INTERNATIONAL UNION OF
PURE AND APPLIED CHEMISTRY

DIVISION OF INORGANIC CHEMISTRY
COMMISSION ON ATOMIC WEIGHTS

ATOMIC WEIGHTS OF ELEMENTS 1967

LONDON
BUTTERWORTHS

DIVISION OF INORGANIC CHEMISTRY

COMMISSION ON ATOMIC WEIGHTS*

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INTRODUCTION

Practically the only source of new measurements upon which improved atomic weights can be based is the mass spectrometric determination of 'absolute' isotopic composition in which the mass spectrometer is corrected for bias by the measurement of standards of known isotopic composition prepared from separated isotopes of high chemical and isotopic purity. The determinations are somewhat tedious and exacting and few laboratories are willing to undertake such measurements. Thus, the number of changes in the atomic weights in any two-year period is likely to be small. The entire Table of Atomic Weights was recalculated and issued on the basis of $^{12}C = 12$ in 1961. No changes were made in the atomic weights in 1963

The Commission on Atomic Weights met in Paris in July 1965 in connection with the 23rd Conference of the International Union of Pure and Applied Chemistry. At that meeting the matter of changes in atomic weights was discussed, and it was decided to recommend that the atomic weights of three elements be changed. The changes are minor as can be seen from the following tabulation:

	1965	1961
Copper	63·546 ± 0·001	63·54
Bromine	79·904 ± 0·001	79·909 ± 0·002
Silver	107·868 ± 0·001	107·870 ± 0·003

The reasons for these changes and references to the measurements from which the atomic weights are calculated were not published after the 1965 meeting. They will be discussed in some detail later in this report since it has been the policy of the Commission to publish the reasons for any changes.

In 1967 the Commission on Atomic Weights did not meet but, in the interest of conserving travelling expenses, has transacted its business by mail. The consensus of the Commission is to recommend small changes in the atomic weights of two elements and the elimination of the previously stated limit of error on a third. The proposed changes are as follows:

	1967	1961
Neon	20·179 ± 0·003	20·183
Magnesium	24·305	24·312
Chromium	51·996	51·996 ± 0·001

* E. Wichers, chairman (U.S.A.), J. Guéron, Secretary (Belgium), S. Fujiwara (Japan), N. N. Greenwood (U.K.), H. S. Peiser (U.S.A.), J. Spaepen (Belgium), H. G. Thode (Canada), A. H. Wapstra (Netherlands), A. E. Cameron (U.S.A.), G. N. Flerov (U.S.S.R.), E. Roth (France), H. J. Svec (U.S.A.).

† Final version of the report adopted on 28th September 1967.

These, like the changes recommended in 1965, are the results of 'absolute' isotopic abundance measurements.

In the general review and recalculation of atomic weights which accompanied the change to the carbon-12 scale in 1961, the values assigned to a number of the elements were derived wholly or in part from chemical ratios involving silver and bromine. Because slight changes were made in the atomic weights for these two elements in 1965, the values of all elements that might be affected by the changes have been reexamined. None of the atomic weights thus recalculated is changed by as much as one unit in the last decimal place.

The Table of the Radioactive Elements has been reviewed and revised through the kindness of Dr. Katharine Way, Director of the Nuclear Data Project at the Oak Ridge National Laboratory and by Dr. A. H. Wapstra of the Commission on Atomic Weights. Dr Wapstra has also reviewed the 'Table of Selected Atomic Masses' and has recommended that no changes be made in it this year.

