**COMMISSION
OF THE
EUROPEAN COMMUNITIES**

Directorate-General
for Social Affairs

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V/F/I

V/F/1966/74 e

NON-ORGANIC MICROPOLLUTANTS OF THE ENVIRONMENT

Volume 1

GENERAL PRESENTATION

REPORT OF A WORKING GROUP OF EXPERTS

Prepared for the Commission of the European Communities

Rapporteur: J. BOUQUIAUX

(Institut d'Hygiène et d'Epidémiologie; Ministère de la Santé Publique,
de la Famille et de l'Environnement, Bruxelles, Belgique)

Luxembourg July 1974

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Volume 1

GENERAL PRESENTATION

Volume 2: Detailed listing of....
Volume 3: Synthesis of data....
Volume 4: Methods of analysis

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NON-ORGANIC MICROPOLLUTANTS OF THE ENVIRONMENT

VOLUME 1. GENERAL PRESENTATION.

SUMMARY

LIST OF EXPERTS

COUNTRY	NAME	ADRESS	PRESENT AT THE MEETING N°
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Meetings n°1 - 7 December 1972

n°2 - 20-21 March 1973

n°3 - 14-15-16 November 1973

COUNTRY	NAME	ADRESS	PRESENT AT THE MEETING N°
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COUNTRY	NAME	ADRESS	PRESENT AT THE MEETING N°
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NON - ORGANIC MICROPOLLUTANTS OF THE ENVIRONMENT

A. FOREWORD

This report has been prepared by the working group on the consequences for man and his environment, of environmental pollution due to non-organic micropollutants; it is part of the outline of actions that have to be undertaken at Community level in the domain of reduction of pollutions and nuisances. These actions are included in a comprehensive programme of the European Communities in the field of environment that has been accepted by the Council of Ministers on the 19th of July 1973.

Non-organic micropollutants are listed in the first category of pollutants of the environment which have to be considered primarily because of their toxicity and of the present state of knowledge concerning their sanitary and ecological importance.

The objective evaluation of risks being the aim of the general programme a knowledge is required of the level of these pollutants in the environment as well as a study and analysis of the undesirable effects which would result from exposure of the target to a given pollution or nuisance.

At a meeting held on December 7th 1972, the working group decided to prepare an inventory of the data available since 1968 on the levels of non-organic micropollutants in the environment. The report has been compiled by Mr BOUQUIAUX from information supplied by delegates of the various Member States. The list of micropollutants was examined at the meeting of December 7th, 1972. The final date agreed by the rapporteur for receipt of information was May 15th 1973.

A first draft of the report was examined at the meeting of March 20th and 21st 1973. The final text was discussed at the meeting on November 14th-16th 1973 and was agreed by the experts present except for Volume 4 which was written by Mr BOUQUIAUX after the last meeting.

It should be remembered that 2 important non-organic micropollutants were studied in depth at the Symposium "Problems of contamination of man and his environment by Mercury and Cadmium" organised by the Commission of the European Communities in Luxembourg on 3-5th July 1973.

The whole report appears in 4 volumes entitled:

Volume 1 - general presentation;
Volume 2 - detailed listing of levels present in the environment;
Volume 3 - synthesis of data;
Volume 4 - methods of analysis.

B. PRESENTATION OF THE DOCUMENTS

The available information for 26 elements sent to the Directorate of Health Protection of the Commission for the European Communities by representatives of its member countries in an attempt to compile an inventory of data on the occurrence of non-organic micropollutants in the environment is presented in Volumes 2 and 3 .
Volume 2 classifies about 77,000 measurements and the data for each element are set out in eleven chapters according to the nature of the samples on which they are based .

Where not already done by the authors of the data, series of individual results have been grouped so as to list the number of samples (n) , the lowest value (X min) , the highest value (X max) - these present the range - and the arithmetic mean ($\overline{X}$) . Data resulting from a special situation or characteristic of the samples analysed have been presented separately eg 'hot-spots' . This treatment of the data has permitted a reasonably homogeneous presentation of results from many sources which is the pre-requisite for an analysis and interpretation of present situation . In this connection it should be remembered that some elements are natural micro-constituents of the environement and where this is the case they are not to be considered as micropollutants .

