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SEVENTEENTH ANNUAL REPORT OF THE COMMITTEE ON ATOMIC WEIGHTS. DETERMINATIONS PUBLISHED DURING 1909.

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The year 1909 has been marked by unusual activity in the determination of atomic weights, and much of the work done was of remarkably high quality. It is also noteworthy because of the publication, in German, of the collected papers by Richards and his colleagues in Harvard University.[1] The actual work of the year, including some data from 1908, may be summarized as follows:

Chlorine and Nitrogen.—The work of Guye and Fluss[2] on nitrosyl chloride, NOCl, appeared in December, 1908, too late for recognition in the report for last year. The weighed gas was passed, first over silver, which absorbed the chlorine; then over heated copper, which fixed the oxygen; and finally over calcium, which combined with the nitrogen. A complete analysis of nitrosyl chloride was thus effected, giving direct comparisons of nitrogen and chlorine with oxygen, independent of every other atomic weight. The following data were obtained, the actual weights being given in the first four columns:

NOCl.	N.	O.	Cl.	At. wt. N.	At. wt. Cl.
0.5341	0.1142	0.1305	0.2893	14.000	35.470
0.4284	0.0916	0.1046	0.2319	14.012	35.472
0.7995	0.1710	0.1954	0.4331	14.002	35.464
0.5639	0.1204	0.1375	0.3048	14.010	35.468
0.5121	0.1095	0.1251	0.2773	14.005	35.466
			Mean,	14.008	35.468

[1] Experimentelle Untersuchungen über Atomgewichte, von Theodore William Richards und seinen Mitarbeitern. Hamburg und Leipzig, 1909.

[2] *J. chim. phys.*, 6, 733. The table given here is abbreviated from the tables as published by Guye and Fluss.

Scheuer[1] deduces the atomic weight of chlorine from the density of gaseous hydrochloric acid. Twenty-eight determinations are given, representing weighings in six different globes. The mean of all, for the weight of a normal liter of hydrochloric acid, is 1.63941 grams. From this figure Scheuer computes, by different methods, values for Cl between 35.442 and 35.454. He concludes that the atomic weight is very near 35.45.

The density, composition by volume, and compressibility of hydrochloric acid have also been determined, with great care, by Gray and Burt.[2] Three series of density determinations are given, with gas from different sources. The following figures give the weight of one liter of hydrochloric acid, at 0°, 760 mm., and at London:

I.	II.	III.
1.64053	1.64022	1.63950
1.64004	1.63999	1.64013
1.64020	1.63976	1.63984
1.63986	1.64083	1.64069
....	1.64030	1.64031
....	1.64021	1.64017
....	1.64027	1.64050
....	....	1.64051
....	....	1.63992
....	....	1.64001

Series I and II are subject to a small correction for gas adsorbed by the walls of the glass bulbs in which the weighings were made. Series III represents weighings in "quartz" glass, and do not need the correction. The final mean, reduced to Lat. 45°, gives for the weight of the normal liter, 1.63915 grams.

In order to determine the volumetric composition of hydrochloric acid, measured volumes of it were decomposed by heated aluminum, and the volume of hydrogen liberated was also measured. From two volumes of hydrochloric acid the following volumes of hydrogen were obtained.

1.00797	1.00781
1.00795	1.00779
1.00790	1.00787
1.00790	1.00798

Mean, 1.00790. Combining this figure with that given for the density, and with Morley's value for the atomic weight of hydrogen, 1.00762, Cl = 35.459. The compressibility measurements, which are too complex

[1] *Compt. rend.*, **149**, 599. Scheuer's complete memoir (*Z. physik. Chem.*, **68**, 575) was received too late for consideration here. Scheuer discusses his own data very fully, and finally combines them with the figures given by Gray and Burt. His final conclusion is that Cl = 35.466.

[2] *J. Chem. Soc.*, **95**, 1633.

for reproduction here, gave with the density determinations, by the method of limiting densities, the value Cl = 35.461. The mean value, 35.460, is adopted by the authors.