DISCUSSION OF RECOMMENDED CHANGES

Because silver, bromine and chlorine were key elements in the chemical determinations of atomic weights from which came most of the measurements prior to 1947, the atomic weights of these elements and the ratio of silver to chlorine and to bromine were carefully and thoroughly reviewed during the preparation of the 1961 Table. [cf. A. E. Cameron and Edward Wichers, *J. Am. Chem. Soc.* **84**, 4175 (1962)]. At that time 'absolute' mass spectrometric determinations of the isotopic abundance of silver and chlorine were available but only preliminary results were available for bromine. The Commission decided that it was premature to base the atomic weight of silver solely on the mass spectrometric determination without having available data for both bromine and chlorine. It was felt that the ratios of chlorine and bromine to silver were probably as accurate as any chemical measurements which had been made and that it would be desirable to compare these chemical ratios with the ratios calculated from the atomic weights of the three elements as determined by mass spectrometry. Accordingly, in the 1961 Table, the atomic weight of silver was chosen as 107·870 $\pm$ 0·003, which was a value midway between the average of the recalculated chemical determinations, $107{\cdot}871_4$ and $107{\cdot}868_5$ calculated from the mass spectrometric results of Shields, Craig and Dibeler[1]. The uncertainty of $\pm$ 0·003 assigned to this number includes both chemical and physical determinations. The atomic weights of chlorine and bromine were tied to this atomic weight through the chemically determined ratios and the assigned uncertainty, $\pm$ 0·001 for chlorine and $\pm$ 0·002 for bromine reflected the uncertainty assigned to silver.

With the appearance in 1964 of the absolute value for the isotopic abundance ratio of bromine[2], the three elements could be considered together. The physically determined atomic weights of silver and of chlorine, 107·868 (accepting the value of Shields, Craig and Dibeler[1]), and 35·453 give a calculated combining weight ratio, AgCl/Ag of 1·328667 which is exactly the pooled chemical combining ratio experimentally determined in the course of extensive work on atomic weight measurements. The atomic weight of bromine from the measurements reported by Catanzaro, Murphy, Garner and Shields[2], 79·904, gives a calculated combining weight ratio, AgBr/Ag of 1·740752 compared to the value of 1·740785 from chemical determinations. The difference of 19 parts per million indicates a bias in the chemical determination of this ratio which does not seem to have existed in the corresponding ratio involving chlorine.

The Commission agreed to abandon the chemical basis for the assignment of the atomic weights of these three elements and to base them upon the physically derived numbers. At the same time, the atomic weight of copper was changed from assignment on the basis of chemical determinations to the physical value of Shields, Murphy and Garner[4]. Interestingly enough, their value adds only one more significant figure to the 1961 value but, of course, does permit applying a confidence limit.

The reviews of the elements are presented below in the form in which the element-by-element review was given in the 1961 Report of the International Commission on Atomic Weights[5].

Atomic No. 10 Neon: ^{20}Ne, ^{21}Ne, ^{22}Ne Atomic Weight 20·179 ± 0·003

The recommended atomic weight of neon for inclusion in the 1961 revision of the Table was 20·183. This was the value obtained by Prof. T. Batuecas by recalculating the gas density measurements made by Baxter and Starkweather (1928)[6] and by Baxter (1928)[7]. The isotopic composition of atmospheric neon has been carefully redetermined in two laboratories by mass spectrometry using synthetic standards to correct for instrumental bias. Eberhardt, Eugster and Marti (1965)[8] prepared a standard by mixing atmospheric neon with ^{22}Ne of 99·7 per cent, isotopic purity. Walton and Cameron (1966)[9] mixed five standards from ^{20}Ne and ^{22}Ne of high isotopic and chemical purity. The isotopic composition reported by the two laboratories and the calculated atomic weights agree excellently. Eberhardt, Eugster and Marti found no difference in composition between commercially produced neon and samples which they recovered from the atmosphere by procedures which should have introduced no isotopic fractionation. Walton and Cameron found no differences within the precision of measurement in isotopic composition of several neon samples obtained from commercial sources. The calculated atomic weight, using the atomic masses from the compilation of Mattauch, Thiele and Wapstra (1965)[10] and the isotopic compositions determined in the two laboratories is 20·179 with a limit of error of ± 0·003 quoted by Walton and Cameron and originating mostly in the gas mixing for the preparation of the standards. Eberhardt, Eugster and Marti estimated their error as ±0·002. The Commission recommended the more conservative figure for inclusion in the Table.