Volume 3 contains an analysis of the results set out in tables that correspond to those in Volume 2. The tables show the 'ordinary' levels of the non-organic micropollutants or micro-constituents that occur in waters, sediments, living organisms, food products, air and soil . The 'ordinary' level is expressed as a range of results from which extreme and exceptional concentrations as well as those from special situations have been omitted (they are the subject of separate consideration) .
In addition to the 'ordinary' concentration there is included a value on which the 'ordinary' concentration is centered .

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This value is not always the average of the results but covers a more restricted area than the range , in which the averages given by authors occur with greater frequency . The numbers of samples on which the 'ordinary' and centre values have been established have been given in the tables so as to give some indication of the confidence that can be attached to them.

This kind of treatment of the data was considered necessay if a picture of the situation was to be presented since it was impossible to derive median values (in the statistical sense) in the absence of availability of every individual result and the fact that in many scientific publications only averages had been quoted . Even so the data have yielded a very useful picture helped by the fact that the majority of the results are of recent origin (1969 to 1973) and with few exceptions they have been obtained using modern methods of analysis such as atomic absorption, neutron activation, X-ray fluorescence and UV-spectrography . It is worth pointing out that although lead was the subject of special consideration by another Working Party , data were also submitted for this exercise and they have been included . In the case of cyanides no data were submitted and according to Belgian, Dutch and United Kingdom experience , the presence of cyanides is exceptional and is limited to specific and controllable pollution .

C. EVALUATION OF THE DATA

The results have been set out in 11 chapters according to origin of the samples (eg waters,sediments, etc..) . In some cases it was necessary to sub-divide chapters and this led to consideration of the results under 20 sections . Since 26 elements were covered there are 520 (20 X 26) element/section combinations . Table 1 sets these out and also gives the following information :- number of samples (n) , the numbers of authors submitting information, the level of the micropollutants in each section expressed as the decimal logarithm of the inverse of the concentration .

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It was to be expected that variations in the amount of information submitted would result in variations in coverage for each micropollutant . In fact although there are 520 possible element/section combinations there are results for only 199 of these combinations . Of these 199, 85 are based on less than 25 samples (or the number of samples was not stated) . 97 combinations are based on less than 50 samples and 133 on less than 100 samples, leaving 66 combinations based on more than 100 samples .

Of these 66 element/section combinations (which accounted for about 85% of the total number of samples), the following observations can be made :

24 combinations are based on data submitted by a single country only	(1 to 7 authors)
14 combinations are based on data submitted by 2 countries	(2 to 11 authors)
12 combinations are based on data submitted by 3 countries	(3 to 10 authors)
4 combinations are based on data submitted by 4 countries	(4 to 9 authors)
7 combinations are based on data submitted by 5 countries	(7 to 14 authors)
3 combinations are based on data submitted by 6 countries	(12 to 18 authors)
2 combinations are based on data submitted by 8 countries	(16 authors)

A further analysis of the data (Table 2) reveals that there were only 13 element/section combinations for which not less than 1,000 samples were available . The breakdown for these is as follows :

1 combination based on results from only a single country	Cd.6	(6 authors)
2 combinations based on results from 3 countries	As.8	(4 authors)
	Pb.6	(6 authors)
2 combinations based on results from 4 countries	Cd.8	(8 authors)
	Cu.8	(9 authors)
4 combinations based on results from 5 countries	Cd.1	(14 authors)
	Cu.1	(13 authors)
	Pb.1	(14 authors)
	Pb.8	(8 authors)

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2 combinations based on results from 6 countries	Hg.1	(18 authors)
	Hg.5	(12 authors)
2 combinations based on results from 8 countries	Hg.6	(16 authors)
	Hg.8	(16 authors)

It is very clear from the above that the 77,000 results submitted are very badly and irregularly distributed amongst the various element/section combinations and Table 1 shows where data are lacking or inadequate . For example the situation for food in respect of the priority micropollutants is that while more than 7,000 results are available for Hg, only between 1,000 and 2,500 are available for As, Cd, Cu, Pb and about 100 results for Cr, Sn and Zn . No data at all were sent in on the occurrence of Be and Ni in food . Nearly all the results for Cd in marine organisms come from the United Kingdom .