Nitrogen and Silver.—A new series of analyses of ammonium chloride is due to Richards, Koethner and Tiede.[1] The results, with all corrections applied, are as follows:

Weight NH_4Cl.	Weight AgCl.	At. wt. N.
2.02087	3.41469	14.009
2.23894	5.99903	14.008
1.55284	4.16076	14.008
1.36579	3.65959	14.007
1.61939	4.33914	14.007
1.93795	5.19219	14.012
2.89057	7.74498	14.009
1.31405	3.52082	14.009
1.82091	4.87921	14.006
	Mean,	14.0085

Calculated with H = 1.0076, Cl = 35.4574, and Ag = 107.881. These values for Cl, Ag and N are obtained by combining the data given above with the ratios Ag : NO_3 and Ag : Cl as formerly determined in the Harvard Laboratory.

Iodine and Silver.—Baxter and Tilley[2] have determined the ratio between iodine pentoxide and silver. The pentoxide was first reduced, in solution, by hydrazine hydroxide, and the iodine was afterwards precipitated and weighed as silver iodide. Two series of determinations were made, one by Tilley, the other by Baxter. The results, with all corrections applied, were as follows:

SERIES I.

Weight I_2O_5.	Silver used.	Ratio.
6.06570 } [3]	3.92027 }	} 0.646234
9.48035 }	6.12611 }	
7.73052	4.99564	0.646223
12.63909	8.16777	0.646231
9.49913	6.13841	0.646208
8.34369	5.39202	0.646239
8.83155	5.70715	0.646223
6.77487	4.37803	0.646216
	Mean,	0.646225

[1] THIS JOURNAL, 31, 6. The actual analyses were all made by Tiede. Richards is only responsible for the methods employed in the work.

[2] THIS JOURNAL, 31, 201.

[3] The first two solutions were inadvertently mixed, and hence are combined here.

SERIES II.

Weight I_2O_5.	Silver used.	Ratio.
12.09036	7.81320	0.646234
6.29744	4.06957	0.646226
10.89880	7.04309	0.646226
9.33895	6.03505	0.646222
10.15370	6.56160	0.646236
11.00453	7.11141	0.646226
7.01649	4.53431	0.646236
9.33573	6.03304	0.646231
8.72163	5.63619	0.646231
9.01524	5.82591	0.646229
	Mean,	0.646230

Combining these figures with the former determinations by Baxter of the silver-iodine ratio, the authors find, with reference to O = 16, Ag = 107.850 and I = 126.891.

Carbon.—Scott[1] has sought to determine the atomic weight of carbon by means of analyses of tetraethylammonium bromide, $C_8H_{20}NBr$. This salt was titrated against silver solutions, and the ratio so determined gave the subjoined molecular weights, when Ag = 107.93.

Weight bromide.	Weight Ag.	Mol. wt. bromide.
5.07039	2.60146	210.360
5.26380	2.70142	210.305
7.10662	3.64683	210.325
6.79951	3.48976	210.293
2.72225	1.39695	210.330
6.24530	3.20481	210.326
5.74581	2.94853	210.323
5.21663	2.67699	210.321

From these figures, when NH_4Br = 97.995 and H = 1.0075, C = 12.026, a very high value. One experiment was also made with the corresponding methyl compound, of which 8.64585 grams balanced 6.05348 grams of silver. Hence, C = 12.024. With Ag = 107.88 the values become C = 12.019 and 12.017. All weights were reduced to a vacuum.

In a criticism of Scott's work, Thorpe[2] has pointed out the possibility of errors due to the vacuum reductions, errors discussed long ago by Marignac, and recently, in more detail, by Guye and Zachariades.[3] The substances analyzed were weighed in powder, under which conditions they are liable to condense and occlude air. A probable correction, applied to Scott's weighings, reduced the atomic weight of carbon to 12.008, in harmony

[1] *J. Chem. Soc.*, **95**, 1200.

[2] *Proc. Chem. Soc.*, **25**, 285.