Atomic No. 12 Magnesium: ^{24}Mg, ^{25}Mg, ^{26}Mg Atomic Weight 24·305

In the 1961 Table of Atomic Weights, the atomic weight of magnesium was based upon the isotopic composition reported by White and Cameron (1948)[11] and the atomic masses from the 1960 compilation of Everling, König, Mattauch and Wapstra (1960)[12]. Catanzaro, Murphy, Garner and Shields (1966)[13] have determined the isotopic composition of naturally occurring magnesium by comparison with samples of known isotopic

Table of Atomic Weights 1967. Alphabetical Order in English

Based on the Atomic Mass of $^{12}C = 12$

The values for atomic weights given in the Table apply to elements as they exist in nature, without artificial alteration of their isotopic composition, and, further to natural mixtures that do not include isotopes of radiogenic origin.

Name	*Symbol*	*Atomic Number*	*Atomic Weight*	*Name*	*Symbol*	*Atomic Number*	*Atomic Weight*
Actinium	Ac	89		Mercury	Hg	80	200·59
Aluminium	Al	13	26·9815	Molybdenum	Mo	42	95·94
Americium	Am	95		Neodymium	Nd	60	144·24
Antimony	Sb	51	121·75	Neon	Ne	10	20·179[b]
Argon	Ar	18	39·948	Neptunium	Np	93	
Arsenic	As	33	74·9216	Nickel	Ni	28	58·71
Astatine	At	85		Niobium	Nb	41	92·906
Barium	Ba	56	137·34	Nitrogen	N	7	14·0067
Berkelium	Bk	97		Nobelium	No	102	
Beryllium	Be	4	9·0122	Osmium	Os	76	190·2
Bismuth	Bi	83	208·980	Oxygen	O	8	15·9994[a]
Boron	B	5	10·811[a]	Palladium	Pd	46	106·4
Bromine	Br	35	79·904[b]	Phosphorus	P	15	30·9738
Cadmium	Cd	48	112·40	Platinum	Pt	78	195·09
Calcium	Ca	20	40·08	Plutonium	Pu	94	
Californium	Cf	98		Polonium	Po	84	
Carbon	C	6	12·01115[a]	Potassium	K	19	39·102
Cerium	Ce	58	140·12	Praseodymium	Pr	59	140·907
Cesium	Cs	55	132·905	Promethium	Pm	61	
Chlorine	Cl	17	35·453[b]	Protactinium	Pa	91	
Chromium	Cr	24	51·996	Radium	Ra	88	
Cobalt	Co	27	58·9332	Radon	Rn	86	
Copper	Cu	29	63·546[a]	Rhenium	Re	75	186·2
Curium	Cm	96		Rhodium	Rh	45	102·905
Dysprosium	Dy	66	162·50	Rubidium	Rb	37	85·47
Einsteinium	Es	99		Ruthenium	Ru	44	101·07
Erbium	Er	68	167·26	Samarium	Sm	62	150·35
Europium	Eu	63	151·96	Scandium	Sc	21	44·956
Fermium	Fm	100		Selenium	Se	34	78·96
Fluorine	F	9	18·9984	Silicon	Si	14	28·086[a]
Francium	Fr	87		Silver	Ag	47	107·868[b]
Gadolinium	Gd	64	157·25	Sodium	Na	11	22·9898
Gallium	Ga	31	69·72	Strontium	Sr	38	87·62
Germanium	Ge	32	72·59	Sulfur	S	16	32·064[a]
Gold	Au	79	196·967	Tantalum	Ta	73	180·948
Hafnium	Hf	72	178·49	Technetium	Tc	43	
Helium	He	2	4·0026	Tellurium	Te	52	127·60
Holmium	Ho	67	164·930	Terbium	Tb	65	158·924
Hydrogen	H	1	1·00797[a]	Thallium	Tl	81	204·37
Indium	In	49	114·82	Thorium	Th	90	232·038
Iodine	I	53	126·9044	Thulium	Tm	69	168·934
Iridium	Ir	77	192·2	Tin	Sn	50	118·69
Iron	Fe	26	55·847[b]	Titanium	Ti	22	47·90
Krypton	Kr	36	83·80	Tungsten	W	74	183·85
Lanthanum	La	57	138·91	Uranium	U	92	238·03
Lawrencium	Lr	103		Vanadium	V	23	50·942
Lead	Pb	82	207·19	Xenon	Xe	54	131·30
Lithium	Li	3	6·939	Ytterbium	Yb	70	173·04
Lutetium	Lu	71	174·97	Yttrium	Y	39	88·905
Magnesium	Mg	12	24·305	Zinc	Zn	30	65·37
Manganese	Mn	25	54·9380	Zirconium	Zr	40	91·22
Mendelevium	Md	101					

