2.3 (-11)	7.2 (-17)
2.0	5.0	3.7 (- 9)	1.5 (- 9)	3.9 (-12)
3.0	2.9	4.7	2.7	1.1 (-10)
4.0	1.9	4.1	3.4	4.0
5.0	1.5	3.7	3.3	6.7
6.0	1.1	3.0	3.3	8.4
7.0	8.4 (-10)	2.7	3.1	9.6
8.0	7.0	2.2	3.0	1.1 (- 9)
9.0	5.7	2.0	2.8	1.2
10.0	4.8	1.7	2.6	1.4
20.0	1.8	8.2 (-10)	1.5	1.4
		h = 150		
0.5	1.4 (-11)	7.2 (-21)	5.3 (-32)	=
1.0	2.0 (- 9)	2.5 (-12)	4.5 (-16)	6.2 (-29)
2.0	3.4	3.4 (-10)	2.0 (-11)	9.6 (-18)
3.0	2.4	1.2 (- 9)	1.8 (-10)	3.8 (-14)
4.0	1.7	1.6	4.2	1.3 (-12)
5.0	1.3	1.7	5.8	5.4
6.0	1.0	1.8	7.8	1.1 (-11)
7.0	7.9 (-10)	1.7	8.8	1.9
8.0	6.7	1.5	9.7	3.1
9.0	5.5	1.4	1.1 (- 9)	4.8
10.0	4.7	1.3	1.1	8.5
20.0	1.8	7.0 (-10)	9.6 (-10)	2.2 (-10)

KRIPTON 85
DESTRUCTIVE TEST WITH ONE ORGEL ELEMENT

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	2.6 (-14)	3.4 (-18)	5.4 (-23)	1.4 (-41)
1.0	1.1 (-13)	1.1 (-15)	3.3 (-16)	1.0 (-21)
2.0	7.1 (-14)	5.3 (-14)	2.2 (-14)	5.5 (-17)
3.0	4.1	6.7	3.9	1.6 (-15)
4.0	2.7	5.8	4.8	5.7
5.0	2.1	5.2	4.7	9.6
6.0	1.5	4.3	4.6	1.2 (-14)
7.0	1.2	3.8	4.5	1.4
8.0	1.0	3.2	4.2	1.5
9.0	8.1 (-15)	2.9	4.0	1.7
10.0	6.9	2.4	3.7	2.1
20.0	2.6	1.2	2.1	2.0
		h = 150		
0.5	2.1 (-16)	1.0 (-26)	7.6 (-37)	=
1.0	2.8 (-14)	3.5 (-17)	6.4 (-21)	8.8 (-34)
2.0	4.9	4.8 (-15)	2.8 (-16)	1.4 (-22)
3.0	3.4	1.7 (-14)	2.6 (-15)	5.5 (-19)
4.0	2.4	2.2	6.1	1.8 (-17)
5.0	1.8	2.4	8.3	7.7
6.0	1.4	2.5	1.1 (-14)	1.6 (-16)
7.0	1.1	2.5	1.3	2.7
8.0	9.5 (-15)	2.2	1.4	4.4
9.0	7.8	2.1	1.5	6.8
10.0	6.6	1.9	1.6	1.2 (-15)
20.0	2.6	9.9 (-15)	1.4	3.2

XENON 133 m
DESTRUCTIVE TEST WITH ONE ORGEL ELEMENT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	PEAK CONCENTRATION(c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	3.3 (- 8)	4.3 (-12)	6.9 (-17)	1.7 (-35)
1.0	1.4 (- 7)	1.4 (- 8)	4.2 (-10)	1.3 (-15)
2.0	9.1 (- 8)	6.8	2.7 (- 8)	7.1 (-11)
3.0	5.3	8.5	4.9	2.0 (- 9)
4.0	3.5	7.4	6.1	7.3
5.0	2.7	6.6	6.0	1.2 (- 8)
6.0	2.0	5.4	5.9	1.5
7.0	1.5	4.8	5.7	1.7
8.0	1.3	4.0	5.3	1.9
9.0	1.0	3.6	5.1	2.2
10.0	8.6 (- 9)	3.1	4.7	2.6
20.0	3.2	1.5	2.6	2.5
		h = 150		
0.5	2.6 (-10)	1.3 (-19)	9.7 (-31)	=
1.0	3.6 (- 8)	4.5 (-11)	8.2 (-15)	1.1 (-27)
2.0	6.3	6.2 (- 9)	3.6 (-10)	1.7 (-16)
3.0	4.4	2.1 (- 8)	3.3 (- 9)	7.0 (-13)
4.0	3.1	2.8	7.7	2.3 (-11)
5.0	2.4	3.1	1.1 (- 8)	9.8
6.0	1.8	3.3	1.4	2.0 (-10)
7.0	1.4	3.2	1.6	3.5
8.0	1.2	2.8	1.7	5.6
9.0	9.9 (- 9)	2.6	1.9	8.6
10.0	8.4	2.2	2.0	1.5 (- 9)
20.0	3.2	1.2	1.7	3.9

XENON 133 m
DESTRUCTIVE TEST WITH ONE ORGEL ELEMENT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION (c/m³)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	7.9 (-10)	1.1 (-13)	1.7 (-18)	4.2 (-37)
1.0	3.4 (- 9)	3.4 (-10)	1.0 (-11)	3.2 (-17)
2.0	2.2	1.7 (- 9)	6.7 (-10)	1.7 (-12)
3.0	1.3	2.1	1.2 (- 9)	4.9 (-11)
4.0	8.4 (-10)	1.8	1.5	1.8 (-10)
5.0	6.5	1.6	1.5	2.9
6.0	4.7	1.3	1.4	3.7
7.0	3.7	1.2	1.4	4.2
8.0	3.1	9.8 (-10)	1.3	4.7
9.0	2.5	8.9	1.2	5.3
10.0	2.1	7.5	1.1	6.3
20.0	7.8 (-11)	3.5	6.3 (-10)	6.1
		h = 150		
0.5	6.4 (-12)	3.2 (-21)	2.4 (-32)	=
1.0	8.7 (-10)	1.1 (-13)	2.0 (-16)	2.7 (-29)
2.0	1.5 (- 9)	1.5 (-10)	8.8 (-12)	4.2 (-18)
3.0	1.1	5.2	8.0 (-11)	1.7 (-14)
4.0	7.5 (-10)	6.9	1.9 (-10)	5.7 (-13)
5.0	5.8	7.6	2.6	2.4 (-12)
6.0	4.4	8.1	3.4	4.9
7.0	3.5	7.7	3.8	8.4
8.0	2.9	6.8	4.2	1.3 (-11)
9.0	2.4	6.5	4.7	2.1
10.0	2.0	5.7	4.8	3.7
20.0	7.7 (-11)	3.0	4.1	9.5

XENON 133 m
DESTRUCTIVE TEST WITH ONE ORGEL ELEMENT
(After the adsorption column - stack inlet)

u = 2 m/s

DISTANCE Km	PEAK CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	6.8 (-12)	9.1 (-16)	1.4 (-20)	3.6 (-39)
1.0	2.9 (-11)	2.9 (-12)	8.8 (-14)	2.7 (-19)
2.0	1.9	1.4 (-11)	5.8 (-12)	1.5 (-14)
3.0	1.1	1.8	1.0 (-11)	4.2 (-13)
4.0	7.2 (-12)	1.5	1.3	1.5 (-12)
5.0	5.6	1.4	1.3	2.5
6.0	4.1	1.1	1.2	3.2
7.0	3.2	1.0	1.2	3.6
8.0	2.6	8.4 (-12)	1.1	4.0
9.0	2.1	7.6	1.1	4.6
10.0	1.8	6.5	9.9 (-12)	5.4
20.0	6.7 (-13)	3.0	5.5	5.3
		h = 150		
0.5	5.5 (-14)	2.8 (-23)	2.0 (-34)	=
1.0	7.5 (-12)	9.5 (-15)	1.7 (-18)	2.4 (-31)
2.0	1.3 (-11)	1.3 (-13)	7.6 (-14)	3.6 (-20)
3.0	9.1 (-12)	4.5 (-12)	6.9 (-13)	1.5 (-16)
4.0	6.4	6.0	1.6 (-12)	4.9 (-15)
5.0	5.0	7.6	2.2	2.0 (-14)
6.0	3.8	8.1	2.9	4.2
7.0	3.0	6.6	3.3	7.3
8.0	2.5	5.8	3.7	1.2 (-13)
9.0	2.1	5.6	4.0	1.8
10.0	1.7	4.9	4.2	3.2
20.0	6.6 (-13)	2.6	3.5	8.2

XENON 133 m
DESTRUCTIVE TEST WITH ONE ORGEL ELEMENT
(After the adsorption column - stack inlet)

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	1.7 (-13)	2.2 (-17)	3.5 (-22)	8.8 (-41)
1.0	7.1	7.1 (-14)	2.1 (-15)	6.7 (-21)
2.0	4.6	3.5 (-13)	1.4 (-13)	3.6 (-16)
3.0	2.7	4.3	2.5	1.0 (-14)
4.0	1.8	3.7	3.1	3.7
5.0	1.4	3.4	3.1	6.2
6.0	1.0	2.8	3.0	7.7
7.0	7.7 (-14)	2.5	2.9	8.8
8.0	6.4	2.0	2.7	9.8
9.0	5.2	1.9	2.6	1.1 (-13)
10.0	4.4	1.6	2.4	1.3
20.0	1.6	7.4 (-14)	1.3	1.3
		h = 150		
0.5	1.3 (-15)	6.7 (-25)	5.0 (-36)	=
1.0	1.8 (-13)	2.3 (-16)	4.2 (-20)	5.8 (-33)
2.0	3.2	3.1 (-14)	1.8 (-15)	8.9 (-22)
3.0	2.2	1.1 (-13)	1.7 (-14)	3.5 (-18)
4.0	1.6	1.5	3.9	1.2 (-16)
5.0	1.2	1.6	5.4	5.0
6.0	9.2 (-14)	1.7	7.1	1.0 (-15)
7.0	7.3	8.6	8.1	1.8
8.0	6.1	1.4	8.9	2.8
9.0	5.0	1.3	9.8	4.4
10.0	4.3	1.2	1.0 (-13)	7.8
20.0	1.6	6.4 (-14)	8.6 (-14)	2.0 (-14)