Some interesting observations can be made in respect of some geographical areas. Thus the influence of geology can be noted in the River Conway (UK) where there is a marked difference in Cd and especially Zn between the eastern (non-mineralized sector) and the western (mineralized sector) . For sea water the following situations are apparent :

Eastern Irish Sea	-raised Cd and Zn levels
Welsh coastal areas	-raised Cd,Cu,Pb levels
English Channel;Severn Estuary and Belgian coastal area	-raised Cd, Cu, Pb,Zn levels.

For marine organisms :

English Channel; Severn Estuary	-raised Cd,Pb,Hg,Zn levels
UK estuaries and Mediterranean Sea	-raised Hg levels

For types of sample :

Tuna (especially blue fin) Swordfish	-raised Hg levels
Crab (brown meat)	-raised Cd levels

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D. COMPARISON OF RESULTS WITH EXISTING STANDARDS

Table 4 gives the international standards for drinking water (WHO 1972) together with the average and highest values sent in for drinking and river waters . The standards for Cd, Pb and Hg are exceeded by some samples of drinking water .

No such comparisons were made for food because of the lack of international standards . It can be pointed out however that some of the data (eg Hg in fish) show levels that could lead in special cases to an intake that may exceed the provisional tolerable weekly intakes recommended by FAO/WHO where these are available .

E. METHODS OF ANALYSIS

Table 5 shows the approximate percentages of samples analysed by the different techniques available. Wherever it was possible to use it atomic absorption was the method most frequently employed . X-ray fluorescence was used by only two authors for measuring Fe and Ti in soils and plants (ref.32) and for Cd, Pb and Ni in air particulates and in rain (ref.43) . UV-spectrography was used by one author for work on river and sea sediments, soils and plants (ref 15 and 32) . Polarography was used by five authors for work on river and sea waters (ref 13,19,24,25,50) and by one (ref.55) for measuring Cu in fruit . Neutron activation was used for the determination of Hg in various kinds of samples and for Mn and Zn in butter (ref 6.4 /6.7, 16,22,23,30.4, 34,36, 41 and 59) . Methyl-Hg was measured by gas chromatography .

For details on analytical methods , see Volume 4 .

F. CONCLUSIONS

1. Even though 77,000 analytical results were submitted it must be realised that they cover a considerable number of micropollutants and sections of the environment (199 element/ section combinations) and that the distribution of the results between these combinations and the member states of the Community is extremely variable .

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The overall statistical validity of the data is generally doubtful or low . This was to be expected because some of the results arose from isolated determinations while others were the result of designed programmes of work carried out to assess the current national situations in respect of specific non-organic micropollutants .
Even so the documents presented are valuable since they constitute a compendium of information which was previously lacking . In some cases results are available from a significant number of samples and from more than one or two countries .

2. The Council of Ministers (R/2255e/73(EW9)) agreed that certain non-organic micropollutants should be listed in an order of priority and that certain action should be taken by prescribed dates . The study that has been made of the presently available data which has not been done for every element in great depth shows clearly that more data will be required in certain sectors. Even amongst the priority elements there are some on which existing information is scarce eg Zn, Cu and Sn . Elements such as As,Ba,Be, Bi, Mo, Sb and V are only sporadically represented in the data . Further examination of the data may show other gaps and presumably further work , in some cases of an exploratory nature, should be encouraged .

3. To this end and to ensure as far as is possible that any further data obtained are both representative and comparable, any further work to be done should be carried out according to a generally accepted scheme . In this way the interpretation of data from the point of view both of its toxicological significance for man and for the quality of the other sectors of the environment can be made as realistic as possible .

4. For some micropollutants and for some sectors of the environment it appears that present data, though limited, may not require to be supplemented since their toxicological and environmental importance are already known from experimental work and the indications are that standards are not presently required . Where this is the case it is doubtful whether the limited resources of manpower and equipment should be used for work the results of which may not influence present thinking .

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Furthermore it should be remembered that there are other substances beside the non-organic micropollutants for which further data may be required .

5. Additionally , the situation in respect of the priority micropollutants should be kept under review so as to assess the success of any measures taken to limit their occurrence and to detect trends .

