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TRACE ELEMENTS IN HUMAN TISSUE*

PART III. SUBJECTS FROM AFRICA, THE NEAR AND FAR EAST AND EUROPE

I. H. TIPTON,† H. A. SCHROEDER,‡ H. M. PERRY, Jr.§ and M. J. COOK‖

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Abstract—Central values and an estimate of variation about the central values are given for twenty-four trace elements and the ash per cent of dry weight of samples of ten different tissues of 162 adult subjects from outside continental United States. When groups of adult males from different geographical locations were compared, "essential" elements showed little geographical variation but those elements for which no role is known showed significant geographical difference.

INTRODUCTION

ONE of the objectives of the program for spectrographic analysis of human tissue which was described in the two previous papers[1,2] has been to estimate the variation in elemental composition of human beings with geographical location. In this phase of the program tissues from some 200 subjects from outside continental United States have been analyzed. Less than half of these subjects were victims of instantaneous accidental death and thus the majority were not "normal" by the criterion by which the American subjects were collected as described in Part I of this series.[1] The tissues from which the samples were taken showed no gross abnormalities, however.

Table 1 summarizes the distribution as to age, sex and geographical origin of all the subjects from outside the continental United States from whom samples of tissue were analyzed. The samples from African subjects were collected by Dr. PERRY and those from Europe and the Near East by Dr. SCHROEDER. To conserve space and to provide a larger sample for statistical treatment, subgroups of adults with approximately the same diets have been combined into four larger groups, Far Eastern, Near Eastern, African and Swiss, in reporting descriptive statistics.

The African adult subjects included forty-one negroids from five locations most of whom had lived under primitive conditions, and thirteen caucasoids from Addis Ababa and Cairo. The thirty-seven Near Eastern adult subjects were all caucasoids from cities in India and from Beirut, Lebanon. The Far Eastern group were all mongoloids from Thailand, Formosa, Hong Kong, Japan and the Philippine Islands. The nine Swiss subjects were all caucasoids. (Data and, when the sample size allows, descriptive statistics for each subgroup and for children in each group may be had on request to the authors.)

A sample of every tissue was not obtained from every subject. Table 1a shows the number of samples of each tissue that was included in the descriptive statistics for each of the larger groups of adults. Tables 1 and 1a also include information about samples from subjects from Alaska, Hawaii and Tokyo which were not included in the above-mentioned four groups because they either did not fit into the category of "similar diets" (Alaskan and Hawaiian

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† Department of Physics, The University of Tennessee, Knoxville, Tennessee.

‡ Department of Physiology, Dartmouth Medical School, Hanover, New Hampshire.

§ Established Investigator of the American Heart Association, Hypertension Division, Department of Internal Medicine, Washington University School of Medicine, St. Louis, Missouri.

‖ Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

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Table 1. Distribution of individuals from outside United States as to location of origin, age and sex

	Children 0–19 years		Adults >20 years		Sub-total		
Sex	M	F	M	F	Children	Adult	Total
African Continent	2	3	37	17	5	54	59
Caucasoid	—	—	5	8	—	13	
Egypt, Cairo	—	—	2	6	—	8	
Ethiopia, Addis Ababa	—	—	3	2	—	5	
Negroid	2	3	32	9	5	41	
Gabon, Lambarene	—	—	4	2	—	6	
Nigeria, Lagos	2	1	12	5	3	17	
Orange Free State, Welkom	—	—	5	—	—	5	
Burundi, Usumbura	—	2	7	2	2	9	
Uganda, Kampala	—	—	4	—	—	4	
Near East							
Caucasoid	9	—	30	7	9	37	46
India, Bombay	1	—	8	—	1	8	
India, Delhi	2	—	6	2	2	8	
India, Lucknow	1	—	4	—	1	4	
India, Vellore	5	—	7	3	5	10	
Lebanon, Beirut	—	—	5	2	—	7	
Far East							
Mongoloid	2	1	50	20	3	70	73
Formosa, Taipei	—	—	10	—	—	10	
Hong Kong	—	—	9	1	—	10	
Japan, Chiba	—	—	8	3	—	11	
Japan, Kyoto	—	—	8	3	—	11	
Japan, Tokyo	2	—	5	3	2	8	
Philippine Is., Manila	—	1	5	5	1	10	
Thailand, Bangkok	—	—	5	5	—	10	
Switzerland, Bern							
Caucasoid	—	—	5	4	—	9	9
*Alaska, Anchorage							
Mongoloid	—	—	2	—	—	2	2
*Hawaii, Honolulu	—	—	4	5	—	12†	12†
Caucasoid	—	—	2	2	—	4	
Mongoloid	—	—	2	3	—	5	
Grand total					17	184	201

* At the time of collection these countries were not states.
† Includes 3 Hawaiians of unknown race and sex.

subjects) or else did not receive the same analytical treatment (Yamagata group from Tokyo). (Data and, where possible, descriptive statistics are available for these three small groups.)

Table 1b shows the number of samples of the various tissues for adult males (20–59 years) from the United States and three of the large foreign groups (the Swiss group of this age was too small) which were compared for significant differences.

METHODS

The methods of collection and sample preparation have been discussed in earlier papers.[1,3]

Distribution-free statistical methods described in two earlier papers[1,4] were used in treating the data. In these methods a few extremely high values do not affect the measure of central tendency nor the analysis of variance. Distribution-free methods are in general not as sensitive

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Table 1a. *Number of samples of tissues of adult subjects*

	Number of subjects	Aorta	Brain	Heart	Kidney	Liver	Lung	Ovary	Pancreas	Spleen	Testis
African Continent	54	16	17	43	48	45	44	2	6	40	2
Nigeria, Lagos	17	10	4	17	16	15	13	—	—	13	—
Burundi, Usumbura	9	—	2	9	9	9	8	—	—	9	—
Uganda, Kampala	4	—	—	—	4	4	4	—	—	4	—
Gabon, Lambarene	6	—	—	6	5	5	6	—	—	5	—
Orange Free State, Welkom	5	2	2	3	5	3	3	—	—	2	—
Egypt, Cairo	8	1	5	3	4	4	5	1	3	2	—
Ethiopia, Addis Ababa	5	3	4	5	5	5	5	1	3	5	2
Near East	37	15	18	20	31	33	34	—	26	34	18
India, Bombay	8	3	8	7	8	8	7	—	8	8	7
India, Delhi	8	8	8	8	8	8	8	—	8	8	8
India, Lucknow	4	4	2	3	3	3	4	—	3	4	3
India, Vellore	10	—	—	2	6	8	8	—	6	8	—
Lebanon, Beirut	7	—	—	—	6	6	7	—	1	6	—
Far East	70	66	51	64	66	67	70	11	59	62	39
Formosa, Taipei	10	9	6	8	10	10	10	—	8	9	6
Hong Kong	10	10	10	10	10	10	10	1	9	10	9
Japan, Chiba	11	9	4	8	9	11	11	—	6	9	1
Japan, Kyoto	11	10	9	11	11	8	11	1	10	11	7
Japan, Tokyo	8	8	7	7	7	8	8	2	7	7	5
Philippines Is., Manila	10	10	5	10	9	10	10	2	10	7	6
Thailand, Bangkok	10	10	10	10	10	10	10	5	9	9	5
Switzerland, Bern	9	5	8	8	9	9	7	—	4	8	4
Alaska, Anchorage	2	2	—	2	2	1	2	—	1	2	—
Hawaii, Honolulu	12	8	4	11	12	10	11	4	9	11	3
Tokyo (Yamagata group)	18	13	17	16	16	15	15	1	10	9	8

Table 1b. *Number of samples of tissues of males* 20–59 *years*

	Number of subjects	Aorta	Brain	Heart	Kidney	Liver	Lung	Pancreas	Spleen	Testis
United States	88	64	74	83	87	88	85	82	86	60
Africa	34	13	9	28	32	30	28	2	28	2
Near East	24	9	12	13	19	22	22	16	22	13
Far East	39	35	22	34	38	38	38	31	35	26

nor as powerful as conventional methods but, when the distribution function is not known, as is the case for elements in this study, conventional methods may lead to erroneous conclusions.

RESULTS

As in the second paper of this series, values for concentration are reported as concentration in ash. The ash per cent of dry weight is included in the tables so that values can be converted to the dry basis. Since all samples of tissues had been preserved in formalin, it was impossible to obtain wet weights.

Statistics for the concentrations of elements and for the ash per cent of dry weight in ten tissues of adult subjects from Africa, the Near East, the Far East and Switzerland are given in Tables 2 through 11.

The descriptive statistics are the same as those reported in the preceding paper on adults from the United States[2] with two exceptions. First, the 80 per cent range and

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*Table 2. Concentrations of elements in tissues—aorta**

	Fraction observed	Total range		Median	95 Per cent confidence interval for Median		Mean	Std. error	Limits of sample mean value†	
	African subjects age ≥20 years									
Ash % of dry	16/16	0.2	12	4.4	1.9	6.3	4.4	0.73		
g/100 g of tissue ash										
Calcium	16/16	0.38	7.6	3.4	1.8	4.8	3.3	0.53		
Iron	16/16	0.16	1.2	0.27	0.19	0.50	0.41	0.08		
Magnesium	16/16	0.98	5.0	1.7	1.4	2.8	2.0	0.26		
Phosphorus	16/16	4	17	6	5	8	6	0.7		
Potassium	15/15	3	14	7	5	11	7	0.9		
μg/g of tissue ash										
Aluminum	16/16	60	1400	860	230	1100	740	100		
Copper	16/16	42	220	110	64	180	120	14		
Manganese	14/14	8	68	13	11	25	20	4.1		
Strontium	16/16	13	>100	34	23	78	54	12.0		
Zinc	16/16	450	2500	1600	1200	2200	1600	150		
Barium	16/16	4.0	33	15	10	22	16	2.0		
Bismuth	3/16	<2	33	<2	<2	<2			3	5
Boron	1/16	<10	20	<10	<10	<10			1	11
Cadmium	1/16	<50	50	<50	<50	<50			3	50
Chromium	15/15	0.1	31	5.4	1.8	6.6	6.6	2.1		
Cobalt	10/16	<2	700	2	<2	8			89	90
Gold	1/16	<10	10	<10	<10	<10			0	10
Lead	16/16	22	400	71	28	130	110	26		
Molybdenum	0/16	<4	<4	<4	<4	<4			0	4
Nickel	10/16	<5	60	6	<5	16			13	15
Silver	6/16	<0.1	1.0	<0.1	<0.1	0.5			0.1	0.2
Tin	6/16	<5	28	<5	<5	16			6	9
Titanium	13/16	<5	110	18	5	47			31	32
Vanadium	2/16	<1	1	<1	<1	<1			0	1

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	Near Eastern subjects age ≥20 years									
Ash % of dry	15/15	0.2	13	3.0	1.7	4.2	3.5	0.80		
g/100 g of tissue ash										
Calcium	15/15	0.24	>6.0	3.5	2.7	6.0	4.1	0.65		
Iron	15/15	0.25	1.3	0.46	0.32	0.80	0.59	0.08		
Magnesium	15/15	0.90	3.1	1.5	1.3	2.1	1.7	0.17		
Phosphorus	15/15	7	36	12	8	13	12	1.8		
Potassium	15/15	2	19	8	6	11	8	1.2		
μg/g of tissue ash										
Aluminum	15/15	92	1800	1000	240	1100	800	130		
Copper	15/15	90	410	150	100	310	200	28		
Manganese	13/13	2	46	17	10	30	19	3.3		
Strontium	15/15	7.6	76	39	19	50	39	5.0		
Zinc	13/13	920	2800	2200	1500	2700	2000	170		
Barium	15/15	5.0	>100	19	13	25	30	9.3	0	2
Bismuth	0/13	<2	<2	<2	<2	<2			4	12
Boron	4/13	<10	29	<10	<10	10			17	51
Cadmium	4/13	<50	66	<50	<50	50			23	23
Chromium	13/15	<0.1	180	10	5.3	13			6	7
Cobalt	8/15	<2	29	4	<2	8			19	26
Gold	4/14	<10	110	<10	<10	30				
Lead	13/13	41	340	140	68	330	180	32	0	4
Molybdenum	1/15	<4	10	<4	<4	<4			32	34
Nickel	9/15	<5	150	17	<5	53				
Silver	13/13	0.5	3.4	1.2	0.5	2.3	1.4	0.27	5	7
Tin	7/13	<5	11	10	<5	10			64	65
Titanium	14/15	<5	150	59	12	110			0	1
Vanadium	2/15	<1	3	<1	<1	<1				

* Concentration in aorta as indicated. For each element the column, "Fraction observed", indicates the number of samples in which the element was observed above the limits of detection and was thus actually observed, divided by the number of samples in which a determination of that element was made. For "Ash % of dry" the fraction is the number of samples for which values for this parameter were available, divided by the total number of samples of the tissues analyzed.

† See text (p. 444) for explanation.

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Table 2 (cont.)