XENON 133
DESTRUCTIVE TEST WITH ONE ORGEL ELEMENT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	PEAK CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER. INV.	STRONG INV.
		h = 100		
0.5	1.4 (- 6)	1.8 (-10)	2.8 (-15)	7.2 (-34)
1.0	5.8	5.8 (- 7)	1.7 (- 8)	5.4 (-14)
2.0	3.8	2.8 (- 6)	1.1 (- 6)	2.9 (- 9)
3.0	2.2	3.5	2.0	8.4 (- 8)
4.0	1.4	3.1	2.6	3.0 (- 7)
5.0	1.1	2.7	2.5	5.1
6.0	8.1 (- 7)	2.3	2.5	6.3
7.0	6.3	2.0	2.4	7.2
8.0	5.3	1.8	2.2	8.0
9.0	4.3	1.5	2.1	9.1
10.0	3.6	1.3	2.0	1.1
20.0	1.4	6.1 (- 7)	1.1	1.1
		h = 150		
0.5	1.1 (- 8)	4.5 (-18)	4.0 (-29)	=
1.0	1.5 (- 6)	1.9 (- 9)	3.4 (-13)	4.7 (-26)
2.0	2.6	2.5 (- 7)	1.5 (- 8)	7.2 (-15)
3.0	1.8	8.8	1.4 (- 7)	2.9 (-11)
4.0	1.3	1.2 (- 6)	3.2	9.7 (-10)
5.0	1.0	1.3	4.4	4.1 (- 9)
6.0	7.6 (- 7)	1.4	5.8	8.3
7.0	6.0	1.3	6.6	1.4 (- 8)
8.0	5.0	1.2	7.3	2.3
9.0	4.1	1.1	8.0	3.6
10.0	3.5	9.7 (- 7)	8.3	6.4
20.0	1.3	5.2	7.1	1.7 (- 7)

XENON 133
DESTRUCTIVE TEST WITH ONE ORGEL ELEMENT
(Before the adsorption column)

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	1.4 (- 8)	1.9 (-12)	3.0 (-17)	7.6 (-36)
1.0	6.6	6.1 (- 9)	1.8 (-10)	5.7 (-16)
2.0	4.0	2.9 (- 8)	1.2 (- 8)	3.1 (-11)
3.0	2.3	3.7	2.2	8.8 (-10)
4.0	1.5	3.2	2.7	3.2 (- 9)
5.0	1.2	2.9	2.6	5.3
6.0	8.6 (- 9)	2.3	2.6	6.6
7.0	6.7	2.1	2.5	7.6
8.0	5.5	1.8	2.3	8.4
9.0	4.5	1.7	2.2	9.6
10.0	3.8	1.4	2.1	1.1
20.0	1.4	6.4 (- 9)	1.2	1.1
		h = 150		
0.5	1.1 (-10)	5.7 (-20)	4.2 (-31)	=
1.0	1.6 (- 8)	2.0 (-11)	3.6 (-15)	4.9 (-28)
2.0	2.7	2.7 (- 9)	1.6 (-10)	7.6 (-17)
3.0	1.9	9.3	1.4 (- 9)	3.0 (-13)
4.0	1.3	1.2 (- 8)	3.4	1.0 (-11)
5.0	1.1	1.4	4.6	4.3
6.0	8.0 (- 9)	1.5	6.2	8.8
7.0	6.3	1.4	7.0	1.5 (-10)
8.0	5.3	1.2	7.7	2.4
9.0	4.3	1.1	8.4	3.8
10.0	3.7	1.0	8.8	6.8
20.0	1.4	5.5 (- 9)	7.5	1.7 (- 9)

XENON 133
DESTRUCTIVE TEST WITH ONE ORGEL ELEMENT
(After the adsorption column)

u = 2 m/s

DISTANCE Km	PEAK CONCENTRATION(c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	3.6 (- 8)	4.7 (-12)	7.5 (-17)	1.9 (-35)
1.0	1.5 (- 7)	1.5 (- 9)	4.6 (-10)	1.4 (-15)
2.0	1.0	7.5 (- 8)	3.0 (- 8)	7.7 (-11)
3.0	5.8 (- 8)	9.4	5.4	2.2 (- 9)
4.0	3.8	8.1	6.7	8.0
5.0	3.0	7.3	6.6	1.3 (- 8)
6.0	2.2	5.9	6.5	1.7
7.0	1.7	5.3	6.2	1.9
8.0	1.4	4.4	5.9	2.1
9.0	1.1	4.0	5.6	2.4
10.0	9.6 (- 9)	3.4	5.2	2.9
20.0	3.6	1.6	2.9	2.8
		h = 150		
0.5	2.9 (-10)	1.4 (-19)	1.1 (-30)	=
1.0	3.9 (- 8)	4.9 (-11)	9.0 (-15)	1.2 (-27)
2.0	6.9	6.7 (- 9)	4.0 (-10)	1.9 (-16)
3.0	4.8	2.3 (- 8)	3.6 (- 9)	7.6 (-13)
4.0	3.4	3.1	8.5	2.6 (-11)
5.0	2.6	3.4	1.2 (- 8)	1.1 (-10)
6.0	2.0	3.7	1.5	2.2
7.0	1.6	3.5	1.7	3.8
8.0	1.3	3.1	1.9	6.1
9.0	1.1	2.9	2.1	9.5
10.0	9.2 (- 9)	2.5	2.2	1.7 (- 9)
20.0	3.5	1.3	1.9	4.4

XENON 133
DESTRUCTIVE TEST WITH ONE ORGEL ELEMENT
(After the adsorption column)

u = 2 m/s

DISTANCE Km	SATURATION CONCENTRATION (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	3.8 (-10)	5.0 (-14)	8.0 (-19)	2.0 (-37)
1.0	1.6 (- 9)	1.6 (-10)	4.9 (-12)	1.5 (-17)
2.0	1.1	7.9	3.2 (-10)	8.2 (-13)
3.0	6.1 (-10)	9.9	5.7	2.3 (-11)
4.0	4.0	8.5	7.1	8.5
5.0	3.1	7.7	7.0	1.4 (-10)
6.0	2.3	6.3	6.9	1.8
7.0	1.8	5.7	6.6	2.0
8.0	1.5	4.7	6.2	2.2
9.0	1.2	4.3	5.9	2.5
10.0	1.0	3.6	5.5	3.0
20.0	3.8 (-11)	1.7	3.1	3.0
		h = 150		
0.5	3.0 (-12)	1.5 (-21)	1.1 (-32)	=
1.0	4.2 (-10)	5.2 (-13)	9.5 (-17)	1.3 (-29)
2.0	7.3	7.1 (-11)	4.2 (-12)	2.0 (-18)
3.0	5.0	2.5 (-10)	3.8 (-11)	8.1 (-15)
4.0	3.6	3.3	9.0	2.7 (-13)
5.0	2.8	3.6	1.2 (-10)	1.1 (-12)
6.0	2.1	3.8	1.6	2.3
7.0	1.7	3.7	1.8	4.0
8.0	1.4	3.2	2.0	6.5
9.0	1.1	3.1	2.2	1.0 (-11)
10.0	9.8 (-11)	2.7	2.1	1.8
20.0	3.7	1.5	2.0	4.6

KRIPTON 85
CONCENTRATION (c/m3) - FUMIGATION

DISTANCE Km	OPERATION WITH ONE FUEL ROD DEFECT		DESTRUCTIVE TEST WITH ONE ORGEL ELEMENT	
	Before and after the adsorption column		Before and after the adsorption column	
	Peak	Saturation	Peak	Saturation
	H = 150		H = 150	
0.5	2.1 (-10)	3.2 (-15)	7.8 (- 8)	1.1 (-12)
1.0	1.1	1.7	4.2	6.0 (-13)
2.0	5.9 (-11)	8.8 (-16)	2.2	3.1
3.0	4.3	6.5	1.6	2.3
4.0	3.2	4.8	1.2	1.7
5.0	2.7	4.1	1.0	1.5
6.0	2.2	3.3	8.3 (- 9)	1.2
7.0	2.1	3.1	7.6	1.1
8.0	1.8	2.6	6.5	9.3 (-14)
9.0	1.6	2.5	6.1	8.7
10.0	1.4	2.2	5.4	7.7
20.0	8.3 (-12)	1.2	3.1	4.4
	H = 200		H = 200	
0.5	2.6 (-10)	2.4 (-15)	5.9 (- 8)	8.4 (-13)
1.0	8.5 (-11)	1.3	3.1	4.5
2.0	4.4	6.6 (-16)	1.6	2.3
3.0	3.3	4.9	1.2	1.7
4.0	2.4	3.6	8.8 (- 9)	1.3
5.0	2.1	3.1	7.6	1.1
6.0	1.7	2.5	6.2	8.8 (-14)
7.0	1.5	2.3	5.7	8.2
8.0	1.3	2.0	4.9	7.0
9.0	1.2	1.9	4.6	6.5
10.0	1.1	1.6	4.0	5.7
20.0	6.2 (-12)	9.4 (-17)	2.3	3.3