[3] *Compt. rend.*, **149**, 593 and 1122.

with other good determinations. To this criticism Scott[1] published a rejoinder, seeking to show, on the basis of experimental evidence, that the supposed errors do not, in fact, exist. According to Guye and Zachariades, the errors noted by them in the study of 26 compounds may amount to as much as, or even more than, 3 parts in 10,000.

The atomic weight of carbon has also been deduced by Baumé and Perrot[2] from density determinations of methane and ethane. For methane, the following weights of the normal liter are given:

0.71688	0.71633
0.71655	0.71670
0.71631	0.71676
0.71667	0.71723
0.71749	....

From the mean, 0.7168 gram, by different methods of reduction, the authors find values for C ranging from 12.003 to 12.005.

For the normal liter of ethane the following weights were found:

I.	II.
1.35671	1.35600
1.35679	1.35610
1.35671	1.35653
1.35652	1.35640
1.35700	1.35590
1.35640	1.35640

The mean of the second series, 1.3562 grams, is preferred by the authors. Reduced by Leduc's method of molecular volumes it gives C = 11.996. By Berthelot's method of limiting densities, C = 12.004. By reduction with the critical constants C = 12.036. The results from ethane are evidently not conclusive. From the vapor density of toluene, as measured by Ramsay and Steele, Leduc[3] deduces C = 12.003.

Scott,[4] in a preliminary note, gives, without details, the results of combustions of naphthalene and cinnamic acid. In six analyses, 17.6175 grams of naphthalene gave 60.5355 of CO_2. Hence, C = 11.999. In two analyses, 8.6153 grams of cinnamic acid gave 23.0413 of CO_2. Hence, 12.0015. The cause of the discrepancy between these figures and those from the alkylammonium bromides remains to be discovered.

Phosphorus.—Ter Gazarian[5] gives the following figures for the weight of a normal liter of phosphine, PH_3.

[1] *Proc. Chem. Soc.*, **25**, 286.

[2] *J. chim. phys.*, **7**, 369; also *Compt. rend.*, 148, 39.

[3] *Compt. rend.*, 148, 832. For other papers by Leduc on atomic weights and gaseous densities see *Compt. rend.*, 148, 42 and 548.

[4] *Proc. Chem. Soc.*, **25**, 310.

[5] *Compt. rend.*, 148, 1397; *J. chim. phys.*, **7**, 337.

1.52955
1.52907
1.52933
1.52944
1.52907
1.52933

From the mean, 1.5293 grams, he deduces the atomic weight P = 30.906, when H = 1.008. The value found is very low.

Vanadium.—Prandtl and Bleyer[1] have redetermined the atomic weight of vanadium by analyses of carefully purified vanadyl trichloride, $VOCl_3$. The substance, after weighing, was decomposed by water, in presence of a little zinc. The latter reduced the vanadium to its lower form of oxidation, and also prevented the escape of chlorine, either as free element or as oxides. In the filtrate from the solution the chlorine was determined as silver chloride. Two series are given, with vacuum weights, as follows:

I.

Weight $VOCl_3$.	Weight AgCl.	Ratio.
5.47218	13.54724	40.393
5.85234	14.50771	40.346
3.23175	8.00636	40.365
5.24732	13.01359	40.322
3.56589	8.83375	40.367

Hence, rejecting the first analysis, V = 51.133.

II.

Weight $VOCl_3$.	Weight AgCl.	Ratio.
4.91432	12.18494	40.331
3.64470	9.04685	40.287
4.96088	12.30438	40.318
6.46766	16.04292	40.315
4.33158	10.74624	40.308
4.05060	10.04498	40.325

Hence, V = 50.963. Mean of both series, 50.048, when Ag = 107.88 and Cl = 35.46.

Arsenic.—Baxter and Coffin,[2] by analyses of silver arsenate, have redetermined the atomic weight of arsenic. Two essentially distinct methods were employed. First, the arsenate was heated in gaseous hydrochloric acid, and so converted into silver chloride. Secondly, the arsenate was dissolved in nitric acid, and the silver was then precipitated, with the usual precautions, either as chloride or as bromide. Six series of results are given, which, with all corrections applied, are as follows:

[1] *Z. anorg. Chem.*, 65, 152.
[2] THIS JOURNAL, 31, 297.