	Fraction observed	Total range		Median	95 Per cent confidence interval for median		Mean	Std. error	Limits of sample mean value†	
	Far Eastern subjects age ≥20 years									
Ash % of dry	66/66	0.2	7.9	2.6	2.3	3.2	3.0	0.22		
g/100 g of tissue ash										
Calcium	65/65	0.15	>10.0	2.5	2.3	3.5	3.4	0.29		
Iron	65/65	0.08	5.5	0.46	0.38	0.54	0.70	0.09		
Magnesium	65/65	0.29	3.0	1.2	1.1	1.3	1.3	0.06		
Phosphorus	65/65	6	25	11	9	13	12	0.5		
Potassium	65/65	2	22	10	8	12	11	0.6		
μg/g of tissue ash										
Aluminum	65/65	12	7000	320	210	440	630	140		
Copper	65/65	53	1900	170	150	220	250	34		
Manganese	64/64	2	>200	19	16	25	37	5.9		
Strontium	65/65	0.3	>100	26	19	31	30	3.0		
Zinc	65/65	720	30000	2300	2000	2700	3700	610		
Barium	65/65	1.4	100	11	8.0	18	28	5.0		
Bismuth	16/66	<2	1000	<2	<2	<2			27	28
Boron	27/66	<10	550	<10	<10	10			19	25
Cadmium	43/66	<50	2400	50	50	68			120	140
Chromium	63/65	<0.1	260	10	7.0	18			23	23
Cobalt	32/65	<2	>1000	<2	<2	6			63	64
Gold	12/66	<10	110	<10	<10	<10			11	19
Lead	63/66	<5	2300	90	66	120			200	200
Molybdenum	20/65	<4	74	<4	<4	<4			7	9
Nickel	36/65	<5	>500	10	<5	19			29	31
Silver	55/66	<0.1	15	1.0	0.5	1.4			1.7	1.7
Tin	39/66	<5	80	12	<5	19			15	17
Titanium	53/65	<5	270	15	10	24			33	34
Vanadium	8/65	<1	29	<1	<1	<1			1	2

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	Swiss subjects age ≥20 years									
Ash % of dry	5/5	3.5	17	4.6	3.5	17	7.5	2.5		
g/100 g of tissue ash										
Calcium	5/5	3.1	8.8	8.0	3.1	8.8	6.6	1.1		
Iron	5/5	0.06	0.49	0.23	0.06	0.49	0.23	0.07		
Magnesium	5/5	0.40	1.4	0.56	0.40	1.4	0.69	0.18		
Phosphorus	5/5	6	14	8	6	14	8	1.4		
Potassium	4/4	2	20	2	2	20	6	4.5		
μg/g of tissue ash										
Aluminum	5/5	10	300	10	10	300	69	58		
Copper	5/5	47	350	58	47	350	110	59		
Manganese	5/5	4	27	5	4	27	9	4.4		
Strontium	5/5	2.0	18	10	2.0	18	9.8	2.5		
Zinc	5/5	520	1900	1200	520	1900	1300	230		
Barium	5/5	6.0	30	15	6.0	30	17	4.1		
Bismuth	1/5	<2	14	<2	<2	14			2	4
Boron	1/5	<10	10	<10	<10	10			2	10
Cadmium	2/5	<50	200	<50	<50	200			56	86
Chromium	5/5	3.2	120	8.8	3.2	120	30	23		
Cobalt	5/5	6	17	7	6	17	8	2.1		
Gold	1/5	<10	170	<10	<10	170			34	42
Lead	5/5	31	110	32	31	110	61	18		
Molybdenum	5/5	10	12	10	10	12	10	0.4		
Nickel	5/5	10	16	12	10	16	13	1.0		
Silver	2/5	<0.1	2.1	<0.1	<0.1	2.1			0.8	0.8
Tin	3/5	<5	14	10	<5	14			6	8
Titanium	5/5	10	22	10	10	22	12	2.4		
Vanadium	0/5	<1	<1	<1	<1	<1			0	1

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*Table 3. Concentrations of elements in tissues—brain**

	Fraction observed	Total range		Median	95 Per cent confidence interval for median		Mean	Std. error	Range of mean	
	African subjects age ≥20 years									
Ash % of dry	17/17	0.2	7.4	5.1	4.2	5.9	4.8	0.43		
g/100 g of tissue ash										
Calcium	17/17	0.20	1.4	0.60	0.42	0.72	0.61	0.07		
Iron	17/17	0.23	0.53	0.32	0.27	0.39	0.34	0.02		
Magnesium	17/17	0.37	1.8	1.1	0.90	1.3	1.1	0.09		
Phosphorus	17/17	18	30	24	22	27	25	0.8		
Potassium	17/17	5	36	21	14	27	20	1.9		
μg/g of tissue ash										
Aluminum	17/17	10	1800	92	62	190	210	100		
Copper	17/17	140	700	440	420	540	460	31		
Manganese	17/17	13	64	20	16	23	22	2.9		
Strontium	17/17	0.3	7.6	2.5	1.5	4.4	3.1	0.53		
Zinc	17/17	420	2300	760	600	800	930	140		
Barium	16/16	0.9	10	3.1	1.6	6.0	3.9	0.66		
Bismuth	1/17	<2	9	<2	<2	<2			0	2
Boron	4/17	<10	55	<10	<10	<10			5	13
Cadmium	0/17	<50	<50	<50	<50	<50			0	50
Chromium	17/17	0.1	19	0.6	0.2	1.6	2.2	1.1		
Cobalt	3/17	<2	9	<2	<2	<2			1	2
Gold	0/17	<10	<10	<10	<10	<10			0	10
Lead	12/17	<5	74	5	<5	13			12	14
Molybdenum	2/17	<4	19	<4	<4	<4			2	5
Nickel	2/17	<5	16	<5	<5	<5			1	6
Silver	6/17	<0.1	3.9	<0.1	<0.1	0.1			0.5	0.6
Tin	1/17	<5	30	<5	<5	<5			1	6
Titanium	8/17	<5	11	<5	<5	6			3	6
Vanadium	1/17	<1	1	<1	<1	<1			0	1

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	Near Eastern subjects age ≥20 years									
Ash % of dry	18/18	1.9	6.1	3.9	3.7	4.3	3.9	0.24		
g/100 g of tissue ash										
Calcium	18/18	0.29	2.3	0.48	0.37	1.1	0.72	0.12		
Iron	17/17	0.29	0.52	0.38	0.32	0.43	0.38	0.01		
Magnesium	18/18	0.64	1.2	0.86	0.78	1.0	0.89	0.04		
Phosphorus	18/18	17	29	23	21	25	23	0.7		
Potassium	18/18	10	27	20	18	22	20	1.0		
μg/g of tissue ash										
Aluminum	18/18	16	2800	170	100	260	360	160		
Copper	18/18	220	660	460	370	520	450	29		
Manganese	18/18	14	240	21	17	29	34	12		
Strontium	18/18	0.2	21	3.2	1.5	5.3	5.1	1.4		
Zinc	17/17	570	1300	780	720	1000	840	54		
Barium	18/18	0.9	30	4.9	1.5	16	9.0	2.2		
Bismuth	0/17	<2	<2	<2	<2	<2			0	2
Boron	8/17	<10	70	<10	<10	19			12	18
Cadmium	0/17	<50	<50	<50	<50	<50			0	50
Chromium	16/18	<0.1	8.2	2.1	1.6	3.0			2.5	2.5
Cobalt	0/18	<2	<2	<2	<2	<2			0	2
Gold	1/17	<10	22	<10	<10	<10			1	11
Lead	15/17	<5	400	14	10	38			43	44
Molybdenum	1/18	<4	12	<4	<4	<4			0	4
Nickel	1/18	<5	29	<5	<5	<5			1	6
Silver	15/17	<0.1	9.6	1.7	1.3	2.4			2.4	2.4
Tin	0/17	<5	<5	<5	<5	<5			0	5
Titanium	14/18	<5	130	13	5	21			20	21
Vanadium	0/18	<1	<1	<1	<1	<1			0	1

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Table 3 (cont.)

	Fraction observed	Total range		Median	95 Per cent confidence interval for median		Mean	Std. error	Range of mean	
	Far Eastern subjects age ≥20 years									
Ash % of dry	51/51	1.8	13	4.8	4.1	5.0	4.9	0.31		
g/100 g of tissue ash										
Calcium	51/51	0.09	>10	0.40	0.37	0.51	0.84	0.29		
Iron	51/51	0.11	6.0	0.39	0.35	0.44	0.58	0.12		
Magnesium	51/51	0.12	2.0	0.86	0.76	0.94	0.90	0.04		
Phosphorus	51/51	7	27	23	22	24	22	0.5		
Potassium	51/51	2	30	18	15	20	16	0.9		
μg/g of tissue ash										
Aluminum	51/51	10	1500	38	19	64	120	34		
Copper	51/51	60	880	420	370	470	450	26		
Manganese	51/51	2	100	20	18	22	25	2.7		
Strontium	51/51	0.3	48	1.1	0.9	1.9	4.3	1.2		
Zinc	51/51	380	5000	980	870	1200	1200	100		
Barium	51/51	0.3	35	2.3	1.8	3.3	4.5	0.87	4	5
Bismuth	4/51	<2	140	<2	<2	<2			19	25
Boron	22/51	<10	440	<10	<10	10			10	56
Cadmium	4/51	<50	360	<50	<50	<50			5.1	5.1
Chromium	49/51	<0.1	82	2.7	2.3	2.7			33	35
Cobalt	16/51	<2	>1000	<2	<2	<2			1	11
Gold	2/51	<10	40	<10	<10	<10			19	20
Lead	41/51	<5	240	10	10	14			2	5
Molybdenum	10/51	<4	14	<4	<4	<4			4	7
Nickel	15/51	<5	26	<5	<5	<5			2.4	2.4
Silver	39/51	<0.1	>50	0.5	0.5	1.1			1	6
Tin	3/51	<5	31	<5	<5	<5			6	8
Titanium	28/51	<5	31	5	<5	10			0	1
Vanadium	1/51	<1	4	<1	<1	<1				

1133732

	Swiss subjects age ≥20 years								
Ash % of dry	8/8	5.7	9.9	6.8	5.7	9.9	7.0	0.49	
g/100 g of tissue ash									
Calcium	8/8	0.39	1.3	0.52	0.39	1.3	0.62	0.10	
Iron	8/8	0.27	0.45	0.33	0.27	0.45	0.35	0.02	
Magnesium	8/8	0.72	1.1	0.96	0.72	1.1	0.95	0.05	
Phosphorus	8/8	14	26	19	14	26	20	1.6	
Potassium	8/8	11	26	21	11	26	20	2.0	
μg/g of tissue ash									
Aluminum	8/8	6	31	12	6	31	13	2.8	
Copper	8/8	120	500	360	120	500	340	45	
Manganese	8/8	14	26	18	14	26	20	1.7	
Strontium	8/8	1.0	3.6	1.8	1.0	3.6	2.2	0.34	
Zinc	8/8	570	1300	740	570	1300	800	79	
Barium	8/8	1.0	8.8	2.9	1.0	8.8	3.3	0.92	
Bismuth	3/8	<2	12	<2	<2	12			3 4
Boron	1/8	<10	58	<10	<10	58			7 16
Cadmium	2/8	<50	50	<50	<50	50			13 50
Chromium	8/8	0.1	14	1.9	0.1	14	3.5	1.7	
Cobalt	4/8	<2	110	3	<2	110			22 23
Gold	0/8	<10	<10	<10	<10	<10			0 10
Lead	8/8	5	15	5	5	15	6	1.2	
Molybdenum	0/8	<4	<4	<4	<4	<4			0 4
Nickel	2/8	<5	11	<5	<5	11			2 6
Silver	5/8	<0.1	1.7	0.5	<0.1	1.7			0.5 0.6
Tin	0/8	<5	<5	<5	<5	<5			0 5
Titanium	0/8	<5	<5	<5	<5	<5			0 5
Vanadium	0/8	<1	<1	<1	<1	<1			0 1

* Concentration in brain as indicated. For each element the column, "Fraction observed", indicates the number of samples in which the element was observed above the limits of detection and was thus actually observed, divided by the number of samples in which a determination of that element was made. For "Ash % of dry" the fraction is the number of samples for which values for this parameter were available, divided by the total number of samples of the tissues analyzed.