CONCENTRATION (c/m³) - FUMIGATION

DISTANCE Km	KRIPTON 85 m - OPERATION WITH ONE FUEL ROD DEFECT - Before the adsorption column - Peak	KRIPTON 85 m - OPERATION WITH ONE FUEL ROD DEFECT - Before the adsorption column - Saturation	KRIPTON 87 - OPERATION WITH ONE FUEL ROD DEFECT - Before the adsorption column - Peak	KRIPTON 87 - OPERATION WITH ONE FUEL ROD DEFECT - Before the adsorption column - Saturation
	H = 150		H = 150	
0.5	1.0 (- 9)	2.3 (-10)	9.7 (-10)	5.1 (-10)
1.0	5.4 (-10)	1.2	4.8	2.5
2.0	2.7	6.1 (-11)	2.2	1.1
3.0	1.9	4.3	1.4	7.1 (-11)
4.0	1.3	3.0	8.6 (-11)	4.5
5.0	1.1	2.5	6.4	3.4
6.0	8.6 (-11)	1.9	4.5	2.3
7.0	7.6	1.7	3.6	1.9
8.0	6.2	1.4	2.6	1.4
9.0	5.6	1.3	2.1	1.1
10.0	4.7	1.1	1.6	8.3 (-12)
20.0	1.8	4.0 (-12)	2.1 (-12)	1.1
	H = 200		H = 200	
0.5	7.7 (-10)	1.8 (-10)	7.3 (-10)	3.8 (-10)
1.0	4.0	9.2 (-11)	3.6	1.9
2.0	2.0	4.6	1.6	8.4 (-11)
3.0	1.4	3.2	1.0	5.4
4.0	9.9 (-11)	2.3	6.5 (-11)	3.4
5.0	8.3	1.9	4.8	2.5
6.0	6.4	1.5	3.4	1.8
7.0	5.7	1.3	2.7	1.4
8.0	4.6	1.1	2.0	1.0
9.0	4.2	9.5 (-12)	1.6	8.3 (-12)
10.0	3.5	8.0	1.2	6.2
20.0	1.3	3.0	1.5 (-12)	8.0 (-13)

CONCENTRATION (c/m^3) - FUMIGATION

DISTANCE Km	KRIPTON 88 OPERATION WITH ONE FUEL ROD DEFECT — Before the adsorption column		KRIPTON 89 OPERATION WITH ONE FUEL ROD DEFECT — Before the adsorption column	
	Peak	Saturation	Peak	Saturation
	H = 150		H = 150	
0.5	2.2 (- 9)	7.1 (-10)	6.4 (-11)	3.8 (-10)
1.0	1.1	3.7	5.7 (-12)	2.0
2.0	5.5 (-10)	1.8	8.1 (-14)	1.1
3.0	3.8	1.2	1.6 (-15)	7.8 (-11)
4.0	2.6	8.4 (-11)	3.2 (-17)	5.6
5.0	2.1	6.8	7.7 (-19)	4.9
6.0	1.6	5.1	1.7 (-20)	3.9
7.0	1.4	4.4	4.3 (-22)	3.6
8.0	1.1	3.5	1.0 (-23)	3.1
9.0	9.4 (-11)	3.1	2.6 (-25)	2.9
10.0	7.7	2.5	6.2 (-27)	2.5
20.0	2.2	7.3 (-12)	8.2 (-43)	1.4
	H = 200		H = 200	
0.5	1.6 (- 9)	5.3 (-10)	4.8 (-11)	2.9 (-10)
1.0	8.4 (-10)	2.8	4.3 (-12)	1.5
2.0	4.1	1.3	6.1 (-14)	7.9 (-11)
3.0	2.8	9.2 (-11)	1.2 (-15)	5.8
4.0	1.9	6.3	2.4 (-17)	4.2
5.0	1.6	5.1	5.8 (-18)	3.7
6.0	1.2	3.8	1.3 (-20)	3.0
7.0	1.0	3.3	3.2 (-22)	2.7
8.0	8.1 (-11)	2.6	7.5 (-24)	2.3
9.0	7.1	2.3	1.9 (-25)	2.2
10.0	5.8	1.9	4.6 (-27)	1.9
20.0	1.7	5.5 (-12)	6.2 (-43)	1.1

XENON 133 m
CONCENTRATION (c/m3) - FUMIGATION

DISTANCE Km	OPERATION WITH ONE FUEL ROD DEFECT			
	Before the adsorption column		After the adsorption column	
	Peak	Saturation	Peak	Saturation
			H = 150	
0.5	4.4 (-10)	1.0 (-11)	9.2 (-14)	2.2 (-15)
1.0	2.3	5.6 (-12)	4.9	1.2
2.0	1.2	2.9	2.5	6.0 (-16)
3.0	8.9 (-11)	2.1	1.9	4.4
4.0	6.5	1.6	1.4	3.2
5.0	5.6	1.3	1.2	2.8
6.0	4.5	1.1	9.5 (-15)	2.3
7.0	4.2	1.0	8.8	2.1
8.0	3.5	8.5 (-13)	7.4	1.8
9.0	3.3	7.9	7.0	1.6
10.0	2.9	6.9	6.1	1.4
20.0	1.6	3.9	3.4	8.0 (-17)
			H = 200	
0.5	3.3 (-10)	7.9 (-12)	6.9 (-14)	1.6 (-15)
1.0	1.7	4.2	3.7	8.7 (-16)
2.0	9.1 (-11)	2.2	1.9	4.5
3.0	6.6	1.6	1.4	3.3
4.0	4.8	1.2	1.0	2.4
5.0	4.2	1.0	8.8 (-15)	2.1
6.0	3.4	8.1	7.1	1.7
7.0	3.1	7.5	6.6	1.6
8.0	2.6	6.4	5.6	1.3
9.0	2.5	6.0	5.2	1.2
10.0	2.2	5.2	4.6	1.1
20.0	1.2	2.9	2.5	6.0 (-17)

XENON 133 m
CONCENTRATION (c/m^3) - FUMIGATION

DISTANCE Km	DESTRUCTIVE TEST WITH ONE ORGEL ELEMENT			
	Before the adsorption column		After the adsorption column	
	Peak	Saturation	Peak	Saturation
			H = 150	
0.5	1.4 (- 6)	3.5 (- 8)	3.0 (-10)	7.3 (-12)
1.0	7.6 (- 7)	1.9	1.6	3.9
2.0	4.0	9.6 (- 9)	8.3 (-11)	2.0
3.0	2.9	7.1	6.1	1.5
4.0	2.1	5.1	4.4	1.1
5.0	1.8	4.4	3.8	9.3 (-13)
6.0	1.5	3.6	3.1	7.5
7.0	1.4	3.3	2.9	6.9
8.0	1.2	2.8	2.4	5.9
9.0	1.1	2.6	2.3	5.5
10.0	9.5 (- 8)	2.3	2.0	4.8
20.0	5.3	1.3	1.1	2.7
			H = 200	
0.5	1.1 (- 6)	2.6 (- 8)	2.2 (-10)	5.5 (-12)
1.0	5.7 (- 7)	1.4	1.2	2.9
2.0	3.0	7.2 (- 9)	6.2 (-11)	1.5
3.0	2.2	5.3	4.6	1.1
4.0	1.6	3.9	3.3	8.1 (-13)
5.0	1.4	3.3	2.9	7.0
6.0	1.1	2.7	2.3	5.6
7.0	1.0	2.5	2.1	5.2
8.0	8.7 (- 8)	2.1	1.8	4.4
9.0	8.1	1.9	1.7	4.1
10.0	7.1	1.7	1.5	3.6
20.0	3.9	9.6 (-10)	8.3 (-12)	2.0

XENON 133
CONCENTRATION (c/m3) - FUMIGATION

DISTANCE Km	OPERATION WITH ONE FUEL ROD DEFECT			
	Before the adsorption column		After the adsorption column	
	Peak	Saturation	Peak	Saturation
			H = 150	
0.5	3.9 (- 8)	4.2 (-10)	1.0 (- 9)	1.1 (-11)
1.0	2.1	2.2	5.5 (-10)	5.8 (-12)
2.0	1.1	1.2	2.9	3.0
3.0	8.0 (- 9)	8.5 (-11)	2.1	2.2
4.0	5.8	6.2	1.5	1.6
5.0	5.0	5.4	1.3	1.4
6.0	4.1	4.3	1.1	1.1
7.0	3.8	4.0	1.0	1.0
8.0	3.2	3.4	8.5 (-11)	8.9 (-13)
9.0	3.0	3.2	8.0	8.4
10.0	2.6	2.8	7.0	7.4
20.0	1.5	1.6	4.0	4.2
			H = 200	
0.5	3.0 (- 8)	3.1 (-10)	7.8 (-10)	8.2 (-12)
1.0	1.6	1.7	4.1	4.4
2.0	8.1 (- 9)	8.7 (-11)	2.2	2.3
3.0	6.0	6.4	1.6	1.7
4.0	4.4	4.7	1.2	1.2
5.0	3.8	4.0	1.0	1.1
6.0	3.1	3.3	8.1 (-11)	8.5 (-13)
7.0	2.8	3.0	7.5	7.9
8.0	2.4	2.6	6.4	6.7
9.0	2.3	2.4	6.0	6.3
10.0	2.0	2.1	5.2	5.5
20.0	1.1	1.2	3.0	3.1

XENON 133
CONCENTRATION (c/m3) - FUMIGATION

DISTANCE Km	DESTRUCTIVE TEST WITH ONE ORGEL ELEMENT			
	Before the adsorption column		After the adsorption column	
	Peak	Saturation	Peak	Saturation
			H = 150	
0.5	5.9 (- 5)	6.2 (- 7)	1.6 (- 6)	1.7 (- 8)
1.0	3.2	3.3	8.4 (- 7)	8.8 (- 9)
2.0	1.6	1.7	4.4	4.6
3.0	1.2	1.3	3.2	3.4
4.0	8.8 (- 6)	9.3 (- 8)	2.3	2.5
5.0	7.7	8.1	2.0	2.1
6.0	6.2	6.5	1.6	1.7
7.0	5.7	6.0	1.5	1.6
8.0	4.9	5.1	1.3	1.4
9.0	4.6	4.8	1.2	1.3
10.0	4.0	4.2	1.1	1.1
20.0	2.3	2.4	6.0 (- 8)	6.3 (-10)
			H = 200	
0.5	4.4 (- 5)	4.7 (- 7)	1.2 (- 6)	1.2 (- 8)
1.0	2.4	2.5	6.3 (- 7)	6.6 (- 9)
2.0	1.2	1.3	3.3	3.5
3.0	9.1 (- 6)	9.6 (-8)	2.4	2.5
4.0	6.6	7.0	1.8	1.9
5.0	5.7	6.0	1.5	1.6
6.0	4.6	4.9	1.2	1.3
7.0	4.3	4.5	1.1	1.2
8.0	3.6	3.8	9.6 (- 8)	1.0
9.0	3.4	3.6	9.1	9.6 (-10)
10.0	3.0	3.2	7.9	8.4
20.0	1.7	1.8	4.5	4.8

