Fifth Report of the Committee on Atomic Weights of the International Union of Chemistry.

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DURING the year the Committee has suffered an irreparable loss in the death of Mme. P. Curie, Professeur à la Faculté des Sciences de l'Université de Paris.

The following report of the Committee covers the twelve-month period, September 30, 1933, to September 30, 1934.*

Only one change has been made in the table of atomic weights, from 93·3 to 92·91 in the case of columbium (niobium).

CARBON.—Batuecas (*J. Chim. Phys.*, 1934, **31**, 165) has determined the density of propylene at 0° and several pressures. Propylene was prepared by three methods : (1) action of phosphorus pentoxide on *n*-propyl alcohol, (2) catalytic dehydration of *iso*propyl alcohol by aluminium phosphate at 250—300°, (3) catalytic dehydration of propyl alcohol by active aluminium oxide at 270—300°. Chemical purification was followed by fractional distillation. Since the first method yielded a product difficult to purify, density determinations were made only with gas prepared by the second and third methods.

Values in the following table are calculated to 760 mm. ($g = 980·616$).

Density of propylene.

1 Atmosphere.

Method of preparation.	Globe G. 1007·55 ml.	Globe N-3. 772·58 ml.	Average.
2	1·9140	1·9148	1·9144
	1·9147	1·9147	1·9147
	1·9148	1·9158	1·9153
	1·9145	1·9149	1·9147
	1·9156		1·9156
	1·9142	1·9146	1·9144
Average	1·9146	1·9150	1·9148
3	1·9154	1·9149	1·9152
	1·9156	1·9151	1·9153
	1·9144	1·9153	1·9149
	1·9145	1·9147	1·9146
Average	1·9149	1·9151	1·9150
Average of all	1·9148	1·9150	1·9149

2/3 Atmosphere.

Method of preparation.	Globe G. 1007·55 ml.	Globe N-3. 772·58 ml.	Average.
2	1·9003	1·9021	1·9012
	1·9031	1·9031	1·9031
	1·9016	1·9030	1·9023
Average	1·9017	1·9027	1·9022
3	1·9027	1·9011	1·9019
	1·9023	1·9017	1·9020
Average	1·9025	1·9014	1·9020
Average of all	1·9020	1·9022	1·9021

1/2 Atmosphere.

Method of preparation.	Globe G. 1007·55 ml.	Globe N-3. 772·58 ml.	Average.
2	1·8955	1·8959	1·8957
	1·8961		1·8961
Average	1·8958	1·8959	1·8958
3	1·8954	1·8955	1·8955
	1·8963	1·8946	1·8955
Average	1·8959	1·8951	1·8955
Average of all	1·8958	1·8953	1·8956

On the assumption that the change of PV with P is a linear one the following values are calculated :

$$1 + \lambda = 1·0204$$
$$C_3H_6 = 42·062$$
$$C = 12·005$$

CARBON AND NITROGEN.—Moles and Salazar (*Anales Soc. españ. Fis. Quim.*, 1934, **32**, 954) have redetermined the densities of oxygen, carbon monoxide, and nitrogen, using the same (improved) apparatus for all three gases.

Oxygen was prepared by pyrolysis of (*a*) potassium permanganate and (*b*) potassium and sodium chlorates with manganese dioxide. Chemical purification was followed by fractional distillation.

Carbon monoxide was prepared (*a*) from potassium ferrocyanide and sulphuric acid

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* Authors of papers bearing on the subject are requested to send copies to each of the four members of the Committee at the earliest possible moment.

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and (*b*) from formic acid and concentrated sulphuric acid. Chemical and physical purification followed.

Nitrogen, obtained from sodium nitrite and ammonium sulphate, was subjected to chemical purification.

The Density of Oxygen.

	760 mm.				380 mm.		
Method.	Globe G. 987·59 ml.	Globe N. 992·04 ml.	Average.	Method.	Globe G. 987·59 ml.	Globe N. 992·04 ml.	Average.
a	1·42895	1·42899	1·42897	a	1·42832	1·42827	1·42829
a	1·42892	1·42897	1·42894	a	1·42826	1·42835	1·42830
a	1·42903	1·42887	1·42895	a	1·42836	1·42831	1·42833
a	1·42896	1·42894	1·42895	a	1·42830	1·42841	1·42835
a	1·42893	1·42897	1·42895	a	1·42830	1·42835	1·42832
b	1·42897	1·42894	1·42895	b	1·42820	1·42833	1·42826
b	1·42897	1·42894	1·42895	b	1·42832	1·42829	1·42830
Average	1·42896	1·42895	1·42895	Average	1·42829	1·42833	1·42831

The Density of Carbon Monoxide.