[a] Atomic weights so designated are known to be variable because of natural variations in isotopic composition. The observed ranges are:

Boron	± 0·003	Oxygen	± 0·0001
Carbon	± 0·00005	Silicon	± 0·001
Hydrogen	± 0·00001	Sulfur	± 0·003

[b] Atomic weights so designated are believed to have the following experimental uncertainties:

Bromine	± 0·001	Iron	± 0·003
Chlorine	± 0·001	Neon	± 0·003
Copper	± 0·001	Silver	± 0·001

Table of Atomic Weights 1967. Order of Atomic Number

The values for atomic weights given in the Table apply to elements as they exist in nature without artificial alteration of their isotopic composition, and, further, to natural mixtures that do not include isotopes of radiogenic origin.

Atomic Number	*Name*	*Symbol*	*Atomic Weight*	*Atomic Number*	*Name*	*Symbol*	*Atomic Weight*
1	Hydrogen	H	1·00797[a]	53	Iodine	I	126·9044
2	Helium	He	4·0026	54	Xenon	Xe	131·30
3	Lithium	Li	6·939	55	Cesium	Cs	132·905
4	Beryllium	Be	9·0122	56	Barium	Ba	137·34
5	Boron	B	10·811[a]	57	Lanthanum	La	138·91
6	Carbon	C	12·01115[a]	58	Cerium	Ce	140·12
7	Nitrogen	N	14·0067	59	Praseodymium	Pr	140·907
8	Oxygen	O	15·9994[a]	60	Neodymium	Nd	144·24
9	Fluorine	F	18·9984	61	Promethium	Pm	
10	Neon	Ne	20·179[b]	62	Samarium	Sm	150·35
11	Sodium	Na	22·9898	63	Europium	Eu	151·96
12	Magnesium	Mg	24·305	64	Gadolinium	Gd	157·25
13	Aluminium	Al	26·9815	65	Terbium	Tb	158·924
14	Silicon	Si	28·086[a]	66	Dysprosium	Dy	162·50
15	Phosphorus	P	30·9738	67	Holmium	Ho	164·930
16	Sulfur	S	32·064[a]	68	Erbium	Er	167·26
17	Chlorine	Cl	35·453[b]	69	Thulium	Tm	168·934
18	Argon	Ar	39·948	70	Ytterbium	Yb	173·04
19	Potassium	K	39·102	71	Lutetium	Lu	174·97
20	Calcium	Ca	40·08	72	Hafnium	Hf	178·49
21	Scandium	Sc	44·956	73	Tantalum	Ta	180·948
22	Titanium	Ti	47·90	74	Tungsten	W	183·85
23	Vanadium	V	50·942	75	Rhenium	Re	186·2
24	Chromium	Cr	51·996	76	Osmium	Os	190·2
25	Manganese	Mn	54·9380	77	Iridium	Ir	192·2
26	Iron	Fe	55·847[b]	78	Platinum	Pt	195·09
27	Cobalt	Co	58·9332	79	Gold	Au	196·967
28	Nickel	Ni	58·71	80	Mercury	Hg	200·59
29	Copper	Cu	63·546[a]	81	Thallium	Tl	204·37
30	Zinc	Zn	65·37	82	Lead	Pb	207·19
31	Gallium	Ga	69·72	83	Bismuth	Bi	208·980
32	Germanium	Ge	72·59	84	Polonium	Po	
33	Arsenic	As	74·9216	85	Astatine	At	
34	Selenium	Se	78·96	86	Radon	Rn	
35	Bromine	Br	79·904[b]	87	Francium	Fr	
36	Krypton	Kr	83·80	88	Radium	Ra	
37	Rubidium	Rb	85·47	89	Actinium	Ac	
38	Strontium	Sr	87·62	90	Thorium	Th	232·038
39	Yttrium	Y	88·905	91	Protactinium	Pa	
40	Zirconium	Zr	91·22	92	Uranium	U	238·03
41	Niobium	Nb	92·906	93	Neptunium	Np	
42	Molybdenum	Mo	95·94	94	Plutonium	Pu	
43	Technetium	Tc		95	Americium	Am	
44	Ruthenium	Ru	101·07	96	Curium	Cm	
45	Rhodium	Rh	102·905	97	Berkelium	Bk	
46	Palladium	Pd	106·4	98	Californium	Cf	
47	Silver	Ag	107·868[b]	99	Einsteinium	Es	
48	Cadmium	Cd	112.40	100	Fermium	Fm	
49	Indium	In	114·82	101	Mendelevium	Md	
50	Tin	Sn	118·69	102	Nobelium	No	
51	Antimony	Sb	121·75	103	Lawrencium	Lr	
52	Tellurium	Te	127·60				

