# The Journal of the American Chemical Society

with which has been incorporated

The American Chemical Journal

(Founded by Ira Remsen)

VOL. 46 MARCH, 1924 No. 3

THIRTIETH ANNUAL REPORT OF THE COMMITTEE ON ATOMIC WEIGHTS. DETERMINATIONS PUBLISHED DURING 1923

By Gregory Paul Baxter

Received January 31, 1924

The first report of the new International Committee on Elements[1] gives tables of isotopes, and of radioactive elements and their constants.

Reports of German,[2] and Spanish[3] committees on atomic weights have been published.

Moles and Miravalles[4] have investigated the compressibility of exhausted glass globes and find that the formula

$$\text{Contraction per atmosphere} = 17.5 \frac{\text{Volume in cc.}}{\text{Weight in g.}} \times 10^{-3} \text{ cc.}$$

in general gives as reliable results as any experimental method.

Batuecas[5] has extended the work of Guye and Batuecas on the compressibilities of gases and finds the following values.

	$(PV)_0/(PV)_1$	Density	At. wt.
Nitrous oxide	1.00739	1.9778	N = 14.002
Nitric oxide	1.00112	1.3402	N = 14.006
Methyl ether	1.02540	2.1096	C = 12.003

Boron.—Stock and Kuss[6] weighed fractionated diborane (B_2H_6) in a glass globe and measured the volume of hydrogen evolved on hydrolysis.

[1] This Journal, **45**, 867 (1923).

[2] Bodenstein, Hahn, Hönigschmid and Meyer, *Z. angew. Chem.*, **36**, 221 (1923); *Ber.*, **56A**, I–XXXIV (April, 1923).

[3] Cabrera, Mourelo, del Campo, Moles, Batuecas, *Anales soc. españ. fís. quím.*, **21**, 57 (1923).

[4] Moles and Miravalles, *Anales soc. españ. fís. quím.*, **20**, 104 (1922).

[5] Batuecas, *ibid.*, **20**, 441 (1922).

[6] Stock and Kuss, (a) *Ber.*, **56B**, 314 (1923); (b) *Z. anorg. allgem. Chem.*, **128**, 49 (1923).

ATOMIC WEIGHT OF BORON

Wt. of B_2H_6	Wt. of H_2	Ratio $B_2H_6:6H_2O$	At. wt. B
0.109510	0.047865	2.28789	10.810
.105465	.046116	2.28695	10.804
.112181	.049054	2.28689	10.803
.104359	.045642	2.28647	10.802
.108708	.047514	2.28792	10.810
.110924	.048505	2.28686	10.804
	Av.	2.28716	10.807

Baxter and Scott[7] synthesized boron trichloride and boron tribromide from the elements, and fractionally distilled the halides in exhausted glass vessels until the products were free from silicon halides. Fractions of the halides were collected at various stages of the purification in sealed, exhausted glass bulbs. These were weighed, broken under ammonia and, after the glass had been determined, the solution was compared with silver. In some experiments the silver halide was collected and weighed.

In the tables the fractions are numbered in the order of decreasing volatility. Weights are corrected to vacuum. Cl = 35.458; Br = 79.916.

ATOMIC WEIGHT OF BORON

BCl_3. SAMPLE I

Fraction of BCl_3	Wt. of BCl_3 G.	Wt. of Ag G.	Ratio $BCl_3:3Ag$	At. wt. B
6	4.84825	13.39060	0.363063	10.804
4	3.80944	10.51949	.362132	10.826
8	5.67738	15.68073	.362060	10.803
5	5.28752	14.60378	.362065	10.805
7	2.86895	7.92365	.362074	10.808
		Av.	.362079	10.809