I.—First Method.

Weight arsenate.	Weight AgCl.	Ratio.
3.17276	2.94922	0.929544
2.65042	2.46367	0.929539
3.51128	3.26396	0.929564
5.83614	5.42503	0.929558
5.72252	5.31947	0.929568

II.—Second Method.

4.59149	4.26796	0.929537
3.38270	3.14436	0.929542
	Mean, Series I and II,	0.929550

III.—Second Method.

Weight arsenate.	Weight AgBr.	Ratio.
8.75751	10.66553	1.21787
6.76988	8.24545	1.21796
5.19424	6.32590	1.21787
5.33914	6.50258	1.21791
8.24054	10.03552	1.21782
7.57962	9.23147	1.21793
6.05230	7.37106	1.21789

IV.—First Method.

Weight arsenate.	Weight AgCl.	Ratio.
4.67268	4.34389	0.929636
7.71882	7.17597	0.929672
5.28049	4.90908	0.929664
4.25346	3.95424	0.929652
3.47340	3.22893	0.929616
5.17269	4.80879	0.929650
4.10766	3.81858	0.929624

V.—Second Method.

5.47133	5.08643	0.929652
	Mean, Series IV and V,	0.929646

VI.—Second Method.

Weight arsenate.	Weight AgBr.	Ratio.
4.96261	6.04440	1.217988
5.31743	6.47658	1.217991
4.46882	5.44300	1.217995
4.16702	5.07539	1.217990

Series I, II and III are in close agreement, and Series IV, V and VI agree also; but the two groups differ, because of differences in the samples of arsenate employed. The first group is preferred, and gives, in mean, when Ag = 107.88, As = 74.957.

Chromium.—Two memoirs upon the atomic weight of chromium have been issued from the Harvard Laboratory. Baxter, Mueller and Hines[1] analyzed pure silver chromate, by dissolving the salt in dilute

[1] This Journal, 31, 529.

nitric acid, and after reducing the chromium to the chromic state, either by sulphur dioxide or by hydrazine sulphate, precipitating the silver as chloride or bromide. Two series of results are given, as follows; with all corrections applied.

I.—CHLORIDE SERIES.

Weight chromate.	Weight AgCl.	Ratio.
10.30985	8.90908	0.864132
8.26920	7.14492	0.864040
6.56679	5.67444	0.864111
	Mean,	0.864094

II.—BROMIDE SERIES.

Weight chromate.	Weight AgBr.	Ratio.
2.63788	2.98621	1.13205
2.82753	3.20084	1.13203
2.33454	2.64268	1.13199
1.77910	2.01402	1.13204
2.33198	2.63994	1.13206
3.10402	3.51390	1.13205
2.92751	3.31427	1.13211
4.21999	4.77762	1.13214
5.24815	5.94104	1.13203
6.24014	7.06484	1.13216
7.92313	8.96982	1.13211
	Mean,	1.13207

Using the silver-chlorine ratio of Richards and Wells, and the silver-bromine ratio of Baxter, these determinations give 65.0333 as the percentage of silver in Ag_2CrO_4. Hence, if Ag = 107.88, Cr = 52.008.

The second memoir, by Baxter and Jesse,[1] relates to analyses of silver dichromate, by essentially the same methods as those used in the previous investigation. The corrected results are subjoined.

Weight dichromate.	Weight AgBr.	Ratio.
5.71554	4.97149	0.869820
4.87301	4.23888	0.869869
7.45476	6.48425	0.869813
4.75269	4.13420	0.869865
8.15615	7.09495	0.869890
6.15412	5.35309	0.869839
6.83662	5.94678	0.869842
5.39883	4.69631	0.869876

In a single experiment, 6.26657 grams of the dichromate gave 4.16076 of silver chloride. From all of the data, the percentage of silver in $Ag_2Cr_2O_7$ is 49.9692. Hence, with Ag = 107.88, Cr = 52.013. The rounded-off value 52.01 is adopted.