CONCENTRATION (c/m^3) - FUMIGATION

DISTANCE Km	XENON 135 m		XENON 135	
	OPERATION WITH ONE FUEL ROD DEFECT		OPERATION WITH ONE FUEL ROD DEFECT	
	Before the adsorption column		Before the adsorption column	
	Peak	Saturation	Peak	Saturation
	H = 150		H = 150	
0.5	1.5 (- 9)	1.2 (- 9)	1.1 (- 8)	1.5 (- 9)
1.0	5.4 (-10)	4.6 (-10)	6.0 (- 9)	7.8 (-10)
2.0	1.4	1.1	3.1	4.0
3.0	4.9 (-11)	4.1 (-11)	2.2	2.9
4.0	1.7	1.4	1.6	2.1
5.0	7.1 (-12)	6.0 (-12)	1.3	1.8
6.0	2.8	2.3	1.1	1.4
7.0	1.2	1.0	9.6 (-10)	1.3
8.0	5.1 (-13)	4.3 (-13)	8.0	1.1
9.0	2.3	1.9	7.4	9.7 (-11)
10.0	9.8 (-14)	8.2 (-14)	6.4	8.3
20.0	3.8 (-17)	3.2 (-17)	3.0	3.9
	H = 200		H = 200	
0.5	1.1 (- 9)	9.2 (-10)	8.5 (- 9)	1.1 (- 9)
1.0	4.1 (-10)	3.4	4.5	5.9 (-10)
2.0	1.0	8.6 (-11)	2.3	3.0
3.0	3.6 (-11)	3.1	1.7	2.2
4.0	1.3	1.1	1.2	1.6
5.0	5.4 (-12)	4.5 (-12)	1.0	1.3
6.0	2.1	1.8	8.0 (-10)	1.0
7.0	9.3 (-13)	7.8 (-13)	7.2	9.5 (-11)
8.0	3.8	3.2	6.0	7.9
9.0	1.7	1.5	5.5	7.3
10.0	7.3 (-14)	6.1 (-14)	4.8	6.2
20.0	2.9 (-17)	2.4 (-17)	2.2	2.9

CONCENTRATION (c/m^3) - FUMIGATION

DISTANCE Km	XENON 137 — OPERATION WITH ONE FUEL ROD DEFECT — Before the adsorption column — Peak	XENON 137 — OPERATION WITH ONE FUEL ROD DEFECT — Before the adsorption column — Saturation	XENON 138 — OPERATION WITH ONE FUEL ROD DEFECT — Before the adsorption column — Peak	XENON 138 — OPERATION WITH ONE FUEL ROD DEFECT — Before the adsorption column — Saturation
	H = 150		H = 150	
0.5	1.3 (-10)	1.2 (-10)	7.7 (-10)	6.4 (-10)
1.0	1.5 (-11)	1.5 (-11)	2.9	2.4
2.0	4.0 (-13)	3.8 (-13)	7.6 (-11)	6.4 (-11)
3.0	1.5 (-14)	1.4 (-14)	2.8	2.3
4.0	5.3 (-16)	5.1 (-16)	1.0	8.6 (-12)
5.0	2.3 (-17)	2.2 (-17)	4.5 (-12)	3.7
6.0	9.3 (-19)	8.9 (-19)	1.8	1.5
7.0	4.3 (-20)	4.1 (-20)	8.5 (-13)	7.1 (-13)
8.0	1.8 (-21)	1.7 (-21)	3.6	3.0
9.0	8.5 (-23)	8.1 (-23)	1.7	1.4
10.0	3.7 (-24)	3.5 (-24)	7.5 (-14)	6.3 (-14)
20.0	2.0 (-37)	1.9 (-37)	4.4 (-17)	3.6 (-17)
	H = 200		H = 200	
0.5	9.7 (-11)	9.2 (-11)	5.8 (-10)	4.8 (-10)
1.0	1.2	1.1	2.2	1.8
2.0	3.0 (-13)	2.9 (-13)	5.7 (-11)	4.8 (-11)
3.0	1.1 (-14)	1.0 (-14)	2.1	1.8
4.0	4.0 (-16)	3.8 (-16)	7.8 (-12)	6.5 (-12)
5.0	1.7 (-17)	1.6 (-17)	3.4	2.8
6.0	7.0 (-19)	6.7 (-19)	1.4	1.1
7.0	3.2 (-20)	3.1 (-20)	6.4 (-13)	5.3 (-13)
8.0	1.4 (-21)	1.3 (-21)	2.7	2.3
9.0	6.4 (-23)	6.1 (-23)	1.3	1.1
10.0	2.8 (-24)	2.7 (-24)	5.6 (-14)	4.7 (-14)
20.0	1.5 (-37)	1.4 (-37)	3.3 (-17)	2.7 (-17)

KRIPTON 85
MELTING OF AN ORGEL ELEMENT WITHOUT PRESSURE TUBE RUPTURE
(Behind the adsorption column)

u = 2 m/s

DISTANCE Km	Q (0^h) (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
			h = 100	
0.5	1.9 (- 8)	2.5 (-12)	3.9 (-17)	9.9 (-34)
1.0	7.7	8.0 (- 9)	2.4 (-10)	1.6 (-16)
2.0	5.2	3.9 (- 8)	1.5 (- 8)	3.7 (-11)
3.0	3.0	4.7	2.8	1.2 (- 9)
4.0	2.0	4.2	3.5	4.2
5.0	1.5	3.7	3.5	7.0
6.0	1.1	3.1	3.4	8.8
7.0	8.8 (- 9)	2.7	3.3	1.0 (- 8)
8.0	7.3	2.4	3.1	1.1
9.0	5.9	2.1	3.0	1.3
10.0	5.0	1.9	2.7	1.5
20.0	1.9	8.5 (- 9)	1.5	1.5
			h = 150	
0.5	1.5 (-10)	7.5 (-20)	5.6 (-31)	=
1.0	2.1 (- 8)	2.6 (-11)	4.7 (-15)	2.0 (-29)
2.0	3.6	3.5 (- 9)	2.0 (-10)	9.2 (-17)
3.0	2.5	1.2 (- 8)	1.9 (- 9)	4.0 (-13)
4.0	1.8	1.6	4.4	1.3 (-11)
5.0	1.4	1.7	6.1	5.6
6.0	1.0	1.7	8.1	1.2 (-10)
7.0	8.3 (- 9)	1.7	9.2	2.0
8.0	6.9	1.6	1.0 (- 8)	3.2
9.0	5.7	1.5	1.1	5.0
10.0	4.9	1.3	1.2	8.9
20.0	1.9	7.3 (- 9)	1.0	2.3 (- 9)

KRIPTON 85

MELTING OF AN ORGEL ELEMENT WITHOUT PRESSURE TUBE RUPTURE
(Behind the adsorption column)

u = 2 m/s

DISTANCE Km	Q(24h) (c/m³)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
			h = 100	
0.5	1.0 (-13)	1.3 (-17)	2.1 (-22)	5.4 (-39)
1.0	4.2	4.4 (-14)	1.3 (-15)	8.6 (-22)
2.0	2.8	2.1 (-13)	8.1 (-14)	2.0 (-16)
3.0	1.6	2.5	1.5 (-13)	6.3 (-15)
4.0	1.1	2.3	1.9	2.3 (-14)
5.0	8.3 (-14)	2.0	1.9	3.8
6.0	6.1	1.7	1.8	4.7
7.0	4.8	1.5	1.8	5.4
8.0	3.9	1.3	1.7	6.0
9.0	3.2	1.1	1.6	6.8
10.0	2.7	1.0	1.5	8.2
20.0	1.0	4.6 (-14)	8.3 (-14)	8.1
			h = 150	
0.5	8.1 (-16)	4.1 (-25)	3.0 (-36)	=
1.0	1.1 (-13)	1.4 (-16)	2.5 (-20)	1.1 (-34)
2.0	1.9	1.9 (-14)	1.1 (-15)	5.0 (-22)
3.0	1.4	6.3	1.0 (-14)	2.2 (-18)
4.0	1.0	8.8	2.4	7.3 (-17)
5.0	7.5 (-14)	9.4	3.3	3.1 (-16)
6.0	5.7	9.4	4.4	6.3
7.0	4.5	9.1	5.0	1.1 (-15)
8.0	3.8	8.4	5.5	1.7
9.0	3.1	7.9	6.0	2.7
10.0	2.6	7.3	6.3	4.8
20.0	1.0	3.9	5.4	1.3 (-14)