1133733

*Table 4. Concentrations of elements in tissues—heart**

	Fraction observed	Total range		Median	95 Per cent confidence interval for median		Mean	Std. error	Limits of sample mean value†	
	African subjects age ≥20 years									
Ash % of dry	43/43	1.9	10	4.0	3.6	4.4	4.1	0.20		
g/100 g of tissue ash										
Calcium	43/43	0.13	3.7	0.42	0.34	0.55	0.59	0.09		
Iron	43/43	0.24	1.1	0.45	0.41	0.50	0.49	0.02		
Magnesium	43/43	0.76	2.5	1.5	1.4	1.6	1.6	0.06		
Phosphorus	43/43	8	28	16	14	17	16	0.5		
Potassium	42/42	5	37	25	20	26	24	0.9		
μg/g of tissue ash										
Aluminum	43/43	35	700	240	150	330	240	23		
Copper	43/43	200	860	320	300	350	350	19		
Manganese	43/43	7	50	21	19	22	23	1.3		
Strontium	43/43	0.6	17	4.4	2.8	4.9	4.7	0.47		
Zinc	43/43	1000	3800	2200	1900	2400	2300	100		
Barium	43/43	0.6	37	4.3	3.4	5.8	7.9	1.4		
Bismuth	5/43	<2	130	<2	<2	<2			4	5
Boron	3/43	<10	18	<10	<10	<10			0	10
Cadmium	1/43	<50	50	<50	<50	<50			1	50
Chromium	43/43	0.1	10	1.0	0.6	2.0	2.1	0.37		
Cobalt	39/43	<2	110	7	5	11			13	13
Gold	0/43	<10	<10	<10	<10	<10			0	10
Lead	28/43	<5	41	5	<5	12			9	11
Molybdenum	4/43	<4	22	<4	<4	<4			0	4
Nickel	8/43	<5	110	<5	<5	<5			4	8
Silver	2/43	<0.1	1.9	<0.1	<0.1	<0.1			0	0.1
Tin	10/43	<5	28	<5	<5	<5			3	7
Titanium	17/43	<5	24	<5	<5	5			4	7
Vanadium	0/43	<1	<1	<1	<1	<1			0	1

1133734

	Near Eastern subjects age ≥20 years									
Ash % of dry	20/20	0.2	45	2.9	1.9	3.9	4.9	2.1		
g/100 g of tissue ash										
Calcium	20/20	0.16	0.90	0.48	0.40	0.62	0.52	0.04		
Iron	20/20	0.24	0.96	0.44	0.38	0.60	0.49	0.04		
Magnesium	20/20	0.98	2.0	1.5	1.4	1.8	1.6	0.06		
Phosphorus	20/20	12	21	16	14	18	16	0.6		
Potassium	20/20	3	38	21	17	25	21	1.9		
μg/g of tissue ash										
Aluminum	20/20	25	1600	200	150	360	310	76		
Copper	20/20	120	540	290	250	350	320	24		
Manganese	20/20	10	54	22	19	36	28	3.0		
Strontium	20/20	0.7	30	3.5	2.3	7.8	6.3	1.6		
Zinc	19/19	1200	3800	2200	1900	2700	2300	150		
Barium	20/20	1.9	35	6.6	3.3	13	11	2.3		
Bismuth	0/19	<2	<2	<2	<2	<2			0	2
Boron	6/19	<10	68	<10	<10	10			7	15
Cadmium	1/19	<50	50	<50	<50	<50			2	50
Chromium	20/20	0.5	24	3.8	2.8	4.3	5.6	1.4		
Cobalt	16/20	<2	60	12	5	16			12	13
Gold	2/19	<10	36	<10	<10	<10			3	12
Lead	18/19	<5	240	24	16	38			36	36
Molybdenum	4/20	<4	17	<4	<4	<4			2	5
Nickel	7/20	<5	62	<5	<5	10			6	9
Silver	9/19	<0.1	1.4	<0.1	<0.1	0.5			0.3	0.3
Tin	3/19	<5	10	<5	<5	<5			1	5
Titanium	17/20	<5	50	15	10	25			18	18
Vanadium	1/20	<1	10	<1	<1	<1			0	1

1133735

Table 4 (*cont.*)

	Fraction observed	Total range		Median	95 Per cent confidence interval for median		Mean	Std. error	Limits of sample mean value†	
	Far Eastern subjects age ≥20 years									
Ash % of dry	63/64	0.6	7.7	2.9	2.6	3.3	3.1	0.20		
g/100 g of tissue ash										
Calcium	62/62	0.11	6.0	0.43	0.38	0.56	0.77	0.14		
Iron	62/62	0.28	3.4	0.54	0.47	0.64	0.72	0.06		
Magnesium	62/62	0.40	4.6	1.5	1.3	1.6	1.5	0.06		
Phosphorus	62/62	11	27	18	17	19	18	0.4		
Potassium	62/62	5	38	22	20	25	23	0.9		
μg/g of tissue ash										
Aluminum	62/62	11	1400	100	57	160	210	37		
Copper	62/62	100	1200	350	320	380	410	29		
Manganese	62/62	12	>400	22	21	27	41	10		
Strontium	62/62	0.2	150	3.2	1.6	4.1	8.9	2.8		
Zinc	63/63	1500	27000	2600	2500	2800	3400	460		
Barium	62/62	0.8	110	3.5	3.0	4.9	11	2.4		
Bismuth	9/63	<2	120	<2	<2	<2			6	8
Boron	27/63	<10	860	<10	<10	10			26	32
Cadmium	17/63	<50	1500	<50	<50	<50			72	110
Chromium	61/62	<0.1	98	4.8	3.2	12			16	16
Cobalt	36/62	<2	>1000	2	<2	6			46	47
Gold	5/63	<10	88	<10	<10	<10			2	12
Lead	63/63	6	370	19	17	24	42	8.5		
Molybdenum	24/62	<4	90	<4	<4	5			8	11
Nickel	21/62	<5	120	<5	<5	<5			12	16
Silver	29/63	<0.1	14	<0.1	<0.1	0.5			0.5	0.6
Tin	22/63	<5	31	<5	<5	<5			5	8
Titanium	39/62	<5	92	9	<5	10			12	13
Vanadium	6/63	<1	9	<1	<1	<1			0	1

1133736

	Swiss subjects age ≥20 years									
Ash % of dry	8/8	2.4	4.8	3.4	2.4	4.8	3.5	0.31		
g/100 g of tissue ash										
Calcium	8/8	0.29	2.5	0.63	0.29	2.5	1.1	0.31		
Iron	8/8	0.38	0.96	0.51	0.38	0.96	0.57	0.06		
Magnesium	8/8	1.1	2.1	1.6	1.1	2.1	1.6	0.12		
Phosphorus	8/8	10	17	14	10	17	14	0.9		
Potassium	8/8	18	36	29	18	36	28	2.0		
μg/g of tissue ash										
Aluminum	8/8	9	96	22	9	96	30	9.8		
Copper	8/8	220	490	340	220	490	350	30		
Manganese	8/8	12	25	22	12	25	21	1.7		
Strontium	8/8	3.2	17	5.1	3.2	17	7.7	1.8		
Zinc	8/8	2300	3700	2600	2300	3700	2800	180		
Barium	8/8	1.3	40	3.6	1.3	40	8.3	4.6	2	3
Bismuth	2/8	<2	15	<2	<2	15			0	10
Boron	0/8	<10	<10	<10	<10	<10			25	63
Cadmium	2/8	<50	120	<50	<50	120				
Chromium	8/8	0.9	350	4.6	0.9	350	48	43.0	28	29
Cobalt	7/8	<2	76	17	<2	76			14	23
Gold	1/8	<10	110	<10	<10	110				
Lead	8/8	5	74	14	5	74	20	8.2	1	4
Molybdenum	1/8	<4	9	<4	<4	9				
Nickel	8/8	5	20	13	5	20	12	1.9	0	0.1
Silver	1/8	<0.1	0.5	<0.1	<0.1	0.5			5	9
Tin	3/8	<5	20	<5	<5	20			0	5
Titanium	0/8	<5	<5	<5	<5	<5			0	1
Vanadium	0/8	<1	<1	<1	<1	<1				

* Concentration in heart as indicated. For each element the column, "Fraction observed", indicates the number of samples in which the element was observed above the limits of detection and was thus actually observed, divided by the number of samples in which a determination of that element was made. For "Ash % of dry" the fraction is the number of samples for which values for this parameter were available, divided by the total number of samples of the tissues analyzed.

† See text for explanation.

1133737

*Table 5. Concentrations of elements in tissues—kidney**

	Fraction observed	Total range		Median	95 Per cent confidence interval for median		Mean	Std. error	Limits of sample mean value†	
	African subjects age ≥20 years									
Ash % of dry	48/48	2.7	14	4.8	4.2	5.2	4.9	0.23		
g/100 g of tissue ash										
Calcium	47/47	0.34	3.3	0.82	0.70	0.94	0.91	0.07		
Iron	48/48	0.16	4.0	0.56	0.47	0.74	0.76	0.09		
Magnesium	48/48	0.40	2.7	1.2	1.1	1.3	1.2	0.05		
Phosphorus	48/48	10	24	15	13	16	15	0.4		
Potassium	47/47	11	31	17	16	19	18	0.6		
μg/g of tissue ash										
Aluminum	48/48	37	1600	250	170	390	360	47		
Copper	48/48	150	>2000	270	230	350	400	61		
Manganese	48/48	9	180	60	53	72	66	4.6		
Strontium	48/48	1.7	38	7.0	5.7	9.4	8.9	0.95		
Zinc	48/48	1100	9400	3500	2800	4200	3800	270		
Barium	48/48	0.2	>100	4.9	3.8	6.0	10	3.3		
Bismuth	12/48	<2	2400	<2	<2	<2			96	98
Boron	4/48	<10	21	<10	<10	<10			1	10
Cadmium	48/48	150	5300	960	700	1300	1300	180		
Chromium	48/48	0.1	27	2.0	1.6	2.9	3.3	0.72		
Cobalt	21/48	<2	480	<2	<2	2			14	15
Gold	0/48	<10	<10	<10	<10	<10			0	10
Lead	46/48	<5	220	36	27	44			46	46
Molybdenum	43/48	<4	110	24	19	27			23	24
Nickel	21/48	<5	60	<5	<5	7			6	9
Silver	5/48	<0.1	9.2	<0.1	<0.1	<0.1			0.3	0.4
Tin	8/48	<5	30	<5	<5	<5			2	6
Titanium	25/48	<5	47	5	<5	10			7	9
Vanadium	2/48	<1	4	<1	<1	<1			0	1

1133738

	Near Eastern subjects age ≥20 years									
Ash % of dry	31/31	1.3	5.5	3.9	3.1	4.2	3.7	0.17		
g/100 g of tissue ash										
Calcium	30/30	0.46	1.8	0.62	0.57	0.72	0.74	0.06		
Iron	31/31	0.18	1.8	0.72	0.62	0.85	0.77	0.05		
Magnesium	31/31	0.72	2.4	1.4	1.2	1.5	1.3	0.07		
Phosphorus	31/31	10	25	15	14	17	16	0.6		
Potassium	30/30	12	38	17	15	18	18	1.0		
μg/g of tissue ash										
Aluminum	31/31	34	6000	290	160	430	560	190		
Copper	31/31	180	>3000	340	290	430	510	130		
Manganese	31/31	27	190	70	64	86	80	5.5		
Strontium	31/31	4.0	44	8.9	7.2	13	12	1.5		
Zinc	31/31	1800	10000	4200	3200	5000	4500	390		
Barium	31/31	2.1	130	12	8.2	21	20	4.6		
Bismuth	6/31	<2	34	<2	<2	<2			1	3
Boron	18/31	<10	200	10	<10	37			26	31
Cadmium	31/31	160	4500	1800	1200	2300	1900	210		
Chromium	31/31	0.9	130	4.5	3.2	7.8	13	4.3		
Cobalt	15/31	<2	140	<2	<2	9			12	13
Gold	4/31	<10	81	<10	<10	<10			3	13
Lead	31/31	16	260	64	43	78	74	8.9		
Molybdenum	27/31	<4	130	29	23	38			36	37
Nickel	16/31	<5	59	12	<5	25			14	17
Silver	18/31	<0.1	12	0.5	<0.1	0.5			0.8	0.9
Tin	10/31	<5	40	<5	<5	10			4	7
Titanium	22/31	<5	350	22	5	52			47	48
Vanadium	9/31	<1	3	<1	<1	<1			0	1

1133739

Table 5 (cont.)

	Fraction observed	Total range		Median	95 Per cent confidence interval for median		Mean	Std. error	Limits of sample mean value†	
	Far Eastern subjects age ≥20 years									
Ash % of dry	66/66	1.4	11	4.5	3.9	4.9	4.5	0.20		
g/100 g of tissue ash										
Calcium	66/66	0.26	7.0	1.2	1.0	1.3	1.4	0.13		
Iron	66/66	0.16	2.3	0.65	0.58	0.77	0.76	0.05		
Magnesium	66/66	0.57	3.9	1.4	1.3	1.5	1.5	0.06		
Phosphorus	66/66	8	22	16	14	17	15	0.4		
Potassium	61/61	4	49	19	17	20	20	1.1		
μg/g of tissue ash										
Aluminum	66/66	21	1900	94	74	140	210	38		
Copper	66/66	17	4000	410	360	670	700	81		
Manganese	66/66	24	>200	66	60	73	77	6.2		
Strontium	66/66	1.9	>100	7.8	6.8	9.6	16	3.5		
Zinc	66/66	2300	40000	5600	5000	6800	8100	850		
Barium	65/65	0.2	>100	5.0	3.8	6.6	12	2.7	43	44
Bismuth	10/66	<2	1500	<2	<2	<2			9	16
Boron	21/66	<10	78	<10	<10	<10				
Cadmium	66/66	820	20000	4000	3300	5200	5100	470		
Chromium	66/66	0.1	500	3.6	2.9	6.0	24	10.0	38	39
Cobalt	22/66	<2	>1000	<2	<2	<2			4	14
Gold	7/66	<10	91	<10	<10	<10				
Lead	66/66	10	>2500	62	50	86	140	57	25	25
Molybdenum	65/66	<4	86	21	19	26			11	12
Nickel	43/66	<5	68	7	5	10			1.7	1.8
Silver	24/66	<0.1	50	<0.1	<0.1	<0.1			11	14
Tin	27/66	<5	110	<5	<5	<5			8	11
Titanium	32/66	<5	54	<5	<5	7			0	1
Vanadium	10/66	<1	8	<1	<1	<1				

1133740

	Swiss subjects age ≥20 years									
Ash % of dry	9/9	2.5	6.0	4.7	3.5	5.0	4.4	0.34		
g/100 g of tissue ash										
Calcium	9/9	1.1	2.2	1.8	1.1	2.1	1.7	0.14		
Iron	9/9	0.31	1.6	0.56	0.44	0.75	0.67	0.12		
Magnesium	9/9	1.2	1.8	1.4	1.2	1.7	1.4	0.07		
Phosphorus	9/9	9	16	12	11	13	12	0.6		
Potassium	9/9	14	20	17	16	19	17	0.6		
μg/g of tissue ash										
Aluminum	9/9	10	88	20	11	60	35	9.2		
Copper	9/9	110	530	200	150	340	240	42		
Manganese	9/9	30	95	48	40	62	53	6.3		
Strontium	9/9	3.3	14	6.0	5.7	12	7.6	1.1		
Zinc	9/9	1700	6400	4200	2000	6400	4300	650		
Barium	9/9	2.2	12	4.0	3.1	5.9	4.8	0.97		
Bismuth	4/9	<2	70	<2	<2	20			12	13
Boron	1/9	<10	10	<10	<10	<10			1	10
Cadmium	9/9	580	4400	1900	1200	4300	2300	450		
Chromium	9/9	1.1	72	2.5	1.7	46	17	8.4		
Cobalt	4/9	<2	90	<2	<2	85			28	29
Gold	1/9	<10	43	<10	<10	<10			4	14
Lead	9/9	11	110	45	29	72	50	9.4		
Molybdenum	8/9	<4	31	19	4	28			17	18
Nickel	9/9	7	21	10	8	13	11	1.4		
Silver	4/9	<0.1	2.3	<0.1	<0.1	1.2			0.4	0.5
Tin	3/9	<5	17	<5	<5	5			3	6
Titanium	2/9	<5	5	<5	<5	5			1	5
Vanadium	0/9	<1	<1	<1	<1	<1			0	1

* Concentration in kidney as indicated. For each element the column, "Fraction observed", indicates the number of samples in which the element was observed above the limits of detection and was thus actually observed, divided by the number of samples in which a determination of that element was made. For "Ash % of dry" the fraction is the number of samples for which values for this parameter were available, divided by the total number of samples of the tissues analyzed.