BCl_3. SAMPLE II

Fraction of BCl_3	Wt. of BCl_3 G.	Wt. of Ag G.	Ratio $BCl_3:3Ag$	At. wt. B	Wt. of AgCl G.	Ratio $BCl_3:3AgCl$	At. wt. B
25	6.63574	18.32385	0.362136	10.828	....	....	......
1	6.36923	17.58466	.362204	10.850	....	....	......
24	6.37226	17.59666	.362129	10.825	....	....	......
2	5.87852	16.23129	.362172	10.839	....	....	......
3	3.73634	10.31798	.362119	10.822	....	....	......
21	3.95311	10.91751	.362089	10.812	14.50552	.272525	10.816
4	3.53556	9.76236	.362162	10.836	12.97045	.272586	10.842
5	3.55078	9.80556	.362119	10.822	13.02621	.272587	10.842
19	3.45120	9.53188	.362069	10.806	12.66480	.272503	10.806
7	3.59682	9.93339	.362094	10.814	13.19789	.272530	10.818
9	4.33672	11.97678	.362094	10.814	....	....	......
16	3.07091	8.48131	.362080	10.810	11.26819	.272529	10.817
11	3.70594	10.23547	.362068	10.806	....	....	......
14	3.17865	8.77862	.362090	10.813	11.66282	.272546	10.825
6	4.35457	12.02629	.362088	10.812	....	....	......
18	4.10982	11.35029	.362089	10.812	....	....	......
12	3.62520	10.01172	.362096	10.815	....	....	......
		Av.	.362112	10.820		.272544	10.824

[7] Baxter and Scott, *Proc. Am. Acad. Arts Sci.*, **59**, 21 (1923). See also *Science, N. S.*, **54**, 524 (1921).

BBr_3

Fraction of BBr_3	Wt. of BBr_3 G.	Wt. of Ag G.	Ratio BBr_3:3Ag	At. wt. B	Wt. of AgBr G.	Ratio BBr_3:3AgBr	At. wt. B
24	11.94682	15.42731	(0.774394)	(10.877)	....	....	......
22	16.70949	21.58273	.774207	10.816	....	....	......
18	10.62202	13.71957	.774224	10.822	....	....	......
20	5.72663	7.39671	.774213	10.818	....	....	......
4	8.72710	11.27173	.774247	10.829	....	....	......
3	8.01796	10.35513	.774298	10.846	....	....	......
5	7.99444	10.32583	.774218	10.820	....	....	......
6	7.05884	9.11662	.774283	10.841	....	....	......
15	10.56234	13.64271	.774211	10.818	....	....	......
14	7.92601	10.23726	.774232	10.824	....	....	......
13	9.11150	11.76933	.774173	10.805	....	....	......
8	10.45731	13.50655	.774240	10.827	23.51219	0.444761	10.825
9	9.20250	11.88559	.774257	10.833	....	....	......
10	8.85374	11.43655	.774162	10.802	19.90883	.444714	10.799
11	4.75503	6.14211	.774169	10.804	....	....	......
Av., omitting Fraction 24			.774224	10.822		.444738	10.812

The average value, 10.82, is identical with that found by Hönigschmid and Birckenbach.

Sodium.—Moles and Clavera[8] have converted sodium trinitride into sodium nitrate. Weights are corrected to a vacuum.

Wt. of NaN_3	Wt. of $NaNO_3$	Ratio $NaNO_3$:NaN_3		
0.31576	0.41281	1.30735	If N = 14.005	Na = 23.026
.20814	.27211	1.30734	14.006	23.017
.47658	.62307	1.30738	14.007	23.008
.20767	.27150	1.30733	14.008	22.998
.29891	.39077	1.30731	14.009	22.988
.30490	.39862	1.30738	14.010	22.978
.23004	.30074	1.30734	....	....
.20916	.27344	1.30732	....	....
.21966	.28717	1.30734	....	....
.18391	.24043	1.30732	....	....
.24672	.32256	1.30737	....	....
	Av.	1.30734		

Silicon.—Baxter, Weatherill and Scripture[9] synthesized silicon tetrachloride from the elements and purified the product by fractional distillation in exhausted vessels. Samples II and III were found to be contaminated with higher chlorides of silicon. Sample IV was more carefully distilled and apparently was sufficiently pure. The tetrabromide was prepared from pure bromine and silicon and also was subjected to elaborate purification by fractional distillation. Both substances were weighed in sealed, exhausted bulbs and, after decomposition with sodium hydroxide, were compared with silver. Fractions are numbered in the order of decreasing volatility. Weights are corrected to vacuum. Cl = 35.457; Br = 79.916.

[8] Moles and Clavera, *Anales soc. españ. fís. quím.*, **20,** 550 (1922); *Z. physik. Chem.*, **107,** 423 (1923); (reported briefly in the 29th Report).

[9] Baxter, Weatherill and Scripture, *Proc. Am. Acad.*, **58,** 246 (1923).