XENON 133 m
MELTING OF AN ORGEL ELEMENT WITHOUT PRESSURE TUBE RUPTURE
(Behind the adsorption column)

u = 2 m/s

DISTANCE Km	Q (0^h) (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	7.0 (-11)	9.3 (-15)	1.5 (-19)	3.7 (-36)
1.0	2.9 (-10)	3.0 (-11)	9.0 (-13)	5.9 (-19)
2.0	1.9	1.5 (-10)	5.6 (-11)	1.4 (-13)
3.0	1.1	1.7	1.1 (-10)	4.3 (-12)
4.0	7.4 (-11)	1.6	1.3	1.6 (-11)
5.0	5.7	1.4	1.3	2.6
6.0	4.2	1.2	1.3	3.2
7.0	3.3	1.0	1.2	3.7
8.0	2.7	8.8 (-11)	1.1	4.1
9.0	2.2	7.8	1.1	4.7
10.0	1.9	6.8	1.0	5.6
20.0	6.9	3.1	5.6 (-11)	5.4
		h = 150		
0.5	5.6 (-13)	2.8 (-22)	2.1 (-33)	=
1.0	7.8 (-11)	9.7 (-14)	1.8 (-17)	7.3 (-32)
2.0	1.3 (-10)	1.3 (-11)	7.4 (-13)	3.4 (-19)
3.0	9.3 (-11)	4.3	7.0 (-12)	1.5 (-15)
4.0	6.6	6.1	1.7 (-11)	5.0 (-14)
5.0	5.2	6.5	2.3	2.1 (-13)
6.0	3.9	6.4	3.0	4.3
7.0	3.1	6.3	3.4	7.4
8.0	2.6	5.7	3.7	1.2 (-12)
9.0	2.1	5.4	4.1	1.8
10.0	1.8	5.0	4.3	3.3
20.0	6.8 (-12)	2.6	3.6	8.4

XENON 133 m
MELTING OF AN ORGEL ELEMENT WITHOUT PRESSURE TUBE RUPTURE
(Behind the adsorption column)

u = 2 m/s

DISTANCE Km	Q (24^h) (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	2.8 (-16)	3.7 (-20)	5.9 (-25)	1.5 (-41)
1.0	1.2 (-15)	1.2 (-16)	3.6 (-18)	2.4 (-24)
2.0	7.8 (-16)	5.8	2.2 (-16)	5.6 (-19)
3.0	4.5	7.0	4.2	1.7 (-17)
4.0	3.0	6.3	5.2	6.2
5.0	2.3	5.5	5.1	1.0 (-16)
6.0	1.7	4.6	5.0	1.3
7.0	1.3	4.0	4.9	1.5
8.0	1.1	3.5	4.6	1.6
9.0	8.8 (-17)	3.1	4.4	1.9
10.0	7.4	2.7	4.0	2.2
20.0	2.8	1.2	2.2	2.2
		h = 150		
0.5	2.3 (-18)	1.1 (-27)	8.3 (-39)	=
1.0	3.1 (-16)	3.9 (-19)	7.0 (-23)	2.9 (-37)
2.0	5.4	5.3 (-17)	3.0 (-18)	1.4 (-24)
3.0	3.7	1.7 (-16)	2.8 (-17)	6.0 (-21)
4.0	2.6	2.4	6.6	2.0 (-19)
5.0	2.1	2.6	9.0	8.4
6.0	1.6	2.6	1.2 (-16)	1.7 (-18)
7.0	1.2	2.5	1.4	3.0
8.0	1.0	2.3	1.5	4.8
9.0	8.4 (-17)	2.1	1.6	7.4
10.0	7.2	2.0	1.7	1.3 (-17)
20.0	2.7	1.1	1.4	3.4

XENON 133
MELTING OF AN ORGEL ELEMENT WITHOUT PRESSURE TUBE RUPTURE
(Behind the adsorption column)

u = 2 m/s

DISTANCE Km	Q (0^h) (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	3.50 (- 7)	4.67 (-11)	7.35 (-16)	1.85 (-32)
1.0	1.45 (- 6)	1.51 (- 7)	4.52 (- 9)	2.97 (-15)
2.0	9.74 (- 7)	7.32	2.81 (- 7)	6.98 (-10)
3.0	5.67	8.75	5.31	2.17 (- 8)
4.0	3.72	7.91	6.54	7.84
5.0	2.86	6.91	6.45	1.31 (- 7)
6.0	2.11	5.84	6.35	1.63
7.0	1.64	5.05	6.11	1.86
8.0	1.36	4.46	5.74	2.07
9.0	1.10	3.91	5.50	2.35
10.0	9.35 (- 8)	3.45	5.10	2.81
20.0	3.51	1.57	2.85	2.75
		h = 150		
0.5	2.81 (- 9)	1.41 (-18)	1.04 (-29)	=
1.0	3.91 (- 7)	4.85 (-10)	8.77 (-14)	3.66 (-28)
2.0	6.73	6.63 (- 8)	3.71 (- 9)	1.72 (-15)
3.0	4.68	2.18 (- 7)	3.52 (- 8)	7.48 (-12)
4.0	3.30	3.05	8.29	2.52 (-10)
5.0	2.59	3.25	1.14 (- 7)	1.05 (- 9)
6.0	1.96	3.24	1.51	2.16
7.0	1.55	3.15	1.71	3.75
8.0	1.30	2.89	1.89	6.00
9.0	1.06	2.70	2.07	9.31
10.0	9.04 (- 8)	2.51	2.15	1.66 (- 8)
20.0	3.45	1.34	1.84	4.29

XENON 133
MELTING OF AN ORGEL ELEMENT WITHOUT PRESSURE TUBE RUPTURE
(Behind the adsorption column)

u = 2 m/s

DISTANCE Km	Q (24^h) (c/m^3)			
	LAPSE	NEUTRAL	MODE.INV.	STRONG INV.
			h = 100	
0.5	1.79 (-12)	2.38 (-16)	3.76 (-21)	9.47 (-38)
1.0	7.42	7.70 (-13)	2.31 (-14)	1.52 (-20)
2.0	4.98	3.74 (-12)	1.44 (-12)	3.57 (-15)
3.0	2.90	4.47	2.71	1.11 (-13)
4.0	1.90	4.04	3.34	4.00
5.0	1.46	3.53	3.29	6.68
6.0	1.08	2.98	3.24	8.35
7.0	8.36 (-13)	2.58	3.13	9.52
8.0	6.95	2.28	2.93	1.06 (-12)
9.0	5.65	2.00	2.81	1.20
10.0	4.78	1.76	2.61	1.44
20.0	1.79	8.04 (-13)	1.45	1.41
			h = 150	
0.5	1.44 (-14)	7.22 (-24)	5.32 (-35)	=
1.0	2.00 (-12)	2.48 (-15)	4.48 (-19)	1.87 (-33)
2.0	3.44	3.39 (-13)	1.89 (-14)	8.79 (-21)
3.0	2.39	1.11 (-12)	1.80 (-13)	3.82 (-17)
4.0	1.69	1.56	4.24	1.29 (-15)
5.0	1.32	1.66	5.81	5.38
6.0	1.00	1.66	7.73	1.10 (-14)
7.0	7.90 (-13)	1.61	8.73	1.92
8.0	6.62	1.48	9.66	3.07
9.0	5.43	1.38	1.06 (-12)	4.76
10.0	4.62	1.28	1.10	8.48
20.0	1.77	6.87 (-13)	9.42 (-13)	2.19

KRIPTON 85
MELTING OF AN ORGEL ELEMENT WITHOUT PRESSURE TUBE RUPTURE
(Behind the adsorption column)

u = 2 m/s

DISTANCE Km	Q (10^h) (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
			h = 100	
0.5	3.4 (-10)	4.6 (-14)	7.2 (-19)	1.8 (-35)
1.0	1.4 (- 9)	1.5 (-10)	4.4 (-12)	2.9 (-18)
2.0	9.5 (-10)	7.2	2.8 (-10)	6.8 (-13)
3.0	5.6	8.6	5.2	2.1 (-11)
4.0	3.6	7.8	6.4	7.7
5.0	2.8	6.8	6.3	1.3 (-10)
6.0	2.1	5.7	6.2	1.6
7.0	1.6	5.0	6.0	1.8
8.0	1.3	4.4	5.6	2.0
9.0	1.1	3.9	5.4	2.3
10.0	9.2 (-11)	3.4	5.0	2.8
20.0	3.5	1.6	2.8	2.7
			h = 150	
0.5	2.8 (-12)	1.4 (-21)	1.0 (-32)	=
1.0	3.8 (-10)	4.7 (-13)	8.6 (-17)	3.6 (-31)
2.0	6.6	6.5 (-11)	3.6 (-12)	1.7 (-18)
3.0	4.6	2.1 (-10)	3.5 (-11)	7.3 (-15)
4.0	3.2	3.0	8.1	2.5 (-13)
5.0	2.5	3.2	1.1 (-10)	1.0 (-12)
6.0	1.9	3.2	1.5	2.1
7.0	1.5	3.1	1.7	3.7
8.0	1.3	2.8	1.9	5.9
9.0	1.0	2.7	2.0	9.2
10.0	8.9 (-11)	2.5	2.1	1.6 (-11)
20.0	3.4	1.3	1.8	4.3

XENON 133 m
MELTING OF AN ORGEL ELEMENT WITHOUT PRESSURE TUBE RUPTURE
(Behind the adsorption column)

u = 2 m/s

DISTANCE Km	Q (10^{h}) (c/m^{3}) LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	1.2 (-12)	1.6 (-16)	2.4 (-21)	6.2 (-38)
1.0	4.8	5.0 (-13)	1.5 (-14)	9.9 (-21)
2.0	3.2	2.4 (-12)	9.3 (-13)	2.3 (-15)
3.0	1.9	2.9	1.8 (-12)	7.2 (-14)
4.0	1.2	2.6	2.2	2.6 (-13)
5.0	9.5 (-13)	2.3	2.1	4.3
6.0	7.0	1.9	2.1	5.4
7.0	5.4	1.7	2.0	6.2
8.0	4.5	1.5	1.9	6.9
9.0	3.7	1.3	1.8	7.8
10.0	3.1	1.1	1.7	9.3
20.0	1.5	5.1 (-13)	9.3 (-13)	9.0
		h = 150		
0.5	9.4 (-15)	4.7 (-24)	3.5 (-35)	=
1.0	1.3 (-12)	1.6 (-15)	2.9 (-19)	1.2 (-33)
2.0	2.2	2.2 (-13)	1.2 (-14)	5.7 (-21)
3.0	1.6	7.2	1.2 (-13)	2.5 (-17)
4.0	1.1	1.0 (-12)	2.8	8.4 (-16)
5.0	8.6 (-13)	1.1	3.8	3.5 (-15)
6.0	6.5	1.1	5.0	7.1
7.0	5.1	1.0	5.7	1.2 (-14)
8.0	4.3	9.6 (-13)	6.2	2.0
9.0	3.5	8.9	6.8	3.1
10.0	3.0	8.3	7.1	5.5
20.0	1.1	4.4	6.0	1.4 (-13)