† See text for explanation.

1133741

*Table 6. Concentrations of elements in tissues—liver**

	Fraction observed	Total range		Median	95 Per cent confidence interval for median		Mean	Std. error	Limits of sample mean value†	
	African subjects age ≥20 years									
Ash % of dry	45/45	2.4	11	4.6	4.4	4.9	5.0	0.25		
g/100 g of tissue ash										
Calcium	44/44	0.15	1.0	0.37	0.32	0.43	0.40	0.02		
Iron	45/45	0.13	11	1.2	0.98	1.6	1.8	0.29		
Magnesium	45/45	0.32	2.6	1.1	0.98	1.2	1.1	0.05		
Phosphorus	45/45	11	31	20	19	22	21	0.6		
Potassium	44/44	10	45	21	18	25	22	1.1		
μg/g of tissue ash										
Aluminum	45/45	52	600	170	130	230	210	19		
Copper	45/45	120	>2000	700	500	900	870	97		
Manganese	45/45	18	>400	120	100	160	150	12		
Strontium	45/45	0.4	8.4	2.8	2.5	3.3	3.3	0.27		
Zinc	45/45	1900	21000	4200	3600	6400	5800	600		
Barium	43/45	<0.2	42	2.7	2.3	4.2			5.2	5.2
Bismuth	12/45	<2	2900	<2	<2	<2			140	140
Boron	12/45	<10	35	<10	<10	<10			3	11
Cadmium	34/45	<50	2500	50	50	110			150	160
Chromium	43/45	<0.1	17	1.0	0.5	2.0			2.2	2.2
Cobalt	40/45	<2	300	7	5	11			22	22
Gold	0/45	<10	<10	<10	<10	<10			0	10
Lead	45/45	10	700	64	50	88	94	17		
Molybdenum	44/45	<4	240	76	63	88			80	80
Nickel	12/45	<5	35	<5	<5	<5			4	7
Silver	13/45	<0.1	6.2	<0.1	<0.1	<0.1			0.4	0.5
Tin	10/45	<5	38	<5	<5	<5			3	7
Titanium	15/45	<5	59	<5	<5	<5			5	8
Vanadium	3/45	<1	7	<1	<1	<1			0	1

1133742

	Near Eastern subjects age ≥20 years									
Ash % of dry	33/33	2.8	11	4.1	3.8	4.6	4.4	0.24		
g/100 g of tissue ash										
Calcium	32/32	0.19	2.9	0.32	0.30	0.43	0.45	0.08		
Iron	33/33	0.12	3.2	1.0	0.80	1.3	1.1	0.11		
Magnesium	32/32	0.66	2.3	1.2	1.1	1.4	1.3	0.06		
Phosphorus	33/33	14	28	19	18	21	20	0.6		
Potassium	33/33	8	48	18	17	20	20	1.4		
μg/g of tissue ash										
Aluminum	33/33	34	1400	140	90	280	230	45		
Copper	33/33	350	3800	710	620	1100	990	120		
Manganese	33/33	66	370	110	100	140	130	10		
Strontium	33/33	2.1	19	5.4	3.5	8.0	7.1	0.86		
Zinc	33/33	2500	14000	3900	3300	5300	5100	520		
Barium	33/33	1.5	50	5.2	3.4	9.0	10	2.0		
Bismuth	10/33	<2	78	<2	<2	<2			6	7
Boron	23/33	<10	60	17	10	32			23	26
Cadmium	30/33	<50	2500	170	110	250			280	280
Chromium	32/33	<0.1	76	2.4	2.0	4.5			7.6	7.6
Cobalt	27/33	<2	510	13	10	26			34	34
Gold	1/33	<10	15	<10	<10	<10			0	10
Lead	33/33	25	310	72	60	92	95	11		
Molybdenum	33/33	8	310	92	76	120	110	11		
Nickel	13/33	<5	58	<5	<5	10			8	11
Silver	30/33	<0.1	22	1.7	0.6	3.0			3.2	3.2
Tin	15/33	<5	23	<5	<5	10			5	8
Titanium	16/33	<5	210	<5	<5	19			19	22
Vanadium	6/33	<1	5	<1	<1	<1			0	1

1133743

Table 6. (*cont.*)

	Fraction observed	Total range		Median	95 Per cent confidence interval for median		Mean	Std. error	Limits of sample mean value†	
	Far Eastern subjects age ≥20 years									
Ash % of dry	66/67	1.4	15	4.2	4.0	4.5	4.4	0.23		
g/100 g of tissue ash										
Calcium	67/67	0.18	4.2	0.47	0.42	0.53	0.73	0.09		
Iron	67/67	0.17	7.2	1.8	1.4	2.2	2.2	0.20		
Magnesium	67/67	0.60	2.7	1.3	1.2	1.4	1.4	0.05		
Phosphorus	67/67	7	37	21	20	22	21	0.5		
Potassium	62/62	4	48	20	17	23	21	1.2		
μg/g of tissue ash										
Aluminum	67/67	23	1100	84	64	110	180	29		
Copper	67/67	130	>6000	1200	900	1400	1700	190		
Manganese	67/67	7	>400	110	100	140	150	14		
Strontium	67/67	0.5	90	2.9	2.3	3.5	7.2	1.8		
Zinc	67/67	2200	>40000	6400	5100	8000	9300	1100		
Barium	58/67	<0.2	66	3.3	2.2	4.2			6.7	6.8
Bismuth	13/67	<2	2000	<2	<2	<2	<2		56	58
Boron	43/67	<10	640	16	10	20			31	34
Cadmium	66/67	<50	2600	480	330	600			600	600
Chromium	67/67	0.1	66	2.0	1.7	2.9	4.6	1.0		
Cobalt	51/67	<2	900	4	3	5			23	23
Gold	2/67	<10	17	<10	<10	<10			0	10
Lead	66/67	<5	1300	100	74	130			160	160
Molybdenum	67/67	19	240	78	68	96	90	5.7		
Nickel	37/67	<5	160	5	<5	10			11	13
Silver	53/67	<0.1	>50	1.4	1.1	2.0			3.0	3.1
Tin	29/67	<5	90	<5	<5	10			11	14
Titanium	28/67	<5	40	<5	<5	7			5	8
Vanadium	7/67	<1	5	<1	<1	<1			0	1

1133744

	Swiss subjects age ≥20 years								
Ash % of dry	9/9	3.0	5.5	4.8	4.3	5.4	4.7	0.26	
g/100 g of tissue ash									
Calcium	9/9	0.39	0.84	0.53	0.44	0.78	0.58	0.05	
Iron	9/9	0.34	7.8	1.8	0.47	4.0	2.2	0.80	
Magnesium	9/9	0.90	2.1	1.3	0.94	1.9	1.3	0.14	
Phosphorus	9/9	16	29	20	16	26	21	1.5	
Potassium	9/9	16	33	24	16	29	23	2.0	
μg/g of tissue ash									
Aluminum	9/9	16	290	32	17	110	72	29	
Copper	9/9	470	1500	700	510	1200	810	120	
Manganese	9/9	94	220	170	95	190	150	16	
Strontium	9/9	1.2	9.4	2.0	1.5	4.0	2.9	0.86	
Zinc	9/9	2200	9900	5600	3200	7000	5700	740	
Barium	9/9	1.0	8.0	1.8	1.0	5.4	3.0	0.79	
Bismuth	1/9	<2	14	<2	<2	<2			1 3
Boron	2/9	<10	53	<10	<10	10			7 15
Cadmium	9/9	50	400	170	130	260	190	33	
Chromium	9/9	0.5	34	2.9	0.6	5.0	5.8	3.6	
Cobalt	5/9	<2	400	6	<2	70			62 63
Gold	0/9	<10	<10	<10	<10	<10			0 10
Lead	9/9	28	370	59	34	160	100	37	
Molybdenum	9/9	72	150	88	76	150	100	11	
Nickel	6/9	<5	12	7	<5	11			5 7
Silver	8/9	<0.1	3.2	1.3	0.5	2.6			1.5 1.5
Tin	7/9	<5	20	5	<5	5			5 6
Titanium	4/9	<5	12	<5	<5	5			3 5
Vanadium	0/9	<1	<1	<1	<1	<1			0 1

* Concentration of liver as indicated. For each element the column, "Fraction observed", indicates the number of samples in which the element was observed above the limits of detection and was thus actually observed, divided by the number of samples in which a determination of that element was made. For "Ash % dry" the fraction is the number of samples for which values for this parameter were available, divided by the total number of samples of the tissues analyzed.

† See text for explanation.

1133745

Table 7. Concentrations of elements in tissues—lung

	Fraction observed	Total range		Median	95 Per cent confidence interval for median		Mean	Std. error	Limits of sample mean value†	
	African subjects age ≥20 years									
Ash % of dry	44/44	0.4	9.9	5.3	4.9	5.8	5.3	0.24		
g/100 g of tissue ash										
Calcium	44/44	0.24	3.0	0.85	0.70	1.1	0.93	0.07		
Iron	44/44	0.65	7.4	1.8	1.5	2.1	2.1	0.19		
Magnesium	44/44	0.55	2.4	0.92	0.83	1.0	0.99	0.05		
Phosphorus	44/44	5	>30	11	10	13	13	0.9		
Potassium	43/43	8	40	17	15	20	18	1.0		
μg/g of tissue ash										
Aluminum	44/44	48	>10000	3100	2600	4500	4500	570		
Copper	44/44	80	450	150	130	170	170	12		
Manganese	43/43	10	110	20	17	29	26	2.6		
Strontium	44/44	2.5	36	10	8.0	12	11	0.99		
Zinc	44/44	570	2800	1200	1100	1400	1300	74		
Barium	44/44	3.6	>100	23	15	27	28	4.5		
Bismuth	2/44	<2	230	<2	<2	<2			6	8
Boron	15/44	<10	50	<10	<10	<10			6	13
Cadmium	0/44	<50	<50	<50	<50	<50			0	50
Chromium	44/44	0.4	64	13	8.2	20	17	2.3		
Cobalt	32/44	<2	160	4	2	6			16	16
Gold	2/44	<10	10	<10	<10	<10			0	10
Lead	43/44	<5	140	28	20	32			32	33
Molybdenum	3/44	<4	120	<4	<4	<4			3	6
Nickel	25/44	<5	42	6	<5	11			8	11
Silver	8/44	<0.1	3.9	<0.1	<0.1	<0.1			0.2	0.3
Tin	26/44	<5	200	8	<5	14			18	20
Titanium	43/44	<5	1800	300	190	520			430	430
Vanadium	33/44	<1	22	5	3	7			5	5

1133746

	Near Eastern subjects age ≥20 years									
Ash % of dry	34/34	1.5	9.2	5.1	4.4	5.7	5.1	0.29		
g/100 g of tissue ash										
Calcium	34/34	0.06	2.5	0.65	0.54	0.95	0.80	0.07		
Iron	34/34	0.31	6.8	1.9	1.4	2.6	2.1	0.21		
Magnesium	34/34	0.45	2.0	0.96	0.85	1.2	1.0	0.06		
Phosphorus	34/34	1	21	12	10	12	11	0.7		
Potassium	33/33	10	36	17	14	18	17	1.0		
μg/g of tissue ash										
Aluminum	34/34	64	>10000	3100	2100	4500	4500	720		
Copper	33/33	86	>3000	200	170	260	350	130		
Manganese	34/34	5	170	38	30	64	51	6.3		
Strontium	34/34	2.8	68	12	10	16	16	2.2		
Zinc	34/34	720	6800	1600	1200	2000	1800	190		
Barium	34/34	3.8	>100	32	20	47	44	6.0		
Bismuth	13/34	<2	19	<2	<2	2			3	4
Boron	26/34	<10	150	27	10	40			33	35
Cadmium	8/34	<50	170	<50	<50	<50			18	56
Chromium	33/33	2.0	100	21	17	38	27	3.4		
Cobalt	23/34	<2	67	9	<2	13			12	13
Gold	5/34	<10	42	<10	<10	<10			3	12
Lead	34/34	14	620	43	32	53	82	20		
Molybdenum	8/34	<4	200	<4	<4	<4			13	16
Nickel	19/34	<5	92	24	<5	36			22	24
Silver	18/34	<0.1	60	0.3	<0.1	0.5			2.9	2.9
Tin	29/34	<5	200	21	10	27			29	29
Titanium	34/34	10	>2000	420	170	1000	770	150		
Vanadium	27/34	<1	50	7	4	15			13	13

1133747

Table 7. (cont.)