Atomic Weight of Silicon

Sample II

Fraction	Wt. of $SiCl_4$ G.	Wt. of Ag G.	Ratio $SiCl_4$:4Ag	At. wt. Si
7	5.68295	14.43153	0.393787	28.099
13	5.01510	12.73571	.393783	28.097
1	3.73771	9.49172	.393786	28.099
20	7.58979	19.26875	(.393891)	(28.144)
		Av., omitting Fraction 20	.393787	29.099

Sample III

Fraction	Wt. of $SiCl_4$ G.	Wt. of Ag G.	Ratio $SiCl_4$:4Ag	At. wt. Si
1	2.97268	7.54940	.393764	28.089
21	2.49266	6.32800	(.393910)	(28.152)
13	4.38690	11.14090	.393765	28.090
16	4.23780	10.76595	.393630	28.031
		Av., omitting Fraction 21	.393711	28.070

Sample IV

Fraction	Wt. of $SiCl_4$ G.	Wt. of Ag G.	Ratio $SiCl_4$:4Ag	At. wt. Si
1	6.32161	16.05604	.393722	28.071
10	2.50810	6.37059	.393700	28.061
4	6.30110	16.00456	.393707	28.064
8	7.02208	17.83534	.393717	28.069
11	4.14551	10.52942	.393707	28.065
12	6.43140	16.33552	.393707	28.064
14	6.17527	15.68425	.393724	28.072
6	6.56940	16.68571	.393714	28.068
		Av.	.393712	28.067

$SiBr_4$

Fraction	Wt. of $SiBr_4$ G.	Wt. of Ag G.	Ratio $SiBr_4$:4Ag	At. wt. Si
1	6.29408	7.81075	0.805823	28.064
8	7.08409	8.79042	(.805888)	(28.093)
2	8.75434	10.86387	.805821	28.064
4	6.09639	7.56566	.805797	28.054
5	5.89649	7.31754	.805802	28.056
3	5.32962	6.61398	.805811	28.060
7	5.87675	7.29313	.805792	28.052
6	4.16665	5.17067	.805824	28.065
	Av., omitting Fraction 8		.805810	28.059
		Av. of Sample IV of $SiCl_4$ and $SiBr_4$		28.063

Stock and Kuss[6a] by decomposition of fractionated silicon hydride and measurement of the hydrogen evolved find the three values 28.15, 28.16, 28.14.

Chlorine.—Dorenfeldt[10] has compared chlorine found in Bamle apatite with that in ordinary sodium chloride by determining the specific gravities of saturated solutions of sodium chloride. Two sets of final values are given, corresponding to slight differences in temperature.

[10] Dorenfeldt, This Journal, **45,** 1577 (1923).

Densities of Saturated Salt Solutions

	Ordinary	Apatite
I	1.202791	1.202791
II	1.202867	1.202855

Evaporation of the same volume of two corresponding solutions yielded 3.31262 and 3.31267 g. respectively of sodium chloride. This supports the evidence of earlier investigators that chlorine which has not been in the sea is identical with that which has.

Titanium.—Baxter and Fertig[11] fractionated commercial titanium tetrachloride in a vacuum. The product was found by spectroscopic tests to be free from silicon, vanadium and zirconium. The tetrachloride was collected for analysis and weighed in sealed, exhausted glass bulbs. These were broken under nitric acid and after the glass had been collected and weighed the solution was compared with silver in the usual way. The fractions of tetrachloride are numbered in the order of decreasing volatility. Weights are corrected to vacuum. Cl = 35.458.

Atomic Weight of Titanium

Fraction of $TiCl_4$	Wt. of $TiCl_4$ G.	Wt. of Ag G.	Ratio $TiCl_4$:4Ag	At. wt. Ti
6	5.3314	12.1259	0.43967	47.89
1	4.4803	10.1909	.43964	47.88
2	4.8304	10.9909	.43949	47.82
5	4.5808	10.4251	.43940	47.78
3	5.0843	11.5655	.43961	47.87
4	4.3018	9.7859	.43959	47.86
		Av.	.43957	47.85

The present International (1922) value is 48.1.

Iron.—Hönigschmid, Birckenbach and Zeiss[12] synthesized ferric chloride from the elements in quartz apparatus so constructed that the product could be resublimed into a quartz weighing tube without exposure to moist air. The product, which gave no test for ferrous chloride, was dissolved in 1.5% nitric acid at 0° and was immediately precipitated with a weighed equivalent amount of silver, and after standing for several days at 0° the end-point was found nephelometrically. Finally the silver chloride was collected and weighed. Weights are corrected to vacuum. Cl = 35.457.