6. In concluding that there is a need for more work to be done the following observations should be taken into account :

   (i) In relation to the occurrence of micropollutants in human food, information on dietary patterns is very desirable . In some cases total diet studies should be considered . In this connection account must be taken of the considerable organisation required for such work and the costs involved .

   (ii) Account should be taken of especially vulnerable groups or sectors of the population and of 'hot spots' (ie situations where exposure is likely to be abnormally high). This also applies to other sectors of the environment .

7. Although not for this Working Group to undertake and realising that work may be already in hand, it is considered that the appropriate expert groups should address themselves to the following :

   (i) The desirability of collecting data on the occurrence of the listed micropollutants in appropriate humain tissues .

   (ii) Studies on the bio-availability, interactions (synergism/antagonism) of these substances both in man and other sectors of the environment .

   (iii) Recommendations for action to limit sources of contamination where such is possible .

TABLE 1.

GENERAL SYNTHESIS OF RESULTS.

SECTION OF THE ENVIRONMENT.		ANTIMONY			ARSENIC			BARIUM		
		n	Authors	p	n	Authors	p	n	Authors	p
1. River water		8	1	9	558	7	9(-8)			
2. Sea water (filtered)										
3. River sediments	<2µm									
	<16µm									
	80-mesh									
	DRY									
4. Sea sediments	<16µm									
	80-mesh									
	DRY				31	1	5			
5. Fresh water organisms	DRY	12	1	7(-5)	12	1	6(-5)			
	WET									
6. Sea organisms	DRY									
	WET				22	2	6			
7. Drinking water					98	4	≥9			
8. Food	WET	81	1	9	1549	4	9 - 7	65	1	7
9. Air	Air				?	1	12- 11			
	Partic	53	1	5	52	1	5			
	Rain				?	1	9			
10. Soil										
11. Plants	DRY									
		154			>2322			65		

n = number of samples

Authors = number of authors

p = $\log_{10}$ of inverse of concentration (W/W)

Concentrations between brackets are exceptional concentrations.

For the explanation of units, see Table 3.

TABLE 1.

SECTION OF THE ENVIRONMENT.		BERYLLIUM			BISMUTH			BORON		
		n	Authors	p	n	Authors	p	n	Authors	p
1. River water		199	1	>10	21	1	7.3	114	3	8-7
2. Sea water (filtered)										
3. River sediments	<2µm									
	<16µm									
	80-mesh									
	DRY									
4. Sea sediments	<16µm									
	80-mesh									
	DRY									
5. Fresh water organisms	DRY									
	WET									
6. Sea organisms	DRY									
	WET									
7. Drinking water		93	1	>10				11	1	8-7
8. Food	WET									
9. Air	Air									
	Partic									
	Rain									
10. Soil								13	1	4.3
11. Plants	DRY							15	1	5
		292			21			153		

n = number of samples

Authors = number of authors

p = $\log_{10}$ of inverse of concentration (W/W)

Concentrations between brackets are exceptional concentrations.
For the explanation of units, see Table 3.

TABLE 1.

SECTION OF THE ENVIRONMENT.		BROMINE			CADMIUM			CHROME		
		n	Authors	p	n	Authors	p	n	Authors	p
1. River water		8	1	8 (6.3)	994	14	9 (-8)	766	10	9-8 (-7)
2. Sea water (filtered)					277	11	10-9	48	1	>9
3. River sediments	<2µm				?	1	5	?	1	4-3
	<16µm									
	80-mesh							315	1	4
	DRY				83	5	6-5 (-4	78	2	5-4 (-3)
4. Sea sediments	<16µm									
	80-mesh							3	1	4.3
	DRY				42	2	(6)	78	2	5-4
5. Fresh water organisms	DRY	8	1	5-4				20	2	6
	WET				114	3	7			
6. Sea organisms	DRY									
	WET				3061	7	7 (-6-5			
7. Drinking water					170	5	10-9 (-8)	161	4	10-8
8. Food	WET	107	1	6	1577	8	9-7 (-6)	~100	2	8-6
9. Air	Air				?	3	12-10	?	2	12-11
	Partic	52	1	4-3	44	1	6-3	52	1	5-4
	Rain				?	1	>8	?	1	9
10. Soil					?	1	7-6	?	2	6-4
11. Plants	DRY							10	1	5
		175			>6362			>1631		

n = number of samples

Authors = number of authors

p = $\log_{10}$ of inverse of concentration (W/W)

Concentrations between brackets are exceptional concentrations.
For the explanation of units, see Table 3.