	Fraction observed	Total range		Median	95 Per cent confidence interval for median		Mean	Std. error	Limits of sample mean value†	
	Far Eastern subjects age ≥20 years									
Ash % of dry	69/70	0.6	11	5.3	4.8	5.6	5.2	0.21		
g/100 g of tissue ash										
Calcium	69/69	0.43	4.2	1.2	0.96	1.4	1.3	0.07		
Iron	69/69	0.39	8.6	2.5	2.0	3.0	2.7	0.19		
Magnesium	69/69	0.47	2.0	1.1	0.94	1.2	1.1	0.04		
Phosphorus	69/69	6	20	13	11	13	13	0.4		
Potassium	66/66	4	57	19	18	22	21	1.2		
mg/g of tissue ash										
Aluminum	69/69	520	10000	2500	1800	3000	3100	260		
Copper	69/69	17	>6000	230	200	280	420	130		
Manganese	69/69	7	250	25	21	32	36	4.5		
Strontium	69/69	1.8	74	11	7.6	13	14	1.4		
Zinc	69/69	620	17000	1500	1300	1700	2200	310		
Barium	69/69	2.2	>100	16	12	22	25	3.2		
Bismuth	10/69	<2	64	<2	<2	<2			2	4
Boron	25/69	<10	270	<10	<10	<10			15	21
Cadmium	34/69	<50	1200	<50	<50	50			83	110
Chromium	69/69	4.2	180	18	14	27	32	4.2		
Cobalt	28/69	<2	240	<2	<2	2			19	2
Gold	5/69	<10	74	<10	<10	<10			2	12
Lead	68/69	<5	1000	45	38	54			90	90
Molybdenum	19/69	<4	75	<4	<4	<4			5	8
Nickel	44/69	<5	74	10	6	14			14	16
Silver	23/69	<0.1	22	<0.1	<0.1	<0.1			0.7	0.7
Tin	62/69	<5	1200	29	19	38			58	59
Titanium	68/69	<5	1300	140	110	160			220	220
Vanadium	48/69	<1	29	3	1	3			4	4

1133748

	Swiss subjects age ≥20 years									
Ash % of dry	7/7	4.3	6.9	5.6	4.3	6.9	5.7	0.33		
g/100 g tissue ash										
Calcium	7/7	1.2	3.5	1.5	1.2	3.5	1.8	0.30		
Iron	7/7	0.66	7.2	2.3	0.66	7.2	2.7	0.82		
Magnesium	7/7	0.68	1.3	1.1	0.68	1.3	0.98	0.09		
Phosphorus	7/7	6	12	8	6	12	8	0.9		
Potassium	7/7	12	27	19	12	27	19	1.7		
μg/g of tissue ash										
Aluminum	7/7	1000	9000	4300	1000	9000	4400	1000		
Copper	7/7	120	160	130	120	160	130	5.3		
Manganese	7/7	12	42	17	12	42	23	4.3		
Strontium	7/7	7.6	15	11	7.6	15	11	0.96		
Zinc	7/7	960	2400	1300	960	2400	1500	190		
Barium	7/7	24	>100	38	24	>100	52	17		
Bismuth	1/7	<2	2	<2	<2	2			0	2
Boron	0/7	<10	<10	<10	<10	<10			0	10
Cadmium	4/7	<50	300	80	<50	300			110	130
Chromium	7/7	2.9	>1000	62	2.9	>1000	260	210.0		
Cobalt	5/7	<2	240	8	<2	240			47	47
Gold	1/7	<10	10	<10	<10	10			1	10
Lead	7/7	18	60	32	18	60	36	5.7		
Molybdenum	0/7	<4	<4	<4	<4	<4			0	4
Nickel	7/7	7	35	22	7	35	20	3.4		
Silver	1/7	<0.1	0.2	<0.1	<0.1	0.2			0	0.1
Tin	7/7	23	62	28	23	62	37	6.5		
Titanium	7/7	68	320	140	68	320	160	32		
Vanadium	7/7	1	11	2	1	11	3	1.4		

* Concentration in lung as indicated. For each element the column, "Fraction observed", indicates the number of samples in which the element was observed above the limits of detection and was thus actually observed, divided by the number of samples in which a determination of that element was made. For "Ash % dry" the fraction is the number of samples for which values for this parameter were available, divided by the number of samples of the tissues analyzed.

† See text for explanation.

1133749

*Table 8. Concentrations of elements in tissues—ovary**

	Fraction observed	Total range		Median	95 Per cent confidence interval for median	Mean	Std. error	Limits of sample mean value†	
	African subjects age ≥20 years								
Ash % of dry	2/2	2.3	5.5	3.9		3.9			
g/100 g of tissue ash									
Calcium	2/2	1.3	1.3	1.3		1.3			
Iron	2/2	0.39	1.1	0.75		0.75			
Magnesium	2/2	0.84	0.88	0.86		0.86			
Phosphorus	2/2	7	13	10		10			
Potassium	2/2	15	23	19		19			
μg/g of tissue ash									
Aluminum	2/2	150	840	500		500			
Copper	2/2	210	220	220		220			
Manganese	2/2	11	20	16		16			
Strontium	2/2	9.4	14	12		12			
Zinc	2/2	1400	2400	1900		1900			
Barium	2/2	3.1	23	13		13		0	2
Bismuth	0/2	<2	<2	<2				0	10
Boron	0/2	<10	<10	<10				0	50
Cadmium	0/2	<50	<50	<50					
Chromium	2/2	0.5	3.8	2.2		2.2		4	5
Cobalt	1/2	<2	9	5				0	10
Gold	0/2	<10	<10	<10					
Lead	2/2	22	60	41		41		0	4
Molybdenum	0/2	<4	<4	<4				0	5
Nickel	0/2	<5	<5	<5					
Silver	2/2	0.1	0.5	0.3		0.3		6	9
Tin	1/2	<5	13	7					
Titanium	2/2	9	82	46		46		0	1
Vanadium	0/2	<1	<1	<1					

1133750

	Far Eastern subjects age ≥20 years									
Ash % of dry	11/11	0.3	7.1	3.8	1.1	5.6	3.5	0.62		
g/100 g of tissue ash										
Calcium	11/11	0.51	2.0	1.0	0.60	1.6	1.0	0.14		
Iron	11/11	0.19	3.2	0.74	0.20	2.5	1.1	0.31		
Magnesium	11/11	0.47	1.4	0.84	0.57	1.3	0.92	0.11		
Phosphorus	11/11	8	19	13	9	16	13	0.9		
Potassium	11/11	7	27	15	10	19	15	1.7		
μg/g of tissue ash										
Aluminum	11/11	46	>3500	130	56	580	660	470		
Copper	11/11	82	450	220	88	320	230	32		
Manganese	11/11	10	55	22	12	52	27	4.6		
Strontium	11/11	2.4	21	9.8	3.2	17	10	1.8		
Zinc	11/11	530	2300	1500	1200	2100	1500	140		
Barium	11/11	3.0	21	8.8	3.9	17	9.8	1.7		
Bismuth	1/11	<2	40	<2	<2	<2			3	5
Boron	2/11	<10	28	<10	<10	28			5	13
Cadmium	6/11	<50	510	50	<50	340			110	130
Chromium	11/11	1.1	290	5.8	4.5	160	58	29		
Cobalt	2/11	<2	510	<2	<2	5			47	48
Gold	4/11	<10	150	<10	<10	150			29	35
Lead	11/11	10	340	40	10	180	73	30		
Molybdenum	5/11	<4	300	<4	<4	64			35	38
Nickel	5/11	<5	130	<5	<5	45			19	22
Silver	7/11	<0.1	5.2	0.5	<0.1	4.1			1.6	1.7
Tin	5/11	<5	110	<5	<5	27			17	19
Titanium	7/11	<5	200	5	<5	55			28	30
Vanadium	2/11	<1	6	<1	<1	4			0	1

* Concentration in ovary as indicated. For each element the column, "Fraction observed," indicates the number of samples in which the element was observed above the limits of detection and was thus actually observed, divided by the number of samples in which a determination of that element was made. For "Ash % dry" the fraction is the number of samples for which values for this parameter were available, divided by the total number of samples of the tissues analyzed.

† See text for explanation.

1133751

*Table 9. Concentrations of elements in tissues—pancreas**

	Fraction observed	Total range	Median	95 Per cent confidence interval for median		Mean	Std. error	Limits of sample mean value†	
African subjects age ≥20 years									
Ash % of dry	6/6	2.8	5.1	3.9	2.8	5.1	3.9	0.35	
g/100 g of tissue ash									
Calcium	6/6	0.52	1.7	0.80	0.52	1.7	0.88	0.17	
Iron	6/6	0.23	0.62	0.30	0.23	0.62	0.35	0.05	
Magnesium	6/6	0.82	1.5	1.2	0.82	1.5	1.2	0.10	
Phosphorus	6/6	12	25	21	12	25	20	1.8	
Potassium	5/5	14	29	16	14	29	19	2.7	
μg/g of tissue ash									
Aluminum	6/6	60	270	140	60	270	150	33	
Copper	6/6	70	170	150	70	170	140	14	
Manganese	6/6	10	140	72	10	140	73	17	
Strontium	6/6	1.9	14	5.1	1.9	14	6.2	1.7	
Zinc	6/6	1900	6000	2500	1900	6000	3100	640	
Barium	6/6	1.5	43	7.2	1.5	43	14	6.8	0 2
Bismuth	0/6	<2	<2	<2	<2	<2			8 13
Boron	3/6	<10	20	7	<10	20			21 54
Cadmium	2/6	<50	66	<50	<50	66			
Chromium	6/6	0.3	4.0	1.5	0.3	4.0	2.0	0.65	3 4
Cobalt	2/6	<2	12	<2	<2	12			0 10
Gold	0/6	<10	<10	<10	<10	<10			
Lead	6/6	13	60	24	13	60	28	6.9	5 7
Molybdenum	3/6	<4	11	6	<4	11			1 5
Nickel	1/6	<5	10	<5	<5	10			0.3 0.4
Silver	2/6	<0.1	1.8	<0.1	<0.1	1.8			6 8
Tin	3/6	<5	16	6	<5	16	17	3.7	0 1
Titanium	6/6	8	30	15	8	30			
Vanadium	0/6	<1	<1	<1	<1	<1			

1133752

	Near Eastern subjects age ≥20 years									
Ash% of dry	26/26	0.4	7.7	3.2	2.4	4.0	3.4	0.31		
g/100 g of tissue ash										
Calcium	26/26	0.37	4.2	0.69	0.60	0.94	0.93	0.15		
Iron	26/26	0.08	1.0	0.34	0.27	0.43	0.38	0.03		
Magnesium	26/26	0.78	2.2	1.4	1.1	1.6	1.4	0.07		
Phosphorus	26/26	16	27	21	20	23	21	0.5		
Potassium	26/26	3	39	17	15	19	17	1.4		
μg/g of tissue ash										
Aluminum	26/26	60	2000	260	180	530	380	78		
Copper	26/26	57	450	180	150	210	190	16		
Manganese	25/25	2	140	91	79	110	89	5.9		
Strontium	26/26	1.0	28	6.8	3.8	10	9.0	1.5		
Zinc	26/26	1100	3600	2100	1700	2400	2100	130		
Barium	26/26	2.4	92	11	7.0	33	22	4.3		
Bismuth	0/26	<2	<2	<2	<2	<2			0	2
Boron	15/26	<10	40	10	<10	14			11	16
Cadmium	20/26	<50	540	91	50	170			120	140
Chromium	26/26	1.4	21	4.2	3.5	7.5	6.5	1.1		
Cobalt	5/26	<2	88	<2	<2	<2			5	6
Gold	2/26	<10	190	<10	<10	<10			7	17
Lead	26/26	16	180	36	29	50	49	7.4		
Molybdenum	5/26	<4	92	<4	<4	<4			8	12
Nickel	6/26	<5	120	<5	<5	<5			8	12
Silver	20/26	<0.1	7.6	0.5	0.5	0.8			0.8	0.8
Tin	2/26	<5	23	<5	<5	<5			1	5
Titanium	22/26	<5	240	17	5	42			36	37
Vanadium	1/26	<1	26	<1	<1	<1			1	2

1133753

Table 9 (*cont.*)

	Fraction observed	Total range		Median	95 Per cent confidence interval for median		Mean	Std. error	Limits of sample mean value†	
	Far Eastern subjects age ≥20 years									
Ash % of dry	59/59	0.9	13	3.8	2.9	4.1	3.7	0.25		
g/100 g of tissue ash										
Calcium	58/58	0.19	4.2	0.72	0.58	0.78	0.90	0.09		
Iron	58/58	0.15	3.2	0.42	0.38	0.45	0.52	0.06		
Magnesium	58/58	0.52	2.3	1.2	1.0	1.3	1.2	0.05		
Phosphorus	57/57	13	29	20	19	22	21	0.4		
Potassium	58/58	3	28	15	14	19	16	0.6		
μg/g of tissue ash										
Aluminum	58/58	10	>3500	100	64	160	320	98		
Copper	58/58	82	1600	180	150	210	260	35		
Manganese	58/58	13	500	88	80	100	97	9.1		
Strontium	58/58	0.4	130	3.8	2.5	6.4	9.5	2.6		
Zinc	59/59	940	16000	2900	2500	3400	3600	330		
Barium	58/58	0.9	>100	4.2	3.0	5.8	18	4.8		
Bismuth	7/59	<2	300	<2	<2	<2			13	15
Boron	35/59	<10	540	10	<10	15			25	30
Cadmium	54/59	<50	1500	230	180	340			320	320
Chromium	57/58	<0.1	130	6.0	4.5	9.8			16	16
Cobalt	25/58	<2	>1000	<2	<2	3			72	73
Gold	5/59	<10	55	<10	<10	<10			3	12
Lead	59/59	12	1300	40	34	50	66	21		
Molybdenum	24/58	<4	110	<4	<4	10			8	11
Nickel	30/58	<5	120	5	<5	11			14	16
Silver	34/59	<0.1	27	0.5	<0.1	0.5			1.3	1.3
Tin	20/59	<5	41	<5	<5	<5			6	9
Titanium	44/58	<5	>500	10	10	10			27	28
Vanadium	6/58	<1	34	<1	<1	<1			1	2