XENON 133
MELTING OF AN ORGEL ELEMENT WITHOUT PRESSURE TUBE RUPTURE
(Behind the adsorption column)

$u = 2$ m/s

DISTANCE Km	Q (10^{n}) (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
			h = 100	
0.5	6.92 (- 9)	9.23 (-13)	1.45 (-17)	3.66 (-34)
1.0	2.87 (- 8)	2.98 (- 9)	8.94 (-11)	5.88 (-17)
2.0	1.93	1.45 (- 8)	5.56 (- 9)	1.38 (-11)
3.0	1.12	1.73	1.05 (- 8)	4.29 (-10)
4.0	7.35 (- 9)	1.56	1.29	1.55 (- 9)
5.0	5.66	1.37	1.27	2.59
6.0	4.17	1.15	1.26	3.23
7.0	3.24	9.99 (- 9)	1.21	3.69
8.0	2.69	8.82	1.13	4.10
9.0	2.19	7.74	1.09	4.65
10.0	1.85	6.83	1.01	5.55
20.0	6.94 (-10)	3.11	5.63 (- 9)	5.44
			h = 150	
0.5	5.57 (-10)	2.80 (-20)	2.06 (-31)	=
1.0	7.72 (- 9)	9.58 (-12)	1.73 (-15)	7.23 (-30)
2.0	1.33 (- 8)	1.31 (- 9)	7.33 (-11)	3.40 (-17)
3.0	9.25 (- 9)	4.30	6.97 (-10)	1.48 (-13)
4.0	6.53	6.04	1.64 (- 9)	4.99 (-12)
5.0	5.12	6.43	2.25	2.08 (-11)
6.0	3.87	6.41	2.99	4.26
7.0	3.06	6.23	3.38	7.41
8.0	2.56	5.71	3.74	1.19 (-10)
9.0	2.10	5.35	4.10	1.84
10.0	1.79	4.96	4.25	3.28
20.0	6.83 (-10)	2.66	3.65	8.49

KRIPTON 85
FUMIGATION (H = 30 m - $\bar{u}$ = 1 m/s)
MELTING OF AN ORGEL ELEMENT WITHOUT PRESSURE TUBE RUPTURE
(Behind the adsorption column)

(c/m^3)

DISTANCE Km	0^h	10^h	24^h
0.5	4.1 (- 6)	7.5 (- 8)	2.2 (-11)
1.0	2.2	4.0	1.2
2.0	1.1	2.1	6.2 (-12)
3.0	8.0 (- 7)	1.5	4.3
4.0	6.1	1.1	3.3
5.0	5.1	9.4 (- 9)	2.8
6.0	4.3	7.9	2.3
7.0	3.8	7.0	2.1
8.0	3.4	6.2	1.8
9.0	3.1	5.6	1.7
10.0	2.8	5.1	1.5
20.0	2.8	5.0	8.7 (-13)

XENON 133 m
FUMIGATION (H = 30 m - $\bar{u}$ = 1 m/s)
MELTING OF AN ORGEL ELEMENT WITHOUT PRESSURE TUBE RUPTURE
(Behind the adsorption column)

(c/m^3)

DISTANCE Km	0^h	10^h	24^h
0.5	1.5 (- 8)	2.6 (-10)	6.1 (-14)
1.0	8.2 (- 9)	1.4	3.3
2.0	4.2	7.1 (-11)	1.7
3.0	3.0	4.9	1.2
4.0	2.3	3.8	9.1 (-15)
5.0	1.9	3.2	7.6
6.0	1.6	2.6	6.3
7.0	1.4	2.3	5.6
8.0	1.2	2.1	5.0
9.0	1.1	1.9	4.5
10.0	1.0	1.7	4.1
20.0	5.6 (-10)	9.4 (-12)	2.3

XENON 133
FUMIGATION (H = 30 m - $\bar{u}$ = 1 m/s)
MELTING OF AN ORGEL ELEMENT WITHOUT PRESSURE TUBE RUPTURE
(Behind the adsorption column)

(c/m^3)

DISTANCE Km	0^h	10^h	24^h
0.5	7.67 (- 5)	1.52 (- 6)	3.92 (-10)
1.0	4.09	8.09 (- 7)	2.09
2.0	2.13	4.21	1.09
3.0	1.49	2.95	7.61 (-11)
4.0	1.14	2.26	5.85
5.0	9.58 (- 6)	1.89	4.90
6.0	8.01	1.59	4.10
7.0	7.05	1.39	3.60
8.0	6.29	1.24	3.21
9.0	5.68	1.12	2.90
10.0	5.17	1.02	2.64
20.0	2.93	5.80 (- 8)	1.50

KRIPTON 85 m
MELTING OF AN ORGEL ELEMENT AFTER RUPTURE OF A PRESSURE TUBE
(Behind the adsorption column)

u = 2 m/s

DISTANCE Km	(0.1 d) (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	5.46 (-11)	7.28 (-15)	1.15 (-19)	2.89 (-36)
1.0	2.24 (-10)	2.33 (-11)	6.99 (-13)	4.59 (-19)
2.0	1.47	1.11 (-10)	4.25 (-11)	1.06 (-13)
3.0	8.41 (-11)	1.30	7.87	3.21 (-12)
4.0	5.40	1.15	9.50	1.14 (-11)
5.0	4.07	9.83 (-11)	9.17	1.86
6.0	2.93	8.13	8.84	2.28
7.0	2.23	6.90	8.34	2.54
8.0	1.82	5.96	7.67	2.77
9.0	1.45	5.12	7.20	3.08
10.0	1.20	4.42	6.55	3.60
20.0	3.66 (-12)	1.64	2.96	2.87
		h = 150		
0.5	4.40 (-13)	2.21 (-22)	1.63 (-33)	=
1.0	6.04 (-11)	7.49 (-14)	1.36 (-17)	5.65 (-32)
2.0	1.02 (-10)	1.00 (-11)	5.61 (-13)	2.60 (-19)
3.0	6.93 (-11)	3.23	5.23 (-12)	1.11 (-15)
4.0	4.80	4.43	1.20 (-11)	3.66 (-14)
5.0	3.69	4.62	1.62	1.50 (-13)
6.0	2.72	4.51	2.11	3.00
7.0	2.11	4.30	2.33	5.11
8.0	1.73	3.86	2.52	8.02
9.0	1.39	3.54	2.71	1.22 (-12)
10.0	1.16	3.22	2.76	2.13
20.0	3.60 (-12)	1.40	1.92	4.47

KRIPTON 85
MELTING OF AN ORGEL ELEMENT AFTER RUPTURE OF A PRESSURE TUBE
(Behind the adsorption column)

u = 2 m/s

DISTANCE Km	(0.1 d) (c/m³)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	5.35 (-10)	7.14 (-14)	1.12 (-18)	2.83 (-35)
1.0	2.22 (-9)	2.30 (-10)	6.92 (-12)	4.55 (-18)
2.0	1.49	1.12 (-9)	4.30 (-10)	1.07 (-12)
3.0	8.69 (-10)	1.34	8.14	3.32 (-11)
4.0	5.70	1.21	1.00 (-9)	1.20 (-10)
5.0	4.39	1.06	9.89 (-10)	2.01
6.0	3.23	8.97 (-10)	9.75	2.51
7.0	2.52	7.77	9.40	2.86
8.0	2.09	6.86	8.83	3.19
9.0	1.70	6.02	8.47	3.62
10.0	1.44	5.32	7.86	4.33
20.0	5.45 (-11)	2.44	4.42	4.27
		h = 150		
0.5	4.31 (-12)	2.16 (-21)	1.59 (-32)	=
1.0	5.98 (-10)	7.41 (-13)	1.34 (-16)	5.60 (-31)
2.0	1.03 (-9)	1.01 (-10)	5.67 (-12)	2.63 (-18)
3.0	7.16 (-10)	3.33	5.40 (-11)	1.15 (-14)
4.0	5.06	4.68	1.27 (-10)	3.87 (-13)
5.0	3.98	4.99	1.74	1.61 (-12)
6.0	3.00	4.98	2.32	3.31
7.0	2.37	4.84	2.62	5.76
8.0	2.00	4.44	2.91	9.23
9.0	1.64	4.16	3.19	1.43 (-11)
10.0	1.39	3.86	3.31	2.55
20.0	5.36 (-11)	2.09	2.86	6.66

KRIPTON 85
MELTING OF AN ORGEL ELEMENT AFTER RUPTURE OF A PRESSURE TUBE
(Behind the adsorption column)

u = 2 m/s

DISTANCE Km	(2√2 d) (c/m3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	4.0 (-11)	5.4 (-15)	8.5 (-20)	2.1 (-36)
1.0	1.7 (-10)	1.7 (-11)	5.2 (-13)	3.4 (-19)
2.0	1.1	8.5	3.3 (-11)	8.1 (-14)
3.0	6.6 (-11)	1.0 (-10)	6.2	2.5 (-12)
4.0	4.3	9.2 (-11)	7.6	9.1
5.0	3.3	8.0	7.5	1.5 (-11)
6.0	2.4	6.8	7.4	1.9
7.0	1.9	5.9	7.1	2.2
8.0	1.6	5.2	6.7	2.4
9.0	1.3	4.6	6.4	2.7
10.0	1.1	4.0	5.9	3.3
20.0	4.1	1.8	3.3	3.2
		h = 150		
0.5	3.3 (-13)	1.6 (-22)	1.2 (-33)	=
1.0	4.5 (-11)	5.6 (-14)	1.0 (-17)	4.2 (-32)
2.0	7.8	7.7 (-12)	4.3	2.0 (-19)
3.0	5.4	2.5	4.1 (-12)	8.7 (-16)
4.0	3.8	3.5	9.6	2.9 (-14)
5.0	3.0	3.8	1.3 (-11)	1.2 (-13)
6.0	2.3	3.8	1.8	2.5
7.0	1.8	3.7	2.0	4.4
8.0	1.5	3.4	2.2	7.0
9.0	1.2	3.1	2.4	1.1 (-12)
10.0	1.1	2.9	2.5	1.9
20.0	4.1 (-12)	1.6	2.2	5.0