	760 mm.				380 mm.		
Method.	Globe G.	Globe N.	Average.	Method.	Globe G.	Globe N.	Average.
a	1·24998	1·25000	1·24999	a	1·24978	1·24977	1·24977
a	1·25012	1·25001	1·25006	a	1·24970	1·24975	1·24972
a	1·24999	1·25001	1·25000	a	1·24978	1·24979	1·24978
a	1·25000	1·24998	1·24999	a	1·24976	1·24977	1·24976
b	1·25001	1·25001	1·25001	a	1·24978	1·24971	1·24974
b	1·24998	1·25001	1·24999	a	1·24982	1·24975	1·24978
b	1·25003	1·24998	1·25000	b	1·24974	1·24970	1·24972
b	1·25002	1·25000	1·25001	b	1·24976	1·24973	1·24974
Average	1·25002	1·25000	1·25001	b	1·24974	1·24975	1·24974
				Average	1·24976	1·24975	1·24975

The Density of Nitrogen.

Globe G.	Globe N.	Average.
	760 mm.	
1·25049	1·25048	1·25049
	380 mm.	
1·25020	1·25023	1·25022

From these data are calculated the following values :

	Limiting density.	$1 + \lambda$.	Molecular weight.
Oxygen	1·42767	1·00090	
Carbon monoxide	1·24950	1·00040	28·006 (5)
Nitrogen	1·24995	1·00043	28·0165

The atomic weights of carbon and nitrogen, respectively, are thus found to be 12·006 (5) and 14·0083.

NITROGEN.—Moles and Sancho (*Anales Soc. españ. Fis. Quim.*, 1934, **33**, 931) dispute the claim of Dietrichson, Bircher, and O'Brien that very dry glass surfaces adsorb little or no ammonia, and attempt to correct the results of these authors and those of Dietrichson, Orleman, and Rubin on the density of ammonia by using the adsorption data of Moles and Crespi, and Crespi and Aleixandre.

They have also redetermined the density of ammonia at 0° and at 1 atmosphere and ½ atmosphere, using a volumeter method, in which the weight of ammonia is found by the gain in weight of a receptacle containing sulphuric acid.

Synthetic ammonia was dried with potassium hydroxide and barium oxide, and was fractionally distilled from liquid sodium–potassium amalgam.

Improved apparatus was employed. The barometer with its reservoir was maintained at 0° so that no temperature correction was necessary. The volumes of the globes were 5566·52 (G) and 2378·59 (P) ml. Corrections for the compressibility of ammonia were therefore made, as well as for adsorption on the basis of the work of Moles and Crespi.

Pressure.	Globe G.	Globe P.	Globes G + P.
1 Atmosphere	0·77143	0·77145	
	0·77131	0·77150	
	0·77152	0·77133	
	0·77137	0·77150	
Average	0·77141	0·77144	
	Average of all	0·77143*	
1/2 Atmosphere	0·76558	0·76558	0·76572
			0·76572
			0·76540
			0·76570
Average	0·76558	0·76558	0·76564
		Average of all	0·76562

* Incorrectly calculated.

The limiting density of ammonia is calculated on the assumption, which Moles and Sancho prefer, that the compressibility is a linear function of the pressure. The normal molal volume is assumed to be 22·4142 litres. The results on this basis are :

Limiting density	0·75981
Mol. wt. NH_3	17·0305
At. wt. N	14·007

The authors find 14·008 for nitrogen, but this value involves two arithmetical errors, one in the average density at one atmosphere and one in calculating the molecular weight of ammonia.