[a] Atomic weights so designated are known to be variable because of natural variations in isotopic composition. The observed ranges are:

Hydrogen	± 0·00001	Oxygen	± 0·0001
Boron	± 0·003	Silicon	± 0·001
Carbon	± 0·00005	Sulfur	± 0 003

[b] Atomic weights so designated are believed to have the following experimental uncertainties:

Neon	± 0·003	Copper	± 0·001
Chlorine	± 0·001	Bromine	± 0·001
Iron	± 0·003	Silver	± 0·001

Radioactive Elements. Alphabetical Order in English

This table lists selected isotopes of the chemical elements, whether occurring in nature or known only through synthesis, that are commonly classed as radioactive. The listed isotope is the one of longest known half-life, or, for those marked with an asterisk, a better known one.

Name	*Symbol*	*Atomic Number*	*Isotope*	*Half-life*	*Mode of Disintegration*
Actinium	Ac	89	227	21·8y	α, β—
Americium	Am	95	243	$7{\cdot}95 \times 10^3$y	α
Astatine	At	85	210	8·3h	α, e.c.
Berkelium	Bk	97	247	$1{\cdot}4 \times 10^3$y	α
Californium	Cf	98	252*	2·65y	α, fission
Curium	Cm	96	247	$1{\cdot}6 \times 10^7$y	α
Einsteinium	Es	99	254	270d	α
Fermium	Fm	100	257	80d	α, fission
Francium	Fr	87	223	22m	α, β—
Lawrencium	Lr	103	256	45s	α
Mendelevium	Md	101	257	3·0h	α, e.c., fission (?)
Neptunium	Np	93	237	$2{\cdot}14 \times 10^6$y	α
Nobelium	No	102	255	3·0m	α
Plutonium	Pu	94	244	$8{\cdot}2 \times 10^7$y	α
Polonium	Po	84	210*	138·4d	α
Promethium	Pm	61	147*	2·62y	β—
Protactinium	Pa	91	231	$3{\cdot}44 \times 10^4$y	α
Radium	Ra	88	226	1600y	α
Radon	Rn	86	222	3·82d	α
Technetium	Tc	43	99*	$2{\cdot}14 \times 10^5$y	β—
Thorium	Th	90	232	$1{\cdot}41 \times 10^{10}$y	α
Uranium	U	92	238	$4{\cdot}5 \times 10^9$y	α

Radioactive Elements. Order of Atomic Number

This table lists selected isotopes of the chemical elements, whether occurring in nature or known only through synthesis, that are commonly classed as radioactive. The listed isotope is the one of longest known half-life, or, for those marked with an asterisk, a better known one.