KRIPTON 88
MELTING OF AN ORGEL ELEMENT AFTER RUPTURE OF A PRESSURE TUBE
(Behind the adsorption column)

u = 2 m/s

DISTANCE Km	(0.1 d) (c/m^3)			
	LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	2.40 (-12)	3.20 (-16)	5.04 (-21)	1.27 (-37)
1.0	8.00	1.02 (-12)	3.05 (-14)	2.01 (-20)
2.0	6.35	4.78	1.83 (-12)	4.55 (-15)
3.0	3.58	5.52	3.35	1.37 (-13)
4.0	2.27	4.82	3.99	4.78
5.0	1.69	4.08	3.80	7.71
6.0	1.20	3.33	3.62	9.31
7.0	9.02 (-13)	2.78	3.37	1.03 (-12)
8.0	7.24	2.38	3.06	1.11
9.0	5.69	2.02	2.83	1.21
10.0	4.66	1.72	2.54	1.40
20.0	1.25	5.59 (-13)	1.01	9.78 (-13)
		h = 150		
0.5	1.93 (-14)	9.69 (-24)	7.15 (-35)	=
1.0	2.63 (-12)	3.27 (-15)	5.92 (-19)	2.47 (-33)
2.0	4.39	4.32 (-13)	2.42 (-14)	1.12 (-20)
3.0	2.95	1.37 (-12)	2.22 (-13)	4.72 (-17)
4.0	2.01	1.86	5.05	1.54 (-15)
5.0	1.53	1.92	6.70	6.20
6.0	1.11	1.85	8.62	1.23 (-14)
7.0	8.51 (-13)	1.74	9.41	2.07
8.0	6.90	1.54	1.01 (-12)	3.2D
9.0	5.47	1.39	1.07	4.79
10.0	4.50	1.25	1.07	8.26
20.0	1.23	4.78 (-13)	6.55 (-13)	1.53 (-13)

XENON 133 m
MELTING OF AN ORGEL ELEMENT AFTER RUPTURE OF A PRESSURE TUBE
(Behind the adsorption column)

u = 2 m/s

DISTANCE Km	(0.1 d) (c/m³)			
	LAPSE	NEUTRAL	MODER. INV.	STRONG INV.
			h = 100	
0.5	3.0 (-15)	3.9 (-19)	6.2 (-24)	1.6 (-40)
1.0	1.2 (-14)	1.3 (-15)	3.8 (-17)	2.5 (-23)
2.0	8.2 (-15)	6.2	2.4 (-15)	5.9 (-18)
3.0	4.8	7.4	4.5	1.8 (-16)
4.0	3.1	6.7	5.5	6.6
5.0	2.4	5.8	5.4	1.1 (-15)
6.0	1.8	4.9	5.3	1.4
7.0	1.4	4.2	5.1	1.6
8.0	1.1	3.7	4.8	1.7
9.0	9.2 (-16)	3.3	4.6	2.0
10.0	7.8	2.9	4.3	2.3
20.0	2.9	1.3	2.4	2.3
			h = 150	
0.5	2.4 (-17)	1.2 (-26)	8.8 (-38)	=
1.0	3.3 (-15)	4.1 (-18)	7.4 (-22)	3.1 (-36)
2.0	5.7	5.6 (-16)	3.1 (-17)	1.4 (-23)
3.0	3.9	1.8 (-15)	3.0 (-16)	6.3 (-20)
4.0	2.8	2.6	7.0	2.1 (-18)
5.0	2.2	2.7	9.5	8.8
6.0	1.6	2.7	1.3 (-15)	1.8 (-17)
7.0	1.3	2.6	1.4	3.1
8.0	1.1	2.4	1.6	5.0
9.0	8.9 (-16)	2.3	1.7	7.8
10.0	7.6	2.1	1.8	1.4 (-16)
20.0	2.9	1.1	1.5	3.6

XENON 133 m
MELTING OF AN ORGEL ELEMENT AFTER RUPTURE OF A PRESSURE TUBE
(Behind the adsorption column)

u = 2 m/s

DISTANCE Km	(2√2 d) (c/m^3)			
	LAPSE	NEUTRAL	MODER. INV.	STRONG INV.
		h = 100		
0.5	1.94 (-16)	2.59 (-20)	4.08 (-25)	1.03 (-41)
1.0	8.06	8.36 (-17)	2.51 (-13)	1.65 (-24)
2.0	5.40	4.06 (-16)	1.56 (-16)	3.87 (-19)
3.0	3.14	4.85	2.94	1.20 (-17)
4.0	2.06	4.38	3.62	4.34
5.0	1.58	3.82	3.56	7.23
6.0	1.16	3.22	3.51	9.02
7.0	9.03 (-17)	2.79	3.37	1.03 (-16)
8.0	7.49	2.46	3.16	1.14
9.0	6.08	2.16	3.03	1.29
10.0	5.15	1.90	2.81	1.54
20.0	1.91	8.56 (-17)	1.55	1.50
		h = 150		
0.5	1.56 (-18)	7.84 (-28)	5.78 (-39)	=
1.0	2.17 (-16)	2.69 (-19)	4.87 (-23)	2.03 (-37)
2.0	3.73	3.67 (-17)	2.05 (-18)	9.53 (-25)
3.0	2.59	1.20 (-16)	1.95 (-17)	4.14 (-21)
4.0	1.83	1.69	4.59	1.39 (-19)
5.0	1.43	1.80	6.28	5.82
6.0	1.08	1.79	8.35	1.19 (-18)
7.0	8.52 (-17)	1.74	9.42	2.07
8.0	7.14	1.59	1.04 (-16)	3.31
9.0	5.85	1.49	1.14	5.13
10.0	4.97	1.38	1.18	9.12
20.0	1.88	7.32 (-17)	1.00	2.34 (-17)

XENON 133
MELTING OF AN ORGEL ELEMENT AFTER RUPTURE OF A PRESSURE TUBE
(Behind the adsorption column)

u = 2 m/s

DISTANCE Km	(0.1 d) (c/m^3) LAPSE	NEUTRAL	MODER.INV.	STRONG INV.
		h = 100		
0.5	6.30 (-10)	8.40 (-14)	1.32 (-18)	3.33 (-35)
1.0	2.61 (- 9)	2.71 (-10)	8.14 (-12)	5.35 (-18)
2.0	1.75	1.32 (- 9)	5.06 (-10)	1.26 (-12)
3.0	1.02	1.58	9.56	3.90 (-11)
4.0	6.69 (-10)	1.42	1.18 (- 9)	1.41 (-10)
5.0	5.15	1.24	1.16	2.35
6.0	3.79	1.05	1.14	2.94
7.0	2.95	9.10 (-10)	1.10	3.35
8.0	2.45	8.03	1.03	3.73
9.0	1.99	7.05	9.90 (-10)	4.23
10.0	1.68	6.22	9.19	5.06
20.0	6.32 (-11)	2.83	5.12	4.95
		h = 150		
0.5	5.07 (-12)	2.54 (-21)	1.87 (-32)	=
1.0	7.03 (-10)	8.72 (-13)	1.58 (-16)	6.58 (-31)
2.0	1.21 (- 9)	1.93 (-10)	6.67 (-12)	3.10 (-18)
3.0	8.42 (-10)	3.92	6.34 (-11)	1.35 (-14)
4.0	5.94	5.49	1.49 (-10)	4.54 (-13)
5.0	4.66	5.85	2.04	1.89 (-12)
6.0	3.52	5.83	2.72	3.88
7.0	2.78	5.67	3.07	6.75
8.0	2.33	5.20	3.40	1.08 (-11)
9.0	1.91	4.87	3.73	1.68
10.0	1.63	4.52	3.87	2.99
20.0	6.22 (-11)	2.42	3.32	7.73

XENON 133
MELTING OF AN ORGEL ELEMENT AFTER RUPTURE OF A PRESSURE TUBE
(Behind the adsorption column)

u = 2 m/s

DISTANCE Km	(2√2 d) (c/m³)			
	LAPSE	NEUTRAL	MODER. INV.	STRONG INV.
			h = 100	
0.5	4.12 (-11)	5.49 (-15)	8.66 (-20)	2.18 (-36)
1.0	1.71 (-10)	1.77 (-11)	5.33 (-13)	3.50 (-19)
2.0	1.15	8.63	3.31 (-11)	8.22 (-14)
3.0	6.68 (-11)	1.03 (-10)	6.25	2.55 (-12)
4.0	4.38	9.32 (-11)	7.71	9.23
5.0	3.37	8.14	7.59	1.54 (-11)
6.0	2.48	6.88	7.48	1.92
7.0	1.93	5.95	7.20	2.19
8.0	1.60	5.25	6.76	2.44
9.0	1.30	4.61	6.48	2.77
10.0	1.10	4.06	6.01	3.31
20.0	4.13 (-12)	1.85	3.35	3.24
			h = 150	
0.5	3.32 (-13)	1.66 (-22)	1.23 (-33)	=
1.0	4.60 (-11)	5.71 (-14)	1.03 (-17)	4.31 (-32)
2.0	7.93	7.80 (-12)	4.36 (-13)	2.03 (-19)
3.0	5.51	2.56 (-11)	4.15 (-12)	8.81 (-16)
4.0	3.89	3.59	9.76	2.97 (-14)
5.0	3.05	3.83	1.34 (-11)	1.24 (-13)
6.0	2.30	3.82	1.78	2.54
7.0	1.82	3.71	2.01	4.41
8.0	1.53	3.40	2.23	7.07
9.0	1.25	3.18	2.44	1.10 (-12)
10.0	1.07	2.95	2.53	1.95
20.0	4.07 (-12)	1.58	2.17	5.06