SODIUM.—Johnson (*J. Phys. Chem.*, 1933, **37**, 923) has redetermined the ratio of sodium chloride to silver. Sodium chloride was very carefully purified by precipitation with hydrogen chloride and crystallisation. During the last crystallisation it was divided into five fractions. The sodium chloride was fused in a weighed platinum crucible contained in an electrically heated quartz muffle and weighed. The fusion atmosphere in most cases was air, but in analyses 3 and 4 nitrogen was used, and in analysis 6 it was hydrogen chloride and nitrogen. An *N*/5-solution of the sodium chloride was then precipitated with an *N*/5-solution of a very nearly equivalent quantity of the purest silver and the end-point of the comparison was found at 0° with a nephelometer by the " standard solution " method recently developed by Johnson, and also in some cases potentiometrically. In half the analyses the silver solution was added to the chloride, in half the reverse method of precipitation was employed. Finally the silver chloride was collected, dried at 300°, and weighed. Dissolved silver chloride was estimated nephelometrically. Loss in weight of the silver chloride on fusion was not determined. Weights are corrected to vacuum.

The Atomic Weight of Sodium.

Fraction of NaCl.	Wt. of NaCl.	Wt. of Ag.	Ratio NaCl : Ag.	At. wt. Na.	Wt. of AgCl.	Ratio NaCl : AgCl.	At. wt. Na.
1	5·48994	10·13246	0·541817	22·994	13·46165	(0·407821)	(22·999)
1	5·43976	10·03981	0·541819	22·994	13·33993	0·407780	22·993
2	5·48976	10·13223	0·541812	22·994	13·46231	0·407787	22·994
2	5·47090	10·09724	0·541821	22·995	13·41552	0·407804	22·996
3	5·42144	10·00502	(0·541872)	(23·000)	13·29327	(0·407833)	(23·001)
3	5·4360	10·0340	(0·54176)	(22·988)	13·3307	(0·407780)	(22·993)
4	5·59192	10·32064	0·541819	22·994	13·71263	0·407793	22·995
4	5·43087	10·02352	0·541813	22·994	13·31763	0·407796	22·995
5	5·51668	10·18218	(0·541798)	(22·992)	13·52883	(0·407772)	(22·992)
5	5·42755	10·01778	(0·541792)	(22·992)	13·31017	(0·407775)	(22·992)
		Average	0·541817	22·994		0·40779	22·994

The fifth analysis was rejected on the basis of disagreement, the sixth analysis on the basis of acidity of the sodium chloride, the ninth and tenth on the basis of impurity in the sodium chloride, and the first analysis for silver chloride on the basis of a known uncertainty.

The final result for sodium is 0·003 lower than the International value (22·997).

CALCIUM.—Smith and Tait (*Proc. Roy. Soc. Edinburgh*, 1934, **54**, 88) have compared calcium extracted from geologically old, potassium rich, calcium poor minerals with common calcium. Pegmatites from Portsoy, Banffshire, Scotland, and Rhiconich, Sutherlandshire, Scotland, were extracted with hydrochloric acid. About 30% of the original calcium was thus obtained. The purification consisted in five precipitations as oxalate, conversion into nitrate through the oxide, electrolysis of the nitrate solution, five crystallisations of the nitrate, three precipitations as carbonate, conversion into chloride through the oxide, and one crystallisation as chloride (A). In each case a second sample was similarly prepared from the mother-liquors of the third nitrate crystallisation (B). For comparison two preparations were made in a similar way from marine shells from Fifeshire, Scotland, and coral limestone from Bermuda.

The calcium chloride was prepared for weighing by preliminary dehydration in a vacuum at low temperature and finally fusion in an atmosphere of nitrogen and hydrogen chloride in a bottling apparatus. After solution of the weighed salt a correction was determined for deviation from neutrality and then the solution was compared with pure silver in the usual way.

The Atomic Weight of Calcium.