Tellurium.—A new method for detaining the atomic weight of tellurium

[1] THIS JOURNAL, 31, 541.

has been adopted by Lenher.[1] The double bromide, K_2TeBr_6, was converted into KCl by first heating in chlorine, and afterwards in gaseous hydrochloric acid. The determinations were made with tellurium from three widely different sources, and calculated with Cl = 35.46, Br = 79.92, and K = 39.095. All weights were reduced to a vacuum. The results obtained, in three series, were as follows:

I.

Weight K_2TeBr_6.	Weight KCl.	At. wt. Te.
2.33360	0.50779	127.54
1.27372	0.27716	127.54
1.47573	0.32111	127.56
1.65715	0.36059	127.55
1.54006	0.33513	127.5

II.

1.82810	0.39778	127.56
1.87342	0.40765	127.55
1.48045	0.32214	127.55
2.24775	0.48911	127.54

III.

Weight K_2TeBr_6.	Weight KCl.	At. wt. Te.
2.37899	0.51767	127.54
1.79926	0.39146	127.64
0.94102	0.20476	127.56
1.55357	0.33806	127.54
1.95038	0.42440	127.54
1.73248	0.37698	127.5
1.81923	0.39586	127.55

Mean of all as one series, Te = 127.55.

Lenher's researches, like those of several previous investigators, have had in view the determination of the homogeneity of tellurium, a conclusion which seemed to be finally established. Browning and Flint,[2] however, by a special process of fractionation, believe that they have strong evidence in favor of the view that tellurium is complex. When tellurium tetrachloride is decomposed by water, part of the tellurium is precipitated as TeO_2 and part remains in solution, to be recovered by subsequent treatment with ammonia and acetic acid. These two portions, converted into basic nitrate of tellurium, gave different values for the atomic weight of the element. From the first precipitate, Te = 126.49 in mean, and from the second Te = 128.85. The investigation is to be continued.

Mercury.—Preliminary determinations of the atomic weight of mercury have been published by Easley.[3] First, mercuric chloride was reduced

[1] THIS JOURNAL, 31, 20; see also discussion by Hinrichs, *Compt. rend.*, 148, 484.

[2] *Am. J. Sci.*, [4] 28, 347.

[3] THIS JOURNAL, 31, 1207.

by a well-known reaction with hydrogen peroxide. The mercury was collected mainly in a globule, but a small part of it which remained disseminated, was redissolved and determined electrolytically. With vacuum reduction the results obtained were as follows:

Weight $HgCl_2$.	Weight Hg.	At. wt. Hg.
23.43239	17.30826	200.44
12.59751	9.30608	200.52
10.94042	8.08134	200.46
11.73734	8.67044	200.50
	Mean,	200.48

Secondly, mercury was removed from the chloride as in the preceding experiments, and the chlorine in the filtrate was precipitated and weighed as silver chloride, with all the known precautions. The corrected data are as follows:

Weight $HgCl_2$.	Weight AgCl.	At. wt. Hg.
10.50276	11.08744	200.64
9.03634	9.54027	200.62
23.43239	24.73606	200.65
10.94042	11.55158	200.59
11.11409	11.73470	200.60
16.63910	17.56808	200.60
	Mean,	200.62

Calculated with Ag = 107.88 and Cl = 35.46. Easley regards the second series as the more trustworthy. The investigation is to be continued by other methods.

Rhodium.—Two inaugural dissertations on the atomic weight of rhodium have appeared from Gutbier's laboratory at Erlangen. Renz reduced the rhodium pentamine bromide, $Rh(NH_3)_5Br_3$, in hydrogen, and cooled the remaining metal in an atmosphere of carbon dioxide. With H = 1.008, N = 14.01, and Br = 79.92 and vacuum weights, the subjoined results were obtained.