Atomic Number	*Name*	*Symbol*	*Isotope*	*Half-life*	*Mode of Disintegration*
43	Technetium	Tc	99*	$2{\cdot}14 \times 10^5$y	β–
61	Promethium	Pm	147*	2·62y	β–
84	Polonium	Po	210*	138·4d	α
85	Astatine	At	210	8·3h	α, e.c.
86	Radon	Rn	222	3·82d	α
87	Francium	Fr	223	22m	α, β–
88	Radium	Ra	226	1600y	α
89	Actinium	Ac	227	21·8y	α, β–
90	Thorium	Th	232	$1{\cdot}41 \times 10^{10}$y	α
91	Protactinium	Pa	231	$3{\cdot}44 \times 10^4$y	α
92	Uranium	U	238	$4{\cdot}5 \times 10^9$y	α
93	Neptunium	Np	237	$2{\cdot}14 \times 10^6$y	α
94	Plutonium	Pu	244	$8{\cdot}2 \times 10^7$y	α
95	Americium	Am	243	$7{\cdot}95 \times 10^3$y	α
96	Curium	Cm	247	$1{\cdot}6 \times 10^7$y	α
97	Berkelium	Bk	247	$1{\cdot}4 \times 10^3$y	α
98	Californium	Cf	252*	2·65y	α, fission
99	Einsteinium	Es	254	270d	α
100	Fermium	Fm	257	80d	α, fission
101	Mendelevium	Md	257	3·0h	α, e.c., fission (?)
102	Nobelium	No	255	3·0m	α
103	Lawrencium	Lr	256	45s	α

composition carefully prepared from nearly pure separated isotopes. Catanzaro and Murphy report no detectable variations within the limit of error of the measurements in 60 samples of natural magnesium from various geological origins (1966)[14]. With the isotopic composition reported and the masses from the recent compilation of Mattauch, Thiele and Wapstra (1965)[15], the calculated atomic weight is 24·30497 ± 0·00044. The rounded value of 24·305 is recommended for inclusion in the Table and is stated without error.

Atomic No. 17 Chlorine: ^{35}Cl, ^{37}Cl Atomic Weight 35·453 ± 0·001

The atomic weight of chlorine, 35·453, recommended in the 1961 Table was derived from the atomic weight of silver through the silver chloride-silver ratio determined chemically, and the uncertainty assigned to the number was derived from that assigned to silver.

The recommended small change in the atomic weight of silver makes no change in the atomic weight of chlorine stated to five significant figures. The validity of the AgCl/Ag ratio, 1·328667, from chemical atomic weight determinations and the accuracy of the atomic weight of chlorine are now supported by the 'absolute' mass spectrometric measurements of the isotopic composition. Shields, Garner, Murphy and Dibeler (1962)[3] give ^{35}Cl = 75·7705 per cent (+0·0035; −0·046) and ^{37}Cl = 24·2295 per cent (+0·046; −0·035) which with the masses from the compilation of Mattauch, Thiele and Wapstra (1965)[10] give a calculated atomic weight of 35·4527 ± 0·0007. This was rounded to 35·453 ± 0·001.

Atomic No. 24 Chromium: ^{50}Cr, ^{52}Cr, ^{53}Cr, ^{54}Cr Atomic Weight 51·996

The atomic weight recommended for inclusion in the 1961 revision of the Table was calculated from the isotopic composition of the element reported by Flesch, Svec and Staley (1960)[15] with atomic masses from the compilation of Everling, König, Mattauch and Wapstra (1960)[12].

Flesch, Svec and Staley made their measurements upon a mass spectrometer which had been corrected for mass bias by calibration with known mixtures of separated nitrogen isotopes. Within the limits of error they found no variation in isotopic composition of chromium in 18 chromites of various geological origins.

In 1966 Shields, Murphy, Catanzaro and Garner[16] redetermined the isotopic composition of chromium, calibrating the mass spectrometers with carefully prepared gravimetric standards mixed from separated chromium isotopes of very high chemical and isotopic purity. Abundances of the individual isotopes which they report were, in every case, within the limits of error of the Flesch, Svec and Staley measurement. The atomic weight calculated from these abundances and the atomic masses from Mattauch, Thiele and Wapstra (1965)[10] is 51·99612 ± 0·00033 which rounds to precisely what has been appearing in the Table. The Commission recommends retaining the atomic weight of 51·996 but stating it without limit of error.