1133754

	Swiss subjects age ≥20 years									
Ash % of dry	4/4	0.6	4.5	2.4	0.6	4.5	2.5	0.80		
g/100 g of tissue ash										
Calcium	4/4	0.92	4.6	1.8	0.92	4.6	2.3	0.80		
Iron	4/4	0.25	0.60	0.48	0.25	0.60	0.45	0.07		
Magnesium	4/4	1.1	1.9	1.3	1.1	1.9	1.4	0.19		
Phosphorus	4/4	11	21	19	11	21	17	2.4		
Potassium	4/4	18	31	22	18	31	23	2.9		
μg/g of tissue ash										
Aluminum	4/4	23	75	34	23	75	41	12		
Copper	4/4	88	170	160	88	170	140	19		
Manganese	4/4	58	94	77	58	94	77	7.4		
Strontium	4/4	3.4	22	14	3.4	22	13	4.0		
Zinc	4/4	1900	2800	2300	1900	2800	2300	200		
Barium	4/4	3.4	>100	5.3	3.4	>100	41	36		
Bismuth	3/4	<2	19	14	<2	19			12	12
Boron	1/4	<10	10	<10	<10	10			2	10
Cadmium	3/4	<50	150	50	<50	150			63	75
Chromium	4/4	2.3	9.8	5.9	2.3	9.8	6.0	1.6		
Cobalt	3/4	<2	1000	49	<2	1000			270	270
Gold	0/4	<10	<10	<10	<10	<10			0	10
Lead	4/4	33	82	42	33	82	50	11		
Molybdenum	1/4	<4	8	<4	<4	8			2	5
Nickel	3/4	<5	20	11	<5	20			11	12
Silver	1/4	<0.1	0.2	<0.1	<0.1	0.2			0	0.1
Tin	0/4	<5	<5	<5	<5	<5			0	5
Titanium	0/4	<5	<5	<5	<5	<5			0	5
Vanadium	1/4	<1	1	<1	<1	1			0	1

* Concentration in pancreas as indicated. For each element the column, "Fraction observed", indicates the number of samples in which the element was observed above the limits of detection and was thus actually observed, divided by the number of samples in which a determination of that element was made. For "Ash % of dry" the fraction is the number of samples for which values for this parameter were available, divided by the total number of samples of the tissues analyzed.

† See text for explanation.

1133755

*Table 10. Concentrations of elements in tissues—spleen**

	Fraction observed	Total range		Median	95 Per cent confidence interval for median		Mean	Std. error	Limits of sample mean value†	
	African subjects age ≥20 years									
Ash % of dry	40/40	3.0	7.2	5.6	5.1	5.8	5.3	0.15		
g/100 g of tissue ash										
Calcium	40/40	0.21	3.4	0.44	0.37	0.52	0.55	0.08		
Iron	40/40	0.20	8.6	2.1	1.4	2.4	2.4	0.29		
Magnesium	40/40	0.61	1.6	0.92	0.84	1.0	0.96	0.03		
Phosphorus	40/40	10	25	17	15	18	17	0.5		
Potassium	39/39	14	43	24	22	27	25	0.9		
μg/g of tissue ash										
Aluminum	40/40	22	4300	260	170	320	390	110		
Copper	40/40	70	>2000	110	90	120	190	73		
Manganese	40/40	8	140	17	13	21	24	4.5		
Strontium	40/40	0.6	15	4.1	3.3	4.8	4.4	0.45		
Zinc	40/40	460	3600	1300	1200	1500	1400	100		
Barium	39/40	<0.2	25	4.5	3.1	6.4			6.7	6.7
Bismuth	5/40	<2	400	<2	<2	<2			13	15
Boron	9/40	<10	30	<10	<10	<10			3	11
Cadmium	2/40	<50	240	<50	<50	<50			11	58
Chromium	40/40	0.1	28	1.0	0.5	1.7	2.2	0.74		
Cobalt	15/40	<2	300	<2	<2	3			11	12
Gold	0/40	<10	<10	<10	<10	<10			0	10
Lead	32/40	<5	180	21	12	25			26	27
Molybdenum	2/40	<4	31	<4	<4	<4			1	4
Nickel	11/40	<5	40	<5	<5	<5			3	7
Silver	1/40	<0.1	1.7	<0.1	<0.1	<0.1			0	0.1
Tin	10/40	<5	19	<5	<5	<5			3	6
Titanium	15/40	<5	170	<5	<5	6			10	14
Vanadium	1/40	<1	5	<1	<1	<1			0	1

1133756

	Near Eastern subjects age ≥20 years									
Ash % of dry	34/34	0.5	14	3.5	2.9	4.2	3.7	0.37		
g/100 g of tissue ash										
Calcium	34/34	0.05	2.4	0.40	0.31	0.47	0.53	0.07		
Iron	34/34	0.09	6.2	2.2	1.7	2.8	2.3	0.23		
Magnesium	34/34	0.10	1.6	0.92	0.79	1.0	0.92	0.04		
Phosphorus	34/34	4	27	17	14	19	17	0.7		
Potassium	34/34	7	40	22	19	24	22	1.1		
μg/g of tissue ash										
Aluminum	34/34	20	700	220	79	300	230	29		
Copper	34/34	15	2300	140	130	150	200	64		
Manganese	33/33	2	130	15	13	18	19	3.5		
Strontium	34/34	0.1	20	5.5	3.8	8.4	7.3	0.96		
Zinc	34/34	820	4700	1500	1300	1800	1700	130		
Barium	34/34	0.2	56	9.1	3.1	16	12	2.2		
Bismuth	5/34	<2	21	<2	<2	<2			1	2
Boron	18/34	<10	56	10	<10	10			11	16
Cadmium	7/34	<50	210	<50	<50	<50			17	57
Chromium	34/34	0.1	50	3.0	1.8	3.8	5.5	1.6		
Cobalt	7/34	<2	40	<2	<2	<2			2	3
Gold	2/34	<10	94	<10	<10	<10			3	13
Lead	34/34	14	200	41	36	62	57	6.9		
Molybdenum	3/34	<4	84	<4	<4	<4			3	7
Nickel	7/34	<5	200	<5	<5	<5			13	17
Silver	14/34	<0.1	2.0	<0.1	<0.1	0.5			0.4	0.4
Tin	17/34	<5	31	6	<5	10			7	9
Titanium	22/34	<5	43	11	<5	21			14	16
Vanadium	0/34	<1	<1	<1	<1	<1			0	1

1133757

Table 10 (*cont.*)

	Fraction observed	Total range		Median	95 Per cent confidence interval for median		Mean	Std. error	Limits of sample mean value†	
	Far Eastern subjects age ≥20 years									
Ash % of dry	62/62	1.5	11	4.5	4.2	4.8	4.5	0.20		
g/100 g of tissue ash										
Calcium	62/62	0.14	6.8	0.44	0.38	0.52	0.70	0.12		
Iron	62/62	0.23	>10	2.7	2.0	3.8	3.8	0.44		
Magnesium	62/62	0.24	2.0	0.98	0.90	1.1	1.0	0.04		
Phosphorus	61/61	5	33	18	17	20	19	0.6		
Potassium	62/62	3	45	25	22	28	25	1.2		
μg/g of tissue ash										
Aluminum	62/62	10	1200	92	66	130	180	31		
Copper	62/62	51	840	180	150	210	220	19		
Manganese	62/62	5	140	17	15	20	26	3.3		
Strontium	62/62	0.2	53	2.0	1.4	2.7	4.8	1.1		
Zinc	62/62	640	7600	1500	1400	1700	1900	170		
Barium	62/62	0.2	45	3.2	2.1	4.4	7.8	1.4		
Bismuth	7/62	<2	130	<2	<2	<2			5	7
Boron	28/62	<10	200	<10	<10	10			14	20
Cadmium	41/62	<50	800	50	50	68			90	110
Chromium	60/62	<0.1	64	2.9	2.7	4.9			7.8	7.8
Cobalt	20/62	<2	900	<2	<2	<2			34	35
Gold	5/62	<10	48	<10	<10	<10			1	11
Lead	59/62	<5	510	32	26	46			56	56
Molybdenum	22/62	<4	45	<4	<4	<4			5	7
Nickel	17/62	<5	>1000	<5	<5	<5			29	33
Silver	23/62	<0.1	35	<0.1	<0.1	0.5			1.1	1.1
Tin	31/62	<5	48	<5	<5	10			7	10
Titanium	35/62	<5	56	5	<5	10			8	11
Vanadium	1/62	<1	13	<1	<1	<1			0	1

1133758

	Swiss subjects age ≥20 years								
Ash % of dry	8/8	4.9	10	5.5	4.9	10	6.1	0.59	
g/100 g of tissue ash									
Calcium	8/8	0.33	0.90	0.53	0.33	0.90	0.54	0.06	
Iron	8/8	1.5	12	2.7	1.5	12	3.8	1.20	
Magnesium	8/8	0.60	1.1	0.90	0.60	1.1	0.89	0.06	
Phosphorus	8/8	9	20	15	9	20	14	1.3	
Potassium	8/8	20	37	27	20	37	27	2.2	
μg/g of tissue ash									
Aluminum	8/8	5	170	40	5	170	58	19	
Copper	8/8	56	140	89	56	140	100	11	
Manganese	8/8	9	20	14	9	20	14	1.4	
Strontium	8/8	1.7	19	3.5	1.7	19	5.9	2.1	
Zinc	8/8	660	2000	1300	660	2000	1300	150	
Barium	8/8	0.2	28	4.4	0.2	28	9.9	3.7	
Bismuth	1/8	<2	2	<2	<2	2			0 2
Boron	1/8	<10	48	<10	<10	48			6 15
Cadmium	3/8	<50	70	<50	<50	70			21 53
Chromium	8/8	0.8	86	4.5	0.8	86	20	11.0	
Cobalt	4/8	<2	100	3	<2	100			18 19
Gold	0/8	<10	<10	<10	<10	<10			0 10
Lead	8/8	14	250	20	14	250	59	30	
Molybdenum	0/8	<4	<4	<4	<4	<4			0 4
Nickel	6/8	<5	28	15	<5	28			14 16
Silver	1/8	<0.1	0.1	<0.1	<0.1	0.1			0 0.1
Tin	3/8	<5	19	<5	<5	19			5 8
Titanium	1/8	<5	5	<5	<5	5			0 5
Vanadium	0/8	<1	<1	<1	<1	<1			0 1

* Concentration in spleen as indicated. For each element the column, "Fraction observed", indicates the number of samples in which the element was observed above the limits of detection and was thus actually observed, divided by the number of samples in which a determination of that element was made. For "Ash % of dry" the fraction is the number of samples for which values for this parameter were available, divided by the total number of samples of the tissues analyzed.

† See text for explanation.