TABLE 1.

SECTION OF THE ENVIRONMENT.		COBALT			COPPER			FLUORINE		
		n	Authors	p	n	Authors	p	n	Authors	p
1. River water		544	7	10-8	1130	13	9-8 (-7)	100	1	7
2. Sea water (filtered)		~60	2	>8.3	405	10	10-9 (-8)			
3. River sediments	<2µm	?	1	4.3	?	1	4			
	<16µm				?	1	4			
	80-mesh	315	1	5-3	315	1	5-4			
	DRY	92	3	5	78	2	5-3			
4. Sea sediments	<16µm				?	1	4.3			
	80-mesh	3	1	5	3	1	5			
	DRY	43	1	6	78	2	6-4			
5. Fresh water organisms	DRY	4	1	6	20	2	6-5			
	WET									
6. Sea organisms	DRY									
	WET				598	5	6-5			
7. Drinking water		162	4	9-8	258	4	(9)-8 (-7)			
8. Food	WET	110	2	9-8	2736	9	8-6 (-5)			
9. Air	Air	?	2	13-12	?	3	12-10			
	Partic	52	1	5	43	1	4-2			
	Rain	?	1	10	?	1	8			
10. Soil		19	1	6-5	?	3	5 (-4-3)	4314	1	6-2.3
11. Plants	DRY				31	1	5 (-4)			
		>1404			>5695			4414		

n = number of samples

Authors = number of authors

p = $\log_{10}$ of inverse of concentration (W/W)

Concentrations between brackets are exceptional concentrations.
For the explanation of units, see Table 3.

TABLE 1.

SECTION OF THE ENVIRONMENT.		IRON			LEAD			MANGANESE		
		n	Authors	p	n	Authors	p	n	Authors	p
1. River water		527	6	8-6 (-5)	1018	14	9-8 (-7)	563	5	8-7 (-6.3)
2. Sea water (filtered)		174	3	10-8 (-7)	254	6	10-9 (-8)	202	2	10-8 (-7)
3. River sediments	<2µm				?	1	4-3.3			
	<16µm									
	80-mesh				315	1	4 (-2)	315	1	3.3-2
	DRY	12	1	2	99	3	4.3-3	84	2	4-3
4. Sea sediments	<16µm									
	80-mesh				3	1	4.3	3	1	3.3
	DRY				85	3	5-4	43	1	4-3
5. Fresh water organisms	DRY				58	2	6-5			
	WET									
6. Sea organisms	DRY	79	1	4-3				79	1	5-4
	WET				2212	6	7-6.3 (-6-5)			
7. Drinking water		631	2	8-6	166	5	9-8 (-7)	158	3	8-7
8. Food	WET	115	2	6-5	2155	8	7 (-6)	?	2	8-5
9. Air	Air	?	2	10-8	?	4	10-8	?	3	11-10
	Partic									
	Rain	?	1	7	?	1	7.3	?	1	8
10. Soil		17	1	3-2	?	3	5-4 (-3.3)	19	1	4
11. Plants	DRY	30	1	4-3	15	1	5	31	1	4
		>1585			>6380			>1497		

n = number of samples

Authors = number of authors

p = $\log_{10}$ of inverse of concentration (W/W)

Concentrations between brackets are exceptional concentrations
For the explanation of units, see Table 3.

TABLE 1.

SECTION OF THE ENVIRONMENT		MERCURY			MOLYBDENUM			NICKEL		
		n	Authors	p	n	Authors	p	n	Authors	p
1. River water		2254	18	11-9	281	3	10-9	946	13	9-8 (-7)
2. Sea water (filtered)		120	5	11-10				212	4	9
3. River sediments	<2µm	?	1	6-5				?	1	4
	<16µm	?	1	6-5						
	80-mesh				315	1	6-5	315	1	4.3-4
	DRY	460	4	8-7 (-6)				99	3	5-4
4. Sea sediments	<16µm									
	80-mesh				3	1	>6	3	1	5
	DRY	96	3	7 (-6)				43	1	5
5. Fresh water organisms	DRY							20	2	6-5
	WET	1754	12	7-6.3 (-6)						
6. Sea organisms	DRY							91	2	6-5
	WET	15351	16	7 (-6)						
7. Drinking water		123	8	10 (-8)	88	3	10-9	156	4	9-8
8. Food	WET	7174	16	9-8 (-7)	100	1	8			
9. Air	Air	?	2	13				?	2	12-10
	Partic	51	1	7-5						
	Rain	?	1	>10				?	1	>8.3
10. Soil								24	1	5
11. Plants	DRY									
		>27383			787			>1909		