Sample.	Wt. of $CaCl_2$.	Wt. of Ag.	Ratio $CaCl_2 : 2Ag$.	At. wt. Ca.	Sample.	Wt. of $CaCl_2$.	Wt. of Ag.	Ratio $CaCl_2 : 2Ag$.	At. wt. Ca.
Coral A	1·77727	3·45491	0·514419	40·077	Marine Shells A	2·02793	3·94230	0·514403	40·074
A	1·82493	3·54743	0·514437	40·081	A	2·09760	4·07770	0·514408	40·075
A	1·81606	3·53030	0·514421	40·077	B	2·23959	4·35369	0·514412	40·076
A	1·74543	3·39311	0·514404	40·074	A	2·18660	4·25062	0·514419	40·077
A	1·75771	3·41695	0·514409	40·075	B	2·13950	4·15897	0·514430	40·079
		Average	0·514418	40·077	B	2·04200	3·96947	0·514426	40·079
							Average	0·514416	40·076

Sample.	Wt. of $CaCl_2$.	Wt. of Ag.	Ratio $CaCl_2 : 2Ag$.	At. wt. Ca.	Sample.	Wt. of $CaCl_2$.	Wt. of Ag.	Ratio $CaCl_2 : 2Ag$.	At. wt Ca.
Portsoy B	1·70015	3·30465	0·514472	40·088	Rhiconich B	1·94278	3·77612	0·514491	40·093
B	1·78487	3·46928	0·514479	40·090	B	1·98782	3·86364	0·514494	40·093
A	1·74779	3·39721	0·514478	40·090	A	1·88677	3·66715	0·514505	40·096
A	1·69538	3·29562	0·514434	40·080 *	B	1·96884	3·82687	0·514478	40·090
B	1·87366	3·64188	0·514476	40·089	B	2·19803	4·27222	0·514494	40·093
B	2·07253	4·02853	0·514463	40·087	A	2·17033	4·21850	0·514479	40·090
		Average	0·514468	40·087			Average	0·514490	40·092

* Incorrectly calculated in the original paper.

The atomic weight found for common calcium (40·076) is not far from that found by Richards and Hönigschmid (40·074), but is lower than that found by Hönigschmid and Kempter (40·084). Some uncertainty exists as to the vacuum corrections for calcium chloride and silver applied by Smith and Tait, who took into consideration the densities of both the brass and the aluminium weights. If this was not done also in the standardisation of the weights, the vacuum corrections as applied are incorrect. The possible error in the atomic weight of calcium would vary with the proportion of fractional weights employed, and in the experiments of Smith and Tait may amount to from + 0·008 to − 0·007.

The differences in the atomic weight of calcium from the different sources are used to calculate the half life of ^{41}K (See Fourth Report of this Committee).

KRYPTON.—Heuse and Otto (*Physik. Z.*, 1934, **35**, 57) have redetermined the density of krypton. The gas was carefully purified first with hot calcium, then by fractional distillation. The coefficient of compressibility was found at 0° to be − 0·00279 and the temperature coefficient $0{\cdot}0036609 + 358 \times 10^{-7}\,p$ (metres). With a 267·53-ml. globe the following results were obtained, using the density of oxygen 1·42900 and the compressibility coefficient − 0·00094.

The Density of Krypton.

Weight.	Pressure.	Temperature.	Density.	At. wt. Kr.
0·83479	681·84	20·60°	3·7432	83·668
0·85258	684·27	15·50	3·7428	83·659
0·84484	681·32	16·87	3·7427	83·657
0·88107	715·13	19·11	3·7433	83·670
		Average	3·743	83·66

COLUMBIUM (NIOBIUM).—Hönigschmid and Wintersberger (*Z. anorg. Chem.*, 1934, **219**, 161) have determined the ratio of columbium pentachloride to silver. Potassium columbium oxyfluoride was fractionally crystallised from hydrochloric acid solution with rejection of the most soluble and the least soluble (containing tantalum) fractions, until the head fraction gave no evidence of tantalum upon *X*-ray analysis (Prandtl and von Hevesy). The product was converted into sodium columbate and residual iron was removed with ammonium sulphide. Next columbic acid was precipitated with sulphurous acid, washed, and ignited. Further extraction with hydrochloric acid and water followed. This material still contained titanium and a trace of zirconium (Sample I).

Purified columbic acid, prepared by Fetkenheuer but still containing 0·1% of tantalum, was converted into potassium columbic oxyfluoride, and this substance was fractionally crystallised until free from tantalum. Zirconium was removed by fusion with potassium carbonate and extraction, and iron was removed as sulphide. Columbium was then precipitated with salicylic acid to eliminate titanium, and the precipitate was ignited to oxide (Sample II).