KRIPTON 85 m
FUMIGATION (H = 30 m - $\bar{u}$ = 1 m/s)
MELTING OF AN ORGEL ELEMENT AFTER RUPTURE OF A PRESSURE
(Behind the adsorption column)

(c/m^3)

DISTANCE Km	0.1 d	$2\sqrt{2}$ d
0.5	1.18 (- 8)	=
1.0	6.19 (- 9)	=
2.0	3.09	=
3.0	2.07	=
4.0	1.53	=
5.0	1.23	=
6.0	9.86 (-10)	=
7.0	8.32	=
8.0	7.12	=
9.0	6.17	=
10.0	5.39	=
20.0	2.02	=

KRIPTON 85
FUMIGATION ($H = 30$ m - $\bar{u} = 1$ m/s)
MELTING OF AN ORGEL ELEMENT AFTER RUPTURE OF A PRESSURE
(Behind the adsorption column)

(c/m^3)

DISTANCE Km	0.1 d	$2\sqrt{2}$ d
0.5	1.17 (- 7)	8.87 (- 9)
1.0	6.27 (- 8)	4.74
2.0	3.27	2.47
3.0	2.29	1.73
4.0	1.76	1.33
5.0	1.48	1.12
6.0	1.24	9.34 (-10)
7.0	1.09	8.23
8.0	9.73 (- 9)	7.36
9.0	8.80	6.65
10.0	8.03	6.07
20.0	4.62	3.49

KRIPTON 88
FUMIGATION (H = 30 - ū = 1 m/s)
MELTING OF AN ORGEL ELEMENT AFTER RUPTURE OF A PRESSURE
(Behind the adsorption column)

(c/m^3)

DISTANCE Km	0.1 d	$2\sqrt{2}$ d
0.5	5.17 (-10)	=
1.0	2.67	=
2.0	1.30	=
3.0	8.49 (-11)	=
4.0	6.09	=
5.0	4.77	=
6.0	3.73	=
7.0	3.07	=
8.0	2.56	=
9.0	2.16	=
10.0	1.84	=
20.0	5.31 (-12)	=

XENON 133 m
FUMIGATION (H = 30 m - $\bar{u}$ = 1 m/s)
MELTING OF AN ORGEL ELEMENT AFTER RUPTURE OF A PRESSURE
(Behind the adsorption column)

(c/m^3)

DISTANCE Km	0.1 d	$2\sqrt{2}$ d
0.5	6.5 (-13)	4.25 (-14)
1.0	3.4	2.27
2.0	1.8	1.18
3.0	1.3	8.22 (-15)
4.0	9.6 (-14)	6.30
5.0	8.0	5.27
6.0	6.7	4.40
7.0	5.9	3.86
8.0	5.2	3.44
9.0	4.7	3.10
10.0	4.3	2.82
20.0	2.4	1.57

XENON 133
FUMIGATION (H = 30 m - $\bar{u}$ = 1 m/s)
MELTING OF AN ORGEL ELEMENT AFTER RUPTURE OF A PRESSURE
(Behind the adsorption column)

DISTANCE Km	(c/m^3) 0.1 d	$2\sqrt{2}$ d
0.5	1.38 (- 7)	9.03 (- 9)
1.0	7.37 (- 8)	4.82
2.0	3.84	2.51
3.0	2.68	1.75
4.0	2.06	1.35
5.0	1.72	1.13
6.0	1.44	9.44 (-10)
7.0	1.27	8.30
8.0	1.13	7.41
9.0	1.02	6.69
10.0	9.31 (- 9)	6.09
20.0	5.28	3.45

BIBLIOGRAPHY

ANZANI A., GANDINO C. - 1960 - Misure di temperature sulla torre meteorologica di Ispra - CNI 83

BOHM S., SANTOMAURO L., SENNIS C. - 1961 - Reattore Ispra - 1 - Rapporto di Sicurezza - CNI - 99

BOLLINI G. - 1965 - Precipitazioni atmosferiche ad Ispra (1959 - 1964) C.C.R. Ispra

BOLLINI G., GANDINO C., SANTOMAURO L. - 1960 - 2° Annuario Osservatorio Meteorologico Ispra - CNI - 82

BOLLINI G., GANDINO C., SCAGLIANTI B. - 1961 - 3° Annuario Meteorologico Osservatorio Ispra - EUR 27.1

BOLLINI G., DANESE L., GANDINO C., SCAGLIANTI B. - 1962 4° Annuario Meteorologico Osservatorio Ispra - EUR 276.1

BOLLINI G., GANDINO C., SCAGLIANTI B. - 1963 - 5° Annuario Meteorologico Osservatorio Ispra - EUR 1617.1

CHURCH P.E. - 1949 - Dilution of waste stack gases in the atmosphere, Ind.and Eng. Chem., 41, p. 2753

CLARKE J.F. - 1964 - A simple diffusion model for calculating point concentrations from multiple sources, APCA J. 14, p. 347

DAVENPORT A.G. - 1961 - The spectrum of horizontal gustiness near the ground in the high winds, Quar. J. Roy. Met. Soc., 87, p. 194

DAVIDSON W.F. - 1942 - A study of atmospheric pollution, Mo. Weath. Rev., 70, p. 225

DEACON E.L. - 1959 - The problem of atmospheric pollution, Int. J. Air Poll., 2, p. 92

FARMER F.R. - 1962 - The evaluation of power reactor sites, UKAEA, DPR/INF/266

GANDINO C. - 1959 - 1° Annuario dell'Osservatorio Meteorologico di Ispra - CNRN Ispra

GANDINO C. - 1962 - Anemologia ad Ispra - Geof. e Met. Vol.X

GANDINO C. - 1965 - La XIII Assemblea della Soc. It. di Geof. e Met. - Ing. Nucl. n. 3

GIFFORD F.A. - 1959 - Meteorology in relation to reactor hazards and sites evaluation, VI Rass. Int. Elettronica e Nucl. - Roma - Vol. II Parte II p. 5

HOLLAND I.Z., MYERS R.F. - 1952 - A contribution to the climatology of turbulence, Bull. Am. Met. Soc., 33, p. 2

LAIHTHAM D.L. - 1959 - Boundary layer turbulence and external parameters, Adv. in Geoph., Vol. 6

LAIHTHAM D.L. - 1961 - Fizika pogranichnogo sloya atmosphery, Gimiz - Leningrad

LUMLEY J.L., PANOFSKY H.A. - 1964 - The structure of atmospheric turbulence, John Wiley and S., London

Mc CORMICK R.A. - 1953 - The partition of eddy energy at 300 feet the surface during unstable condition at Upton N.Y., Bull. Am. Met. Soc., 79, p. 939

MEADE P.J., PASQUILL F. - 1957 - A study of the average distribution around Staythorpe, J.Atm. Poll. res., 1, p. 60

MONIN A.S., OBUKHOV A.M. - 1954 - Basic regularity in turbulent mixing in the surface layer of the atmosphere, Trudy Geophys. Inst. ANSSSR, n. 24

MOSES H., STROM G.H., CARSON G.E. - 1964 - Effects of Meteorological and Engineering Factors on Stack Plume Rise - Nuclear Safety - Vol. 6, 1

PANOFSKY H.A. - 1953 - The variation of the turbulence spectrum with height under superadiabatic conditions, Qaur. J. Roy. Met. Soc., 79 p. 939

PANOFSKY H.A. - 1962 - Scale analysis of atmospheric turbulence at 2 m, Quar. J. Roy. Met. Soc., 88,p. 57

PANOFSKY H.A., Mc CORMICK R.A. - 1960 - The spectrum of vertical velocity near the surface, Quar. J. Roy. Met. Soc., 87, p. 194

PASQUILL F. - 1961 - The estimation of the dispersion of windborne material, The Met. Mag., 90,p.33

PRIESTLEY C.H.B., Mc CORMICK R.A. - 1958 - Turbulent diffusion in the atmosphere, O.M.M., Techn.Note n.24

SANTOMAURO L. - 1956 - Gli aspetti meteorologici degli inquinamenti atmosferici, Atti Conv. sull'inquin. dell'atm., Milano

SANTOMAURO L. - 1959 - Esempio di una organizzazione di misure meteorologiche nell'interno di un impianto nucleare, VI Rass. Int. Elettron, e Nucl., Vol. II, p. 155

SANTOMAURO L. - 1960 - Studio analitico preliminare della struttura termica dei bassi strati atmosferici della Valpadana, Atti Ass. Geof. It. X Convegno

SANTOMAURO L. - 1962 - Scarico di rifiuti gassosi radioattivi nell'atmosfera, CNEN - Roma

SANTOMAURO L. - 1964 - Caratteristiche meteorologiche invernali dell'area milanese - Tecn. San., 5, p. 577

SCHMIDT F.H. - 1960 - On the dependence on stability of the parameter in Sutton's diffusion formula, Beitr. Phys. Atm.,33,p.112

SINGER I.A. , SMITH M.E. - 1953 - Relation of gustiness to other meteorological parameters, J. of Met. 10, p. 121

SMITH F.B. - 1965 - The role of wind shear in horizontal diffusion of ambient particles, Quar. J. Roy. Met. Soc., 91, p. 318

SMITH M.E. - 1951 - The forecasting of micrometeorological variables, Met. Mon. 1.4.

SUTTON O.G. - 1953 - Micrometeorology, Mc Graw-Hill

TYLDESLEY J.B., WALLINGTON C.E. - 1965 - The effect of wind shear and vertical diffusion on horizontal dispersion, Quar.J. Roy. Met. Soc., 91, p. 158

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