Atomic Weight of Iron

Preliminary Series

Wt. of $FeCl_3$ G.	Wt. of Ag G.	Ratio $FeCl_3$:3Ag	At. wt. Fe	Wt. of AgCl G.	Ratio $FeCl_3$:3AgCl	At. wt. Fe
2.56636	5.11975	0.501267	55.859	...	...	....
2.34933	4.68715	.501228	55.846	...	...	....
1.03565	...	...	....	2.74519	.377260	55.855
1.67263	...	...	....	4.43559	.377263	55.856
1.68182	...	...	...	4.45818	.377244	55.848
	Av.	.501248	55.853		.377256	55.853

[11] Baxter and Fertig, This Journal, **45,** 1228 (1923).

[12] Hönigschmid, Birckenbach and Zeiss, *Ber.*, **56**B, 1473 (1923).

FINAL SERIES

Wt. of $FeCl_3$ G.	Wt. of Ag G.	Ratio $FeCl_3$:3Ag	At. wt. Fe	Wt. of AgCl G.	Ratio $FeCl_3$:3AgCl	At. wt. Fe
2.57785	5.14290	0.501244	55.852	6.83313	0.377258	55.854
1.23313	2.46017	.501238	55.870	3.26848	.377279	55.863
1.13715	2.26839	.501303	(55.871)	3.01404	.377284	(55.865)
1.34904	2.69146	.501230	55.847	3.37610	.377238	55.845
1.86946	3.27970	.501236	55.849	4.95513	.377278	55.863
2.08337	4.15642	.501241	55.850	...	...	....
2.67942	5.34559	.501239	55.850	7.10276	.377236	55.845
2.40666	4.80129	.501253	55.854	6.37929	.377261	55.856
3.25209	6.48850	.501208	(55.840)	8.62125	.377102	(55.837)
1.35432	2.70190	.501247	55.853	3.58996	.377252	55.852
3.71092	7.40326	.501255	55.855	9.83634	.377266	55.858
3.73866	7.45862	.501254	55.855	9.91005	.377259	55.855
4.07234	8.12422	.501259	55.857	10.79471	.377253	55.852
	Av.	.501245	55.852		.377258	55.854

The average value, 55.853, is 0.01 unit higher than the present International (1922) value which rests on the value found by Baxter and Hoover, 55.847, by reduction of ferric oxide, and the analysis of ferrous bromide by Baxter, Thorvaldson and Cobb who obtained 55.838.

Nickel.—Baxter and Hilton[13] have recompared terrestrial and meteoric nickel by analysis of the chloride. After careful purification the chloride was slowly dehydrated in a stream of dry hydrogen chloride in a quartz tube and was several times sublimed until free from silica. The sublimed material was further heated nearly to the sublimation point in dry hydrogen chloride before being weighed. Solution and comparison with silver followed, and the silver chloride was collected and weighed in several experiments. Weights are corrected to vacuum. Cl = 35.458.

ATOMIC WEIGHT OF NICKEL

Sample of $NiCl_2$	Wt. of $NiCl_2$ G.	Wt. of Ag G.	Ratio $NiCl_2$:2Ag	At. wt. Ni	Wt. of AgCl G.	Ratio $NiCl_2$:2AgCl	At. wt. Ni
Terrestrial	5.43432	9.04608	0.600738	58.699	...	...	....
	4.12207	6.86158	.600746	58.701	...	...	....
	4.26173	7.09430	.600726	58.697	...	...	....
	6.06602	10.09778	.600728	58.697	...	...	....
	3.69766	6.15529	.600729	58.697	8.17875	.452106	58.692
	4.01449	6.68285	.600715	58.694	8.87907	.452130	58.699
		Av.	.600730	58.698	...	.452118	58.696
Meteoric	3.96766	6.60461	.600741	58.700	8.77478	.452166	58.709
	4.06949	6.77431	.600724	58.696	9.00019	.452156	58.706
	3.52204	5.86307	.600716	58.695	7.79031	.452105	58.692
	4.22509	7.03333	.600724	58.696	...	...	....
		Av.	.600726	58.697		.452142	58.702
		Av. of all	.600729	58.697		.452133	58.700

As in a previous investigation by Baxter and Parsons with material from the same sources, terrestrial and meteoric nickel are found to be

[13] Baxter and Hilton, THIS JOURNAL, **45**, 694 (1923).

identical. The atomic weight of nickel determined is nearer the value recently obtained by Baxter and Parsons, 58.702, than that found earlier by Richards and Cushman, 58.682.