Weight bromide.	Weight Rh.	At. wt. Rh.
0.87624	0.21057	102.784
1.56500	0.37638	102.980
2.04033	0.49069	102.888
2.00120	0.48135	102.908
1.89278	0.45525	102.901
2.30210	0.55416	103.014
1.02065	0.24555	102.937
1.31485	0.31622	102.890
1.86060	0.44766	102.947
1.51040	0.36339	102.942
	Mean,	102.919

H. Dittmar's dissertation deals with the corresponding chloride,

$Rh(NH_3)_5Cl_3$, by essentially the same method as that of Renz. With vacuum weights and Cl = 35.46, the following results are given:[1]

Weight chloride.	Weight Rh.	At. wt. Rh.
2.01526	0.70465	102.987
1.83589	0.64173	102.937
1.57210	0.54934	102.884
2.17528	0.76046	102.955
2.03911	0.71271	102.925
2.20000	0.76890	102.916
1.02840	0.35941	102.908
	Mean,	102.930

Palladium.—Gutbier, Haas and Gebhardt[2] have redetermined the atomic weight of palladium by analyses of palladosamine bromide, $PdN_2H_6Br_2$. Two series of reductions in hydrogen are given, with vacuum weights, and H = 1.008, N = 14.01, and Br = 79.92 for the antecedent value.

I.

Weight bromide.	Weight Pd.	At. wt. Pd.
0.54402	0.19286	106.495
0.80237	0.28468	106.630
2.06470	0.73274	106.673
2.64770	0.93978	106.697
1.73455	0.61563	106.688
0.91601	0.32509	106.676
1.29106	0.45821	106.682
2.26758	0.80490	106.705
1.77729	0.63082	106.693
1.90770	0.67704	106.677
3.09278	1.09783	106.708
1.98039	0.70288	106.692

II.

Weight bromide.	Weight Pd.	At. wt. Pd.
0.42942	0.15228	106.546
0.76884	0.27271	106.586
3.32461	1.17987	106.673
0.62795	0.22270	106.559
2.68383	0.95245	106.670
1.40117	0.49731	106.689
2.61673	0.92877	106.694
2.64229	0.93787	106.699
2.54424	0.90293	106.674
2.00456	0.71143	106.680
1.50032	0.53253	106.698
2.84500	1.00992	106.715

[1] Dittmar's work has also appeared in *Sitzungsb. phys. Med. Soz. Erlangen*, **40**, 184.

[2] *J. prakt. Chem.*, [2] **79**, 457. This includes the thesis work of Haas cited in my 1908 report. Gutbier has also published the thesis work of Krell and Woernle, *J. prakt. Chem.*, **79**, 235. The data are already given in previous reports of this committee.

The authors reject some of the determinations, and conclude that Pd = 106.689 is the most probable value.

Iridium.—In a preliminary notice presented to the British Association for the Advancement of Science, Archibald[1] states that analyses of potassium chloroiridate give the atomic weight Ir = 192.90. The investigation is not completed, and no details are published.

Platinum.—A very elaborate memoir on the atomic weight of platinum is also due to Archibald.[2] The chloroplatinates and bromoplatinates of potassium and ammonium were analyzed, with all known precautions, and many ratios were so determined. The platinum itself was weighed, and also the silver and silver halide corresponding to the halogens in the several salts. In the analyses of the potassium compound the chlorine or bromine determinations were made in two portions, giving the halogen corresponding to the platinum, that is, the part lost on ignition in hydrogen, or four atoms, and that belonging to the potassium, two atoms.

The actual data relative to the weighings, and the individual determinations of atomic weight, are unfortunately too voluminous to be reproduced here. The mean results given by the various ratios are as follows:

FROM K_2PtCl_6 (14 ANALYSES).

Ratio	$K_2Cl_6 : Pt$	Pt = 195.23
"	$4AgCl : Pt$	195.21
"	$2AgCl : Pt$	195.24
"	$4AgCl : K_2PtCl_6$	195.20
"	$2AgCl : K_2PtCl_6$	195.24
"	$4Ag : Pt$	195.22
"	$2Ag : Pt$	195.23
"	$4Ag : K_2PtCl_6$	195.19
"	$2Ag : K_2PtCl_6$	195.22

FROM $(NH_4)_2PtCl_6$ (5 ANALYSES).