1133759

*Table 11. Concentrations of elements in tissues—testis**

	Fraction observed	Total range		Median	95 per cent confidence interval for median	Mean	Std. error	Limits of sample mean value†	
	African subjects age ≥20 years								
Ash % of dry	2/2	2.7	4.0	3.4		3.4			
g/100 g of tissue ash									
Calcium	2/2	0.47	1.0	0.74		0.74			
Iron	2/2	0.27	0.31	0.29		0.29			
Magnesium	2/2	0.72	1.2	0.96		0.96			
Phosphorus	2/2	15	17	16		16			
Potassium	2/2	18	21	20		20			
μg/g of tissue ash									
Aluminum	2/2	88	200	140		140			
Copper	2/2	110	120	120		120			
Manganese	2/2	11	160	86		86			
Strontium	2/2	3.5	9.0	6.3		6.3			
Zinc	2/2	1400	2300	1900		1900			
Barium	2/2	1.2	39	20		20			
Bismuth	1/2	<2	15	8				7	8
Boron	0/2	<10	<10	<10				0	10
Cadmium	0/2	<50	<50	<50				0	50
Chromium	2/2	1.6	6.8	4.2		4.2			
Cobalt	0/2	<2	<2	<2				0	2
Gold	0/2	<10	<10	<10				0	10
Lead	2/2	25	33	29		29			
Molybdenum	0/2	<4	<4	<4				0	4
Nickel	0/2	<5	<5	<5				0	5
Silver	1/2	<0.1	0.5	0.2				0.2	0.3
Tin	0/2	<5	<5	<5				0	5
Titanium	2/2	5	14	9		9			
Vanadium	0/2	<1	<1	<1				0	1

1133760

	Near Eastern Subjects age ≥20 years									
Ash % of dry	18/18	0.3	15	3.5	2.2	4.4	4.3	0.89		
g/100 g of tissue ash										
Calcium	18/18	0.40	1.4	0.76	0.66	1.0	0.80	0.06		
Iron	18/18	0.14	4.5	0.40	0.36	0.66	0.81	0.24		
Magnesium	18/18	0.66	1.6	0.98	0.80	1.2	0.99	0.06		
Phosphorus	18/18	4	20	12	10	15	12	0.9		
Potassium	18/18	10	40	21	17	24	21	1.8		
mg/g of tissue ash										
Aluminum	18/18	100	1200	490	250	600	510	69		
Copper	18/18	23	220	140	110	170	130	14		
Manganese	18/18	10	39	18	14	23	19	1.6		
Strontium	18/18	0.9	15	6.3	2.8	9.4	6.4	0.97		
Zinc	17/17	720	2800	1500	1200	1800	1500	120		
Barium	18/18	1.9	40	12	5.5	25	15	2.8		
Bismuth	0/17	<2	<2	<2	<2	<2			0	2
Boron	4/17	<10	58	<10	<10	<10			9	17
Cadmium	7/17	<50	420	<50	<50	50			44	73
Chromium	18/18	1.5	25	6.5	4.5	10	7.7	1.3		
Cobalt	3/18	<2	12	<2	<2	<2			1	2
Gold	5/17	<10	86	<10	<10	10			8	16
Lead	17/17	13	220	32	15	92	65	16		
Molybdenum	2/18	<4	20	<4	<4	<4			2	5
Nickel	8/18	<5	60	<5	<5	20			12	15
Silver	12/17	<0.1	6.2	1.3	<0.1	2.6			1.6	1.7
Tin	2/17	<5	17	<5	<5	<5			1	6
Titanium	18/18	10	110	41	17	59	42	6.9		
Vanadium	1/18	<1	2	<1	<1	<1			0	1

1133761

Table 11 (*cont.*)

	Fraction observed	Total range		Median	95 per cent confidence interval for median		Mean	Std. error	Limits of sample mean value†	
	Far Eastern subjects age ≥20 years									
Ash % of dry	39/39	0.3	9.3	3.2	2.7	4.0	3.5	0.30		
g/100 g of tissue ash										
Calcium	39/39	0.32	4.2	0.90	0.64	1.2	1.2	0.14		
Iron	39/39	0.19	3.5	0.42	0.37	0.64	0.61	0.08		
Magnesium	39/39	0.42	2.5	0.96	0.90	1.1	1.0	0.06		
Phosphorus	39/39	8	23	15	13	17	15	0.6		
Potassium	39/39	3	30	18	15	19	17	0.9		
mg/g of tissue ash										
Aluminum	39/39	13	2800	280	96	460	460	99		
Copper	39/39	59	1000	150	130	190	230	33		
Manganese	39/39	12	220	19	16	26	32	6.4		
Strontium	39/39	1.3	68	4.6	3.6	9.0	10	2.4		
Zinc	38/38	900	13000	1600	1500	2200	2500	400		
Barium	39/39	1.1	>100	5.0	3.7	8.6	13	4.0		
Bismuth	7/39	<2	510	<2	<2	<2			16	18
Boron	14/38	<10	560	<10	<10	10			23	30
Cadmium	29/38	<50	1500	50	50	110			160	170
Chromium	39/39	1.4	68	7.6	5.2	9.5	13	2.5		
Cobalt	20/39	<2	280	3	<2	18			29	30
Gold	11/39	<10	55	<10	<10	<10			9	17
Lead	38/38	5	390	36	27	51	59	12		
Molybdenum	10/39	<4	220	<4	<4	<4			14	17
Nickel	17/39	<5	90	<5	<5	16			14	16
Silver	27/38	<0.1	>50	0.5	0.5	1.5			3.0	3.0
Tin	17/38	<5	84	<5	<5	23			14	17
Titanium	30/39	<5	160	10	8	22			21	22
Vanadium	9/39	<1	4	<1	<1	<1			0	1

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	Swiss subjects age ≥20 years									
Ash % of dry	4/4	4.1	5.6	4.5	4.1	5.6	4.7	0.36		
g/100 g of tissue ash										
Calcium	4/4	0.96	5.3	1.5	0.96	5.3	2.3	1.00		
Iron	4/4	0.17	0.70	0.47	0.17	0.70	0.45	0.11		
Magnesium	4/4	0.98	1.5	1.2	0.98	1.5	1.2	0.11		
Phosphorus	4/4	6	11	9	6	11	9	1.1		
Potassium	4/4	11	25	20	11	25	19	3.0		
μg/g of tissue ash										
Aluminum	4/4	32	58	47	32	58	46	6.4		
Copper	4/4	88	150	110	88	150	110	13		
Manganese	4/4	12	27	16	12	27	18	3.3		
Strontium	4/4	5.6	20	10	5.6	20	11	3.5		
Zinc	4/4	1500	2600	1800	1500	2600	1900	250		
Barium	4/4	4.5	25	21	4.5	25	18	4.6		
Bismuth	1/4	<2	26	<2	<2	26			6	8
Boron	0/4	<10	<10	<10	<10	<10			0	10
Cadmium	3/4	<50	180	110	<50	180			98	110
Chromium	4/4	2.2	100	7.3	2.2	100	29	24.0		
Cobalt	3/4	<2	240	24	<2	240			72	72
Gold	1/4	<10	140	<10	<10	140			35	43
Lead	4/4	14	44	23	14	44	26	6.7		
Molybdenum	0/4	<4	<4	<4	<4	<4			0	4
Nickel	4/4	5	12	9	5	12	8	1.7		
Silver	0/4	<0.1	<0.1	<0.1	<0.1	<0.1			0	0.1
Tin	1/4	<5	12	<5	<5	12			3	6
Titanium	2/4	<5	6	3	<5	6			2	5
Vanadium	1/4	<1	1	<1	<1	1			0	1

* Concentration in testis as indicated. For each element the column, "Fraction observed", indicates the number of samples in which the element was observed above the limits of detection and was thus actually observed, divided by the number of samples in which a determination of that element was made. For "Ash % of dry" the fraction is the number of samples for which values for this parameter were available, divided by the total number of samples of the tissues analyzed.

† See text for explanation.

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the standard deviation have been omitted to save space. Second, the heading of the column "Range of mean" has been changed to "Limits of sample mean values". For those elements which were not observed in concentrations above the lower limit of detection in every sample, it was impossible to calculate a mean value for concentration, since it could only be assumed that the concentration of such an element lay somewhere between zero and the lower limit of detection. Therefore, the two limiting values for the mean are given in the last column of the table as "Limits of sample mean value". In some instances, when the element was observed in all but a few samples, the difference between these two values for the mean lies in the second or third digit. The precision of the analytical method at this level is in general only good to one or two digits, and thus only one or two digits are reported; however, in such cases the two estimates of the mean do not differ significantly. The lower limit of concentration of those elements which were not observed in every sample is given as less than the lower limit of detection (<limit of detection). When an element was not observed in at least half the samples, the median value for concentration of that element is given in the tables as less than the lower limit of detection.

DISCUSSION

In comparing the various geographical groups an effort was made to control—or at least to take into account—the variables which might affect the results.

Since the foreign tissues had been preserved in formalin from collection to ashing and the American tissues had been frozen, a preliminary study was made to measure the extent to which the method of preservation affected the trace metal content of a tissue. This study indicated that if the formalin was ashed with the tissue there was no significant difference in trace metal content between an aliquot of a sample of tissue which had been preserved in metal-free formalin and an aliquot of the same sample of tissue which had been preserved by freezing.

A study of the variation with age of the trace element content of tissues indicated a difference between children and adults with respect to certain elements. Differences in the concentrations of certain elements in the tissues of male and female subjects were also observed. Therefore, in making a study of geographical variation, to eliminate variation due to these factors only males between the ages of 20 and 60 were compared, since this age and sex group provided the largest sample.

Males from the American group were compared with males from each of the larger foreign groups described above and males from the larger foreign groups with each other.

The KRUSKAL–WALLIS rank test for one-way classifications[5] was employed for these comparisons. When a test of differences is applied to more than one statistic of a population the stated significance level does not apply to the group of tests jointly, but only to each individual test. In the classical analysis of variance this difficulty is overcome through the use of a method of multiple comparisons such as SCHEFFE's or TUKEY's[6] but the non-normality of the data rules out the use of these techniques here. On the other hand, no reliable distribution-free multiple comparison procedure exists as yet, except for the special situations of equal and very small or very large sample sizes.[7] In this study 1350 tests were made, and the hypothesis that two groups were from the same population was rejected for $p \leq 0.001$. It seems reasonable to assume that a probability of this low level suggests a significant difference.

For small groups where the total number of the two groups of samples together was between seven and thirty, WHITE's table[8] was used in conjunction with the KRUSKAL–WALLIS test to estimate the significance level. Even with this refinement, conclusions based on very small groups should be made with caution.

The median values for concentration of those elements which were observed in at least half of the samples of at least one tissue are given in Table 12. Each group has been assigned a letter (United States A, Africa B, Near East C, Far East D) and beside each median value are the letters corresponding to those groups for which the hypothesis that two groups were from the same population was rejected. The KRUSKAL–WALLIS test detects differences not only in central tendency but

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Table 12. *Geographical variation in concentrations of elements* (males age 20–59)*

Element	Tissue	United States (A)		Africa (B)		Near East (C)		Far East (D)	
Aluminum	Aorta	28	B C D	840	A	1000	A	450	A
(ppm in ash)	Brain	16	B C D	110	A	190	A	63	A
	Heart	20	B C D	250	A	190	A	180	A
	Kidney	25	B C D	250	A	340	A	140	A
	Liver	37	B C D	170	A	140	A	130	A
	Lung	1800	B	3100	A	3100		2500	
	Pancreas	24	C D	150		290	A	140	A
	Spleen	24	B C D	250	A	220	A	110	A
	Testis	30	C D	140		460	A	250	A
Barium	Aorta	7	B C D	14	A	19	A	19	A
(ppm in ash)	Brain	<0.2	B C D	2.9	A	11	A	3.6	A
	Heart	0.7	B C D	5.0	A	7.4	A	3.5	A
	Kidney	1.2	B C D	5.0	A C	15	A B	6.4	A
	Liver	<0.2	B C D	3.6	A	6.5	A	4.0	A
	Lung	13	C	22		28	A	15	
	Pancreas	1.5	C D	7.2		17	A	5.3	A
	Spleen	0.5	B C D	4.2	A	11	A	2.9	A
	Testis	1.0	C D	20		13	A	4.8	A
Cadmium	Aorta	<50		<50		<50		50	
(ppm in ash)	Brain	<50		<50		<50		<50	
	Heart	<50		<50		<50		<50	
	Kidney	3200	B C	810	A D	1600	A D	4200	B C
	Liver	180	B D	50	A C	140	D	480	A B C
	Lung	50	B	<50	A D	<50		50	B
	Pancreas	82	D	46		76		190	A
	Spleen	<50		<50		<50		50	
	Testis	<50		<50		<50		50	
Calcium	Aorta	5.0	D	3.3		2.9		2.4	A
(% in ash)	Brain	0.52		0.64		0.48		0.49	
	Heart	0.38		0.40		0.45		0.43	
	Kidney	0.82	D	0.78	D	0.60	D	1.2	A B C
	Liver	0.39		0.37		0.32		0.51	
	Lung	0.98		0.77	D	0.69	D	1.2	B C
	Pancreas	0.80		1.3		0.79		0.60	
	Spleen	0.52		0.43		0.41		0.43	
	Testis	0.84		0.74		0.72		0.78	
Chromium	Aorta	1.9	C D	5.5		11	A	15	A
(ppm in ash)	Brain	0.2	C D	0.6		2.4	A	2.7	A
	Heart	1.6	D	0.9	D	4.0		6.3	A B
	Kidney	0.8	C D	2.0	C	5.3	A B	3.3	A
	Liver	0.8	C D	1.3		2.1	A	2.0	A
	Lung	14		16		22		23	
	Pancreas	1.6	C D	2.5		4.2	A	6.7	A
	Spleen	0.5	C D	1.3	C D	3.1	A B	3.1	A B
	Testis	1.6	C D	4.2		7.0	A	8.3	A
Copper	Aorta	91	C D	110		180	A	160	A
(ppm in ash)	Brain	360		460		440		420	
	Heart	340		320		290		370	
	Kidney	260	C D	300		350	A	440	A
	Liver	530	D	710		740		1200	A
	Lung	120	C D	140	D	240	A	240	A B
	Pancreas	140		150		170		150	
	Spleen	87	C D	100	D	140	A	190	A B
	Testis	75	D	120		140		150	A

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Table 12 (*cont.*)