Bromine.—Hönigschmid and Zintl[14] have compared bromine and silver and have made complete syntheses of silver bromide. Carefully purified dry bromine was distilled in an exhausted glass system into glass bulbs which were sealed while evacuated. After being weighed, the bulbs were broken under ammoniacal ammonium arsenite and the glass fragments were collected and weighed. The solution was compared with the purest silver, and after the exact end-point had been found a slight excess of silver nitrate was added and the silver bromide was collected and weighed. Several analyses of potassium bromide with and without the addition of arsenite showed that the latter substance had no effect on the result. Weights are corrected to vacuum. Ag = 107.880.

Atomic Weight of Bromine

Wt. of Br G.	Wt. of Ag G.	Ratio Br:Ag	At. wt. Br	Wt. of AgBr G.	Ratio Br:AgBr	At. wt. Br	Wt. of Ag + wt. of Br − wt. of AgBr G.
2.85107	3.84869	0.740790	79.916	....	....	......	....
3.58674	4.84186	.740777	79.915	8.42862	0.425543	79.915	−0.00002
3.14241	4.24203	.740780	79.915	7.38447	.425543	79.915	− .00003
2.20924	2.98220	.740809	79.918	5.19147	.425552	79.918	− .00003
4.20716	5.67931	.740787	79.916	9.88640	.425550	78.917	+ .00007
4.50795	6.08542	.740779	79.915	10.59330	.425547	79.916	+ .00007
4.16666	5.62468	.740782	79.916	9.79138	.425544	79.915	− .00004
1.68886	2.27984	.740780	79.915	3.96868	.425547	79.916	+ .00002
4.47534	6.04125	.740797	79.917	10.51660	.425550	79.917	− .00001
2.28987	3.09116	.740780	79.915	....	....	......	....
	Av.	.740786	79.916		.425547	79.916	+ .000004

The average value for the atomic weight of bromine is identical with that found by Baxter by synthesis of silver bromide from weighed amounts of silver, and by comparison of silver bromide and silver chloride.

Furthermore, the striking agreement between the weight of silver bromide found and the sum of the weights of silver and bromine used affords additional confirmation of the freedom of the silver ordinarily used in this class of work from both metallic and gaseous impurities.

Antimony.—Muzaffar[15] has compared purified metallic antimony from stibnite from different sources with potassium bromate, and finds marked differences in atomic weight.

Source	Hungary	Borneo	Peru	Bolivia
At. wt. Sb	121.144	121.563	121.720	122.374

No. 72. (Celtium-Hafnium.)—Hevesy[16] has published preliminary determinations of the atomic weight of element No. 72, in which the sulfate was converted to oxide by ignition.

[14] Hönigschmid and Zintl, *Ann.*, **433,** 201 (1923).

[15] Muzaffar, This Journal, **45,** 2009 (1923).

[16] Hevesy, *Ber.*, **56B,** 1503 (1923).

Atomic Weight of No. 72

Wt. of sulfate G.	Wt. of oxide G.	Ratio oxide:sulfate	At. wt. No. 72
0.9327	0.5247	0.5629	174.2
1.9081	1.0755	.5636	174.8
		Av.	174.5

Since the preparation contained 5 to 6% of zirconium the atomic weight of No. 72 is apparently between 178.4 and 180.2.

Mercury.—Hönigschmid, Birckenbach and Steinheil[17] have analyzed mercuric chloride and bromide prepared both from ordinary mercury and from metal which had been partially separated into isotopes by Brönsted and Hevesy. Ordinary mercury was treated with mercurous nitrate and distilled thrice in a vacuum. The separated mercury was distilled once. The halides were prepared by heating the metal in a current of dry chlorine, or nitrogen charged with bromine, and after resublimation in a current of the same gas were fused in a quartz weighing tube in a current of nitrogen. After solution of the halides in water the mercury was precipitated with hydrazine and the excess of hydrazine destroyed with hydrogen peroxide. Comparison of the solution with silver followed. Weights are corrected to vacuum. Cl = 35.457; Br = 79.916.