Atomic No. 29 Copper: ^{63}Cu, ^{65}Cu Atomic Weight 63·546 ± 0·001

The atomic weight of copper has been based upon chemical determinations by Hönigschmid and Johannsen (1944)[17] and Ruer and Bode (1924)[18] since 1947. Their chemical ratios were recalculated for the 1961 revision of the Table of Atomic Weights and the atomic weight assigned was 63·54.

Shields, Murphy and Garner[4] have made an absolute determination of the isotopic composition of copper. Mass spectrometer errors were eliminated by calibration with gravimetric standards prepared by mixing separated copper isotopes of high chemical and isotopic purity. With isotopic abundances of $^{63}Cu = 69{\cdot}174 \pm 0{\cdot}020$ and $^{65}Cu = 30{\cdot}826 \pm 0{\cdot}020$ and the atomic masses from the compilation of Mattauch, Thiele and Wapstra (1965)[10] the calculated atomic weight is $63{\cdot}5455 \pm 0{\cdot}001$. Natural variations in the abundance ratio of the copper isotopes were investigated for 106 samples by Shields, Goldich, Garner and Murphy[19]. The conclusion was that a microsample of a secondary copper mineral might show relatively large deviation, up to 9 per cent of the ratio, but that bulk or commercially processed copper would show variations much less than this. The $\pm 0{\cdot}001$-range of variation assigned to the atomic weight includes a very liberal allowance of $\pm 1{\cdot}5$ per cent of the isotopic ratio for this kind of copper.

Atomic No. 35 Bromine: ^{79}Br, ^{81}Br Atomic Weight $79{\cdot}904 \pm 0{\cdot}001$

The atomic weight recommended in the 1961 Table was $79{\cdot}909 \pm 0{\cdot}002$, and was derived from the atomic weight of silver through the ratio AgBr/Ag which had been determined in the course of the extensive chemical work on atomic weights. The atomic weight of bromine calculated from the absolute abundances of the bromine isotopes, $^{79}Br = 50{\cdot}686 \pm 0{\cdot}047$ and $^{81}Br = 49{\cdot}314 \pm 0{\cdot}047$ atom per cent, determined by Catanzaro, Murphy, Garner and Shields (1964)[2] and the atomic masses from Mattauch, Thiele and Wapstra (1965)[10] is $79{\cdot}904 \pm 0{\cdot}001$. The Commission now recommends this value. No provable variations were observed in the $^{79}Br/^{81}Br$ ratios of 29 commercial and natural samples. The AgBr/Ag ratio calculated from the atomic weights based on absolute mass spectrometric determinations is 1·740752 which differs by 19 parts per million from 1·740785 which was the value determined chemically.

Atomic No. 47 Silver: ^{107}Ag, ^{109}Ag Atomic Weight $107{\cdot}868 \pm 0{\cdot}001$

The atomic weight of silver which was recommended in the 1961 Table was midway between the average of recalculated chemical determinations and the atomic weight derived from the absolute mass spectrometric determination of the silver isotopic composition by Shields, Craig and Dibeler (1960)[1]. The absolute mass spectrometric results reported by Crouch and Turnbull (1962)[20] give an atomic weight 0·001 higher than Shields, Craig and Dibeler's results and with an uncertainty of $\pm 0{\cdot}0026$, which is twice that estimated by the latter workers.

The Commission now recommends that the atomic weight be assigned on the basis of the isotopic composition determined by Shields, Craig and Dibeler[1]: $^{107}Ag = 51{\cdot}818 \pm 0{\cdot}052$; $^{109}Ag = 48{\cdot}182 \pm 0{\cdot}052$. From these abundances and the atomic masses from Mattauch, Thiele and Wapstra (1965)[10] the calculated atomic weight is $107{\cdot}8685 \pm 0{\cdot}0013$. The rounded atomic weight of $107{\cdot}868 \pm 0{\cdot}001$ is recommended. Shields *et al.* compared seven samples of native silver from various terrestrial sources to the commercial silver nitrate which they had chosen as a standard. One of the seven samples was statistically slightly different from the standard. Within the quoted limits of error there seems to be no significant variation in the isotopic composition of silver from various sources.

References

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