Ratio	$(NH_4)_2PtCl_6 : Pt$	Pt = 195.21
"	$6AgCl : Pt$	195.22
"	$6AgCl : (NH_4)_2PtCl_6$	195.23
"	$6Ag : Pt$	195.22
"	$6Ag : (NH_4)_2PtCl_6$	195.24

FROM $(NH_4)_2PtBr_6$ (3 ANALYSES).

Ratio	$(NH_4)_2PtBr_6 : Pt$	Pt = 195.25
"	$6AgBr : Pt$	195.22
"	$6AgBr : (NH_4)_2PtBr_6$	195.23
"	$6Ag : Pt$	195.21
"	$6Ag : (NH_4)_2PtBr_6$	195.22

FROM K_2PtBr_6 (6 ANALYSES).

Ratio	$K_2Br_6 : Pt$	Pt = 195.21
"	$4AgBr : Pt$	195.23

[1] *Chem. News*, **100**, 150.

[2] *Proc. Roy. Soc. Edinburgh*, **29**, 721.

Ratio $2AgBr : Pt$	Pt =	195.22
" $4AgBr : K_2PtBr_6$		195.21
" $2AgBr : K_2PtBr_6$		195.22
" $4Ag : Pt$		195.22
" $2Ag : Pt$		195.23
" $4Ag : K_2PtBr_6$		195.20
" $2Ag : K_2PtBr_6$		195.20

The arithmetical mean of these 28 ratios gives Pt = 195.22. Archibald, however, prefers to reject those which involve the weights of the original salts, using only 12 ratios. Mean, Pt = 195.23. This work evidently supplants all previous work on the atomic weight of platinum.

Radium.—From relationships between the wave-lengths of the spectral lines Watts[1] finds Ra = 226.56. Other atomic weights computed with that of radium are Mg, 24.32; Ca, 40.08; Sr, 87.62; and Ba, 137.41.

For the gaseous emanation of radium, by studying its physical properties, Gray and Ramsay[2] find a probable atomic weight of Em = 176. This conclusion, however, is not a finality.

Miscellaneous Notes.—Guye and Tsakalotos[3] have studied the determination of water of crystallization as a means of determining atomic weights. The substance investigated was barium chloride, but the results obtained, regarded as atomic weight determinations, were not satisfactory. Guye[4] has also discussed the variations from the law of Avogadro, and in another paper,[5] the general subject of atomic weight determinations by physical methods. A revision of the atomic weights of the rare earth metals is due to Urbain.[6] In a series of papers, not yet completed, Dubreuil[7] has undertaken to recalculate, by a peculiar mathematical method, the atomic weight determinations of Stas.

Mathematical relations between the atomic weights have been studied by Bernoulli,[8] Delaunay and Garnier,[9] Egerton,[10] Loring,[11] and Moir.[12] Hinrichs has also published summary of his views regarding atomic weights,[13] and also several papers upon his method of calculation.[14]

[1] *Phil. Mag.*, [6] **18**, 411.
[2] *J. Chem. Soc.*, **95**, 1073.
[3] *J. chim. phys.*, **7**, 215.
[4] *Ibid.*, **6**, 769.
[5] *Arch. sci. phys. nat.*, [4] **22**, 557.
[6] *Bull. soc. chim.*, [4] **5**, 133.
[7] *Ibid.*, [4] **5**, 260, 313, 341, 348, 610, 660, 708, 715, 852, 860, 1049, 1053, 1055.
[8] *Z. physik. Chem.*, **65**, 391.
[9] *Chem. Zentr.*, [1] 615 (1909).
[10] *J. Chem. Soc.*, **95**, 238.
[11] *Chem. News*, **99**, 148; **100**, 281.
[12] *J. Chem. Soc.*, **95**, 1752.
[13] *Electrochem. Met. Ind.*, **7**, 317.
[14] *Moniteur Sci.*, [4] **23**, 731. *Compt. rend.*, **148**, 1760; **149**, 1074.