Atomic Weight of Mercury

Wt. of $HgCl_2$ G.	Wt. of Ag G.	Ratio $HgCl_2$:2Ag	At. wt. Hg
Ordinary Mercury			
2.13713	1.69819	1.25848	200.61
3.85034	3.05962	1.25844	200.61
1.68604	1.33978	1.25845	200.61
4.51718	3.58910	1.25858	200.64
4.45234	3.53761	1.25857	200.64
1.75819	1.39716	1.25840	200.60
5.21426	4.14336	1.25846	200.61
3.26948	2.59801	1.25846	200.61
5.56053	4.41849	1.25847	200.61
3.40487	2.70561	1.25845	200.61
6.63476	5.27207	1.25847	200.61
5.88367	4.67531	1.25846	200.61
	Av.	1.25847	200.61
Light Fraction			
4.29696	3.41502	1.258253	200.566
4.34231	3.45108	1.258246	200.565
3.84344	3.05453	1.258275	200.571
	Av.	1.258258	200.567
Heavy Fraction			
4.01298	3.18853	1.258567	200.634
2.90295	2.30650	1.258595	200.640
4.34190	3.44981	1.258591	200.637
	Av.	1.258584	200.637

[17] Hönigschmid, Birckenbach and Steinheil, *Ber.*, **56B,** 1212 (1923). Hönigschmid and Birckenbach, *Ber.*, **56B,** 1219 (1923).

Ordinary Mercury

Wt. of $HgBr_2$ G.	Wt. of Ag G.	Ratio $HgBr_2$: 2Ag	At. wt. Hg
3.97757	2.38097	1.67057	200.61
5.05162	3.02390	1.67057	200.61
3.01322	1.80372	1.67056	200.61
4.42861	2.65096	1.67057	200.61
5.17631	3.09854	1.67056	200.61
3.93433	2.35515	1.67052	200.60
3.14061	1.87997	1.67056	200.61
6.41435	3.83957	1.67059	200.61
	Av.	1.67056	200.61

Light Fraction

2.98314	1.78600	1.670291	200.550
2.65486	1.58936	1.670396	200.573
3.51638	2.10515	1.670370	200.567
3.13551	1.87718	1.670330	200.558
	Av.	1.670347	200.562

Heavy Fraction

5.82553	3.48708	1.670604	200.618
7.87234	4.71220	1.670629	200.623
6.73210	4.02945	1.670724	200.643
5.74331	3.43775	1.670660	200.629
	Av.	1.670654	200.628

The value already found by Easley, and by Baker for ordinary mercury is thus confirmed.

The average values for the light fraction, 200.564, differs from the average for the heavy fraction, 200.632, by 0.068 unit, while the difference in atomic weight calculated from the densities found by Brönsted and Hevesy amounts to the same quantity.

Lead.—Hönigschmid and Steinheil[18] have compared the most and least volatile fractions of lead chloride obtained by Brönsted and Hevesy in

Light Fraction

Wt. of $PbCl_2$ G.	Wt. of Ag G.	Ratio $PbCl_2$:2Ag G.	At. wt. Pb	Wt. of AgCl G.	Ratio $PbCl_2$:2AgCl	At. wt. Pb
3.11854	2.41913	1.289117	207.226	3.21414	0.970257	207.233
3.03220	2.35217	1.289108	207.224	3.12519	.970245	207.230
3.66959	2.84657	1.289127	207.228	3.78213	.970244	207.230
4.90405	3.80412	1.289142	207.231	5.05435	.970263	207.235
4.07526	3.16125	1.289130	207.229	4.20018	.970258	207.234
	Av.	1.289125	207.227		.970253	207.232

Heavy Fraction

3.70960	2.87761	1.289126	207.227	3.82319	.970289	207.243
3.94052	3.05677	1.289113	207.224	4.06123	.970278	207.239
4.41267	3.42293	1.289150	207.233	4.54786	.970274	207.238
4.23655	3.28626	1.289171	207.237	3.66622	.970301	207.246
6.22552	4.82914	1.289158	207.235	6.41624	.970276	207.339
	Av.	1.289144	207.231		.970284	207.241

[18] Hönigschmid and Steinheil, *Ber.*, **56B**, 1831 (1923).

a fractional distillation of this substance. After purification the chloride was sublimed in a current of hydrogen chloride into a quartz weighing tube. Solution and comparison with silver followed the weighing, and finally the silver chloride was determined. Weights are corrected to vacuum. Cl = 35.457.