Element	Tissue	United States (A)		Africa (B)		Near East (C)		Far East (D)	
Iron (% in ash)	Aorta	0.29	D	0.28		0.46		0.56	A
	Brain	0.32		0.31		0.40		0.43	
	Heart	0.47	D	0.47	D	0.45		0.70	A B
	Kidney	0.68		0.66		0.72		0.72	
	Liver	1.5		1.3		1.1		2.0	
	Lung	3.0	B C	1.9	A	1.7	A	2.9	
	Pancreas	0.35		0.43		0.34		0.44	
	Spleen	2.5		2.3		2.0		3.1	
	Testis	0.20	C D	0.29		0.40	A	0.41	A
Lead (ppm in ash)	Aorta	170		76		140		92	
	Brain	5	C	5	C	23	A B	11	
	Heart	5	C D	5	C D	21	A B	21	A B
	Kidney	110	B C	37	A D	70	A	84	B
	Liver	150	B C	60	A D	77	A	110	B
	Lung	51	B	26	A C D	47	B	48	B
	Pancreas	56	C	17		33	A	42	
	Spleen	30		22	C D	58	B	41	B
	Testis	12	C D	29		28	A	33	A
Magnesium (% in ash)	Aorta	1.5		1.5		1.5		1.3	
	Brain	0.90		1.1		0.85		0.89	
	Heart	1.6		1.6		1.5		1.5	
	Kidney	1.2		1.1		1.4		1.4	
	Liver	1.3		1.1		1.1		1.4	
	Lung	0.82	D	0.96		1.0		0.98	A
	Pancreas	1.3		1.2		1.5		1.3	
	Spleen	0.90		0.94		0.92		1.1	
	Testis	1.1		0.96		1.0		0.96	
Manganese (ppm in ash)	Aorta	8	B C D	13	A	18	A	22	A
	Brain	18		20		22		18	
	Heart	19		21		22		23	
	Kidney	78		59		74		71	
	Liver	96		130		110		120	
	Lung	16	C D	21		41	A	25	A
	Pancreas	100		82		92		89	
	Spleen	8	B C D	17	A	16	A	17	A
	Testis	12	D	86		20		18	A
Molybdenum (ppm in ash)	Aorta	<4		<4		<4		<4	
	Brain	<4		<4		<4		<4	
	Heart	<4		<4		<4		<4	
	Kidney	31	B	24	A	37		25	
	Liver	77		70		88		96	
	Lung	<4		<4		<4		<4	
	Pancreas	<4	B D	10	A	<4		<4	A
	Spleen	<4		<4		<4		<4	
	Testis	<4		<4		<4		<4	
Nickel (ppm in ash)	Aorta	<5	D	7		24		21	A
	Brain	<5		<5		<5		<5	
	Heart	<5		<5		<5		<5	
	Kidney	<5	C D	<5		12	A	7	A
	Liver	<5	D	<5		<5		5	A
	Lung	5		7		22		10	
	Pancreas	<5	D	<5		<5		10	A
	Spleen	<5		<5		<5		<5	
	Testis	<5	D	<5		<5		7	A

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Table 12 (*cont.*)

Element	Tissue	United States (A)		Africa (B)		Near East (C)		Far East (D)	
Phosphorus (% in ash)	Aorta	7	C D	6	D	13	A	10	A B
	Brain	20		24		23		23	
	Heart	15	D	15	D	16		19	A B
	Kidney	15		15		16		16	
	Liver	19		20		19		21	
	Lung	10	D	12		12		12	A
	Pancreas	20		23		22		21	
	Spleen	15	D	16		18		18	A
	Testis	12	D	16		13		16	A
Potassium (% in ash)	Aorta	9		9		9		11	
	Brain	18		23		20		14	
	Heart	23		25		19		22	
	Kidney	17		17		18		20	
	Liver	19		21		18		20	
	Lung	18		18		16		19	
	Pancreas	20		14		17		17	
	Spleen	23		25		22		26	
	Testis	18		20		22		17	
Silver (ppm in ash)	Aorta	0.1	C D	<0.1	C D	1.4	A B	1.0	A B
	Brain	0.5	C	<0.1	C	1.6	A B	0.7	
	Heart	<0.1	D	<0.1	C D	0.5	B	0.3	A B
	Kidney	<0.1	B	<0.1	A C	0.5	B	<0.1	
	Liver	1.0	C	<0.1	A C D	2.0	B	1.4	B
	Lung	<0.1		<0.1		0.5		<0.1	
	Pancreas	<0.1	C	0.9		0.5	A	0.5	
	Spleen	<0.1		<0.1	C	0.5	B	<0.1	
	Testis	<0.1	C D	0.3		1.3	A	0.6	A
Strontium (ppm in ash)	Aorta	34		32		35		22	
	Brain	1.2		2.5		3.5		1.5	
	Heart	2.5		3.6		3.1		3.0	
	Kidney	4.9	C D	6.6		7.8	A	6.8	A
	Liver	1.5	B C D	3.0	A	4.9	A	3.1	A
	Lung	8.0	C	9.9		12	A	8.7	
	Pancreas	3.3		9.4		7.4		3.9	
	Spleen	2.1	C	3.9		5.1	A	1.9	
	Testis	4.2		6.3		5.7		4.4	
Tin (ppm in ash)	Aorta	12		<5		10		14	
	Brain	<5		<5		<5		<5	
	Heart	5		<5		<5		<5	
	Kidney	15	B C D	<5	A	<5	A	<5	A
	Liver	20	B C D	<5	A	<5	A	5	A
	Lung	32	B	<5	A D	16		29	B
	Pancreas	<5		9		<5		<5	
	Spleen	10	B	<5	A	10		10	
	Testis	10	C	<5		<5	A	<5	
Titanium (ppm in ash)	Aorta	<5	B C D	20	A	59	A	20	A
	Brain	<5	C D	<5	C	18	A B	10	A
	Heart	<5	C D	<5	C	19	A B	10	A
	Kidney	<5	B C D	8	A	28	A	6	A
	Liver	<5		<5		<5		<5	
	Lung	200		270		390		140	
	Pancreas	<5	C D	15		39	A	10	A
	Spleen	<5	C D	<5		14	A	10	A
	Testis	<5	C D	10		40	A	10	A

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Table 12 (*cont.*)

Element	Tissue	United States (A)		Africa (B)		Near East (C)		Far East (D)	
Vanadium (ppm in ash)	Aorta	<1		<1		<1		<1	
	Brain	<1		<1		<1		<1	
	Heart	<1		<1		<1		<1	
	Kidney	<1		<1		<1		<1	
	Liver	<1		<1		<1		<1	
	Lung	<1	C	4		10	A	2	
	Pancreas	<1		<1		<1		<1	
	Spleen	<1		<1		<1		<1	
	Testis	<1		<1		<1		<1	
Zinc (ppm in ash)	Aorta	1800		1500		2000		2500	
	Brain	740		680		780		920	
	Heart	2500		2000		2200		2800	
	Kidney	4500	B D	3100	A D	3300	D	6000	A B C
	Liver	3400	D	4000	D	3800	D	7200	A B C
	Lung	1300	D	1200	D	1600		1600	A B
	Pancreas	2200		2300		1900		2800	
	Spleen	1300	D	1300		1500		1700	A
	Testis	1300		1900		1700		1600	

* Median values for concentration are given. The letters to the right of a median value indicate the groups for which the hypothesis that two groups were from the same population was rejected ($p \leq 0.001$).

also in the distribution of values. This accounts for what may appear to be discrepancies in the Table. For example, for aluminum in lung a median value of 3100 ppm for Africa is significantly different from 1800 ppm for the United States whereas a value of 3100 for the Near East is not significantly different. Although the median values were the same for Africa and the Near East, the distribution of values was quite different in these two groups. Nine of the twenty-eight African values were above 6000 ppm whereas only three of the twenty-two Near Eastern values were this high.

Since Schroeder and others, in their continuing series of papers on abnormal trace metals in man, have discussed at some length the variation with age and geography, the sources, the natural abundance and other pertinent data for the elements cadmium,[9] lead,[10] nickel,[11] chromium,[12] titanium,[13] vanadium[14] and tin,[15] only brief summaries of the results of the statistical tests will be given here.

Aluminum

The concentration of aluminum in lung showed no significant geographical difference except in the case of the higher value for Africans. For other tissues, however, the median value for the foreign groups was significantly higher than for the American group. This elevated concentration of aluminum is at least partly a reflection of contamination by dust at the time of collection which could not be avoided in many of the places where autopsies were performed.

Barium

This element was observed with greater frequency and in higher concentrations in the samples from outside continental United States than in residents of the U.S. All foreign samples of aorta, brain, heart, kidney, liver and spleen, had significantly higher median values for concentration of barium. In comparison with the other groups the group from the Near East showed higher barium in lung, and both Eastern groups had higher barium in pancreas and testis.

Cadmium

This element was observed chiefly in kidney and liver, and with somewhat less frequency in pancreas. It was observed in at least half of the samples for all tissues except brain of Far Eastern group. For concentration in kidney

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and liver the Near Eastern and African subjects had significantly lower median values than the American and Far Eastern subjects. The Far Eastern subjects had median values significantly higher than the Americans in liver and in aorta but the concentration in kidney was not significantly different from the American group. The significantly higher values reported earlier[3] for the geometric mean of the concentration of cadmium in kidney in the various groups from the Far East arose largely from excessively high values in four female subjects and two male subjects over 60 years of age. These values did not enter into the statistical test reported here since for this test only data from males between the ages of 20 and 60 were used.

Calcium

Samples of the aorta from the Far Eastern group had significantly lower, and samples of kidney from this group significantly higher, median values for concentration of calcium than samples from the other three groups. The value for lung for the Far Eastern group was significantly higher than for the African and Near Eastern groups whereas the American group had an intermediate value and was not significantly different from any of the other groups in this respect.

Chromium

The subjects from the Near East and the Far East had significantly higher median values than those from the United States for concentration of chromium in all tissues but lung.

Copper

In aorta, heart, kidney, liver, lung, spleen and testis, the Far Eastern subjects had higher copper than the American and African subjects. The Near Eastern subjects had higher copper in aorta, kidney, lung and spleen.

Iron

In general the median values for the concentration of iron were not significantly different from group to group. The Far Eastern group was significantly higher than the American in aorta, heart and testis. The African and Near Eastern groups were significantly lower than the American in lung. There was a significant difference between the iron content of samples of liver and lung in the South African negroid subjects reported by HARDING–BARLOW[16] and the African negroid subjects included in this study. South African negroes are known to be subject to a disease in which iron is stored, especially in the liver.[17] The elevated concentrations of iron in the kidney, liver and lung of subjects reported by HARDING-BARLOW indicate that even in the tissues of "normal" South African Negroes there is a tendency to store this element.

Lead

In general the American and Far Eastern groups had higher concentrations of lead than the African and Near Eastern groups. The African group had a significantly lower median concentration in lung than any of the other three groups.

Magnesium

There was no significant geographical differences in magnesium content.

Manganese

This element showed interesting differences. In the kidney and liver where manganese is known to play an essential role,[18] there was no significant geographical variation. In aorta lung and spleen, however, the median value for the concentration of this element was significantly higher in all foreign groups than in the American group and there was no significant differences among the foreign groups.

Molybdenum

The median value for the concentration of molybdenum in liver showed no significant geographical differences. The African group had a significantly lower median value for the concentration in kidney than the American group.

Nickel

The Far Eastern and Near Eastern groups had significantly higher median values than the American group for concentration of nickel in kidney and the Far Eastern higher values in aorta, liver, pancreas and testis as well.

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Phosphorus

In general median values for phosphorous were not significantly different from group to group. The Far Eastern group was higher than the American group in aorta, heart, lung, spleen and testis, and the Near Eastern higher than the American in aorta. The Far Eastern group was significantly higher than the African in aorta and heart.

Potassium

As might have been expected, there were no significant geographical differences in potassium content of any tissues.

Silver

In most tissues the Near Eastern subjects had significantly higher median values for concentration of silver than the African subjects, and in aorta, brain, pancreas and testis they had higher values than the American subjects. The Far Eastern subjects also had significantly higher values for silver than the American in aorta, heart and liver.

Strontium

All foreign groups had higher median values than the American group for the concentration of strontium in liver. Also, in comparison with the American group the Far Eastern and Near Eastern groups had higher values in kidney, and the Near Eastern in lung and spleen. The foreign groups did not differ among themselves.

Tin

All foreign groups had median values significantly lower than the American group for the concentration of tin in kidney and liver, and the African group had lower values in lung and spleen as well.

Titanium

As in the case of aluminum, there were no significant geographical differences in the median values of concentration of titanium in lung. The median values were significantly higher in the aorta and kidney of the African, Far Eastern and Near Eastern groups than in the group from the United States. This element was highly correlated with aluminum in lung.

Vanadium

The concentration of vanadium in lung was significantly higher in the group from the Near East than in the American group.

Zinc

In general the median values for the concentration of this essential element were higher in the Far Eastern group than in any of the other three groups.

Racial groups were also compared. There was no evidence that race *per se* had any influence on the trace metal content in the body. The American negroids did not differ significantly from the American caucasoids except for higher lead in some tissues of the negroids which could well be due to a difference in occupational exposure. Nor were there many significant differences between the African negroid and caucasoid groups. The American and African negroids were very different, however, as were the American and African caucasoids.

In general "essential" elements demonstrated no marked geographical variations, especially in those tissues where the element was known to have a metabolic function. Copper and zinc were much higher in the Near and Far Eastern groups than in the other groups. To determine whether this was due to a higher exposure to these metals or to a disturbance in metabolism of copper and zinc in individuals with certain diseases will require further investigation.

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ADDENDUM

For a study of ^{137}Cs in human tissue Drs. NOBURU and TOSHIKO YAMAGATA collected and ashed (450°C) samples of tissue from eighteen subjects from Tokyo, Japan.[19] Aliquots of this ash were analyzed for stable trace elements at the University of Tennessee laboratory.*

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Since the treatment of the samples was not identical with that for the samples collected by SCHROEDER, the data for these samples were not included in the descriptive statistics in this report. This group was compared with the American group and with the group from Tokyo which SCHROEDER collected. For most elements the two groups from Tokyo were similar and both differed from the American group in essentially the same way. However, the median value for cadmium in kidney for the Yamagata group from Tokyo was not different from that for the group from the United States but was significantly lower than that for the Schroeder group from Tokyo. The median values for cadmium in liver for both groups from Tokyo were significantly higher than for the American group.

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