n = number of samples

Authors = number of authors

p = $\log_{10}$ of inverse of concentration (W/W)

Concentrations between brackets are exceptional concentrations
For the explanation of units, see Table 3.

TABLE 1.

SECTION OF THE ENVIRONMENT.		SELENIUM			SILVER			STRONTIUM		
		n	Authors	p	n	Authors	p	n	Authors	p
1. River water		451	6	9	6	1	9	21	1	7 (-6)
2. Sea water (filtered)					20	1	11-10			
3. River sediments	<2µm									
	<16µm									
	80-mesh									
	DRY									
4. Sea sediments	<16µm									
	80-mesh									
	DRY									
5. Fresh water organisms	DRY	12	1	6-5						
	WET									
6. Sea organisms	DRY				71	1	7-6			
	WET									
7. Drinking water		95	3	9						
8. Food	WET	99	1	7						
9. Air	Air									
	Partic	53	1	6-5						
	Rain									
10. Soil										
11. Plants	DRY									
		710			97			21		

n = number of samples

Authors = number of authors

p = $\log_{10}$ of inverse of concentration (W/W)

Concentrations between brackets are exceptional concentrations

For the explanation of units, see Table 3.

TABLE 1.

SECTION OF THE ENVIONMENT.		TIN			TITANIUM			VANADIUM		
		n	Authors	p	n	Authors	p	n	Authors	p
1. River water								300	2	9-8
2. Sea water (filtered)										
3. River sediments	<2µm									
	<16µm									
	80-mesh	315	1	5-4	315	1	3-2.3	315	1	4
	DRY									
4. Sea sediments	<16µm									
	80-mesh	3	1	6	3	1	3	3	1	4.3
	DRY									
5. Fresh water organisms	DRY	10	1	5 (-3)						
	WET									
6. Sea organisms	DRY									
	WET									
7. Drinking water								72	3	9-8
8. Food	WET	99	3	6-4						
9. Air	Air							?	2	12-10
	Partic	42	1	4-3						
	Rain							?	1	9
10. Soil		14	2	5(-4.3)	11	1	2	24	1	5-4
11. Plants	DRY				13	1	5-4			
		483			342			>714		

n = number of samples

Authors= number of authors

p = $\log_{10}$ of inverse of concentration (W/W)

Concentrations between brackets are exceptional concentrations

For the explanation of units, see Table 3.

TABLE 1.

SECTION OF THE ENVIRONMENT		ZINC			ZIRCONIUM					
		n	Authors	p	n	Authors	p	n	Authors	p
1. River water		883	12	8-7 (-6)						
2. Sea water (filtered)		357	7	9-8 (-7.3)						
3. River sediments	<2µm	?	1	4-3						
	<16µm									
	80-mesh	315	1	4-3 (-2)						
	DRY	92	3	4-3 (-2.3)						
4. Sea sediments	<16µm									
	80-mesh	3	1	4						
	DRY	85	3	(5)-4 (-3.3)						
5. Fresh water organisms	DRY	20	2	4						
	WET									
6. Sea organisms	DRY									
	WET	322	6	5 (-4)						
7. Drinking water		264	5	8-7						
8. Food	WET	137	4	7-4						
9. Air	Air	?	2	10-8.3						
	Partic	52	1	3.3-1.3						
	Rain	?	1	7						
10. Soil		?	2	5-3.3 (-2.3)	24	1	4			
11. Plants	DRY	31	1	4.3 (-3)						
		>2561			24					

n = number of samples

Authors = number of authors

p = $\log_{10}$ of inverse of concentration (W/W)

Concentrations between brackets are exceptional concentrations

For the explanation of units, see Table 3.