The difference between the two fractions is not only less than was expected but is within the limit of error of the experiment. Furthermore when all the values for the atomic weight of lead are averaged the result, 207.23, is perceptibly higher than any value found by the numerous recent investigators on this subject.

Atkinson[19] claims to have separated lead by fractional crystallization into material of higher (11.345) and lower (11.313) density than that of ordinary lead (11.328).

Radioactive Lead.—Hönigschmid and Birckenbach[20] and Richards and Putzeys[21] have determined the atomic weight of lead obtained from minerals associated with the deposit of uraninite in the Belgian Congo. Weights are corrected to vacuum. Cl = 35.458.

Atomic Weight of Lead

Hönigschmid and Birckenbach

Wt. of $PbCl_2$ G.	Wt. of Ag G.	Ratio $PbCl_2:2Ag$	At. wt. Pb
	Congo Lead		
6.53232	5.08881	1.283664	206.047
5.79082	4.51117	1.283663	206.047
8.51297	6.63180	1.283660	206.045
	Av.	1.283662	206.046
	Richards and Putzeys		
	Ordinary Lead		
5.70194	4.42331	1.28906	207.21
4.65819	3.61405	1.28891	207.18
4.87664	3.78388	1.28879	207.15
	Av.	1.28892	207.18
	Congo Lead, Preliminary		
3.38089	2.63325	1.28392	206.10
4.21302	3.28093	1.28409	206.14
	Av.	1.28400	206.12
	Congo Lead, Final		
3.66388	2.85263	1.28439	206.20
4.30262	3.34997	1.28438	206.20
	Av.	1.28439	206.20

Moles and Clavera[22] recalculate certain fundamental atomic weights from earlier measurements.

[19] Atkinson, *Nature*, **112**, 282 (1923).

[20] Hönigschmid and Birckenbach, *Ber.*, **56B**, 1837 (1923).

[21] Richards and Putzeys, This Journal, **45**, 2954 (1923).

[22] Moles and Clavera, *Anales soc. españ. fís. quím.*, **20**, 550 (1922).

Recent evidence concerning the isotopic character of the following elements has been given by Aston.[23]

ISOTOPIC CHARACTER OF ELEMENTS

Element	Atomic number	Atomic weight	Minimum number of isotopes	Mass number in order of intensity
Sc	21	45.1	1	45
Ti	22	48.1	1	48
V	23	51.0	1	51
Cr	24	52.0	1	52
Mn	25	54.93	1	55
Co	27	58.94	1	59
Cu	29	63.57	2	63, 65
Ga	31	69.72	2	69, 71
Ge	32	72.42	3	74, 72, 70
Sr	38	87.63	1	88
Y	39	88.9	1	89
Ag	47	107.88	2	107, 109
Sb	51	121.77	2	121, 123

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THE ACTION OF ARSENIC TRIOXIDE IN WATER SOLUTION ON CERTAIN METALLIC HYDROXIDES

BY LEROY GRANVILLE STORY AND ERNEST ANDERSON

RECEIVED JULY 16, 1923

Many arsenites have been described in the literature,[1] some of which have a complex composition. Frequently these substances were prepared under conditions that might easily give rise to mixtures. Indeed, the analyses of the products often do not agree with the formulas assigned to them. Biltz[2] studied the action of ferric hydroxide, aluminum hydroxide and silicic acid separately on water solutions of arsenic trioxide and found that no compounds were formed but adsorption phenomena occurred. The results in the case of ferric hydroxide could be represented by an equation. The amounts of arsenic trioxide adsorbed by aluminum hydroxide and silicic acid were very small and practically independent of the concentration of the arsenic trioxide in solution. These facts led to the investigation of the action of arsenic trioxide in water solution on certain metallic hydroxides in order to determine the composition of the products formed.

[23] Aston, *Nature*, **110**, 732 (1922); **112**, 449 (1923).

[1] Stavenhagen, *J. prakt. Chem.*, **51**, 1 (1895). Reichard, *Ber.*, **27**, 1019 (1894), and **31**, 2165 (1898).

[2] Biltz, *Ber.*, **37**, 3138 (1904).