TABLE 2.

RESULTS BASED ON MORE THAN 1000 SAMPLES

ELEMENT	SECTION OF THE ENVIRONMENT		ORDER OF MAGNITUDE OF CONCENTRATION		
	CODE	MEDIUM	n		up to
Arsenic	As.8	Food(except sea organisms)	1549	0.001 to 0.1 mg/kg	
Cadmium	Cd.1	River water	994	1 µg/ℓ	10 µg/ℓ
Cadmium	Cd.6	Sea organisms	3061	0.1 mg/kg	1 to 10 mg/kg
Cadmium	Cd.8	Food	1577	0.001 to 0.1 mg/kg	1 mg/kg
Copper	Cu.1	River water	1130	1 to 10 µg/ℓ	100 µg/ℓ
Copper	Cu.8	Food	2736	0.01 to 1 mg/kg	10 mg/kg
Lead	Pb.1	River water	1018	1 to 10 µg/ℓ	100 µg/ℓ
Lead	Pb.6	Sea organisms	2212	0.1 to 0.5 mg/kg	1 to 10 mg/kg
Lead	Pb.8	Food	2155	0.1 mg/kg	1 mg/kg
Mercury	Hg.1	River water	2254	0.01 to 1 µg/ℓ	
Mercury	Hg.5	Fresh water organisms	1754	0.1 to 0.5 mg/kg	1 mg/kg
Mercury	Hg.6	Sea organisms	15351	0.1 mg/kg	1 mg/kg
Mercury	Hg.8	Food	7174	0.001 to 0.01mg/kg	0.1 mg/kg

n = number of samples

Note : Results for Cd.6 are coming from one single country (UK)

TABLE 3.

EXPLANATION OF UNITS USED.

UNITS OF CONCENTRATION			INVERSE	LOG. INVERSE = p
1ppt	1 ng/kg	10^{-12}	10^{12}	12
1ppb	1 µg/kg, 1µg/ℓ	10^{-9}	10^{9}	9
1ppm	1 mg/kg	10^{-6}	10^{6}	6
	1 g/kg	10^{-3}	10^{3}	3
		$5X10^{-3} = 0.5X10^{-2}$	$2X10^{2}$	2.3
		10^{-2}	10^{2}	2

The expression p used in Table 1 , is useful for showing directly the order of concentration between various media .

TABLE 4.

COMPARISON OF RESULTS WITH EXISTING STANDARDS

	WHO STANDARDS 1972 µg/ℓ			RESULTS µg/ℓ	
	Limit conc.	max. recomm.	max. permiss.	Drinking water **	River water ** (unfiltered)
Arsenic	50			1.75 up to 8	6 up to 26
Cadmium	10(5)*			2 up to 13	2.5 up to 10
Copper		50	1500	39 up to 600	19 up to 300
Iron		100	1000	up to 8000	up to 20000
Lead	100(50)*			16 up to 110	19 up to 128
Manganese		50	500	24 up to 540	125 up to 650
Mercury	1			0.25 up to 13.5	0.35 up to 4.45
Selenium	10			~1 up to 5	~2.5 up to 10
Zinc		5000	15000	250 up to 1670	200 up to 3250

Remarks : * Between brackets : newly proposed standards (WHO, Helsinki meeting 1972)

** First number : mean of the results - of Vol.3

TABLE 5.

Approximate percentages of samples measured by the different methods .

Method	Total of samples	Sb	As	Ba	Be	Bi	B	Br	Cd	Cr	Co	Cu	F	Fe	Pb	Mn	Hg	Mo	Ni	Se	Ag	Sr	Sn	Ti	V	Zn	Zr
AA	81				100	100			88	84	80	83		67	93	90	92		93		100	100			3.5	84	
Col	8.5		98				85		2.5			6		25	0.5		0.1	87.5		75					91		
NA	7	100	2	100				100	2.5	8	11	2.5		7			8	12.5		25			90			6	
Pol	2								6			6			4											5	
UV	1.5						15		0.7	8	9	2.5		0.25	2.5	10	0.1		7				10		5.5	5	10(
X									<0.1					0.1	<0.1				0.1					100			

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