A portion of Sample I was freed from zirconium as in the case of Sample II (Sample III).

Solutions obtained in the course of the earlier analyses were freed from silver by precipitation as chloride and from oxalic acid by ignition. The columbic acid was recovered from alkaline solution by precipitation with sulphur dioxide (Sample IV).

Columbium pentachloride was prepared by treatment of the sulphide with chlorine. To prepare the sulphide, hydrogen sulphide charged with carbon disulphide was conducted over the columbic oxide at 1000°. The pentachloride was then produced by passing a current of chlorine, carefully freed from oxygen, into a nitrogen-filled glass bulb containing the sulphide and warmed to 250°. Fractional distillation of the pentachloride in an exhausted glass system followed, and the samples for analysis were sealed off in glass bulbs. Considerable difficulty was experienced at first in eliminating the higher-boiling oxychloride on the one hand and the lower-boiling sulphur chloride on the other, but this difficulty was eventually overcome.

The weight of the pentachloride was found by weighing the bulb and then, after breaking the bulb under saturated oxalic acid solution and acidification with nitric acid, the glass fragments were collected and weighed. Comparison with silver followed. All weights are corrected to vacuum.

The Atomic Weight of Columbium.

Sample.	Wt. of $CbCl_5$.	Wt. of Ag.	Ratio $CbCl_5 : 5Ag$.	At. wt. Cb.	Sample.	Wt. of $CbCl_5$.	Wt. of Ag.	Ratio $CbCl_5 : 5Ag$.	At. wt. Cb.
II	3·04386	6·07711	0·50087	92·886	III	0·94171	1·87985	0·50095	92·927
II	4·15231	8·28917	0·50093	92·918	II	0·79636	1·58976	0·50093	92·917
II	3·04987	6·08879	0·50090	92·900	II	1·03393	2·06422	0·50088	92·891
II	2·50957	5·00994	0·50092	92·910	II	1·62481	3·27968	0·50091	92·903
II	1·20611	2·40770	0·50094	92·921	IV	1·13889	2·27376	0·50088	92·892
III	0·79147	1·57998	0·50094	92·920	IV	2·48870	4·96803	0·50094	92·924
III	1·44972	2·89407	0·50093	92·915	IV	2·27453	4·54070	0·50092	92·912
							Average	0·50092	92·909

The average value of the atomic weight of columbium, 92·91, agrees almost exactly with Aston's finding that columbium is probably a simple element with an atomic weight 92·90 on the chemical scale. The value 92·91 replaces in the table the older value 93·3, which was a compromise value from earlier determinations.

MOLYBDENUM.—Lautié (*Compt. rend.*, 1933, **197**, 1730) has determined the ratio of molybdenum to its trioxide in two ways. Impure trioxide was converted into the volatile chlor-hydrine by heating in a current of dry hydrogen chloride, with rejection of the first and last portions. The product was dissolved in ammonia, and the solution evaporated to dryness. Nitric acid was then added and after heating to 400° in oxygen the residual molybdenum trioxide was five times resublimed. Portions of about 1·5 g. were heated to constant weight in a quartz boat, and then gradually to 800° in a current of activated hydrogen. The resulting metal was weighed in an atmosphere of argon or nitrogen.

In this way the ratio Mo/MoO_3 was found to be 0·66669. By reoxidation of the molybdenum the value 0·66668 was found for the same ratio. The former corresponds to the atomic weight 96·01, the latter to 96·02.

IODINE, CARBON, SODIUM.—Baxter and Hale (*J. Amer. Chem. Soc.*, 1934, **56**, 615) have compared sodium carbonate and iodine pentoxide by neutralisation. Sodium carbonate was purified by repeated crystallisation and was prepared for weighing by fusion in an atmosphere of carbon dioxide. Iodic acid was prepared from purified iodine, through potassium and barium iodates, and was fractionally crystallised until free from non-volatile residue. By gradual heating to 240°, the iodic acid was dehydrated to iodine pentoxide, and weighed. Nearly equivalent amounts of the two substances were allowed to react in dilute aqueous solution and the resulting solution was brought to neutrality in an atmosphere free from carbon dioxide with bromothymol-blue as indicator, by adding very dilute acid and base solutions. Weights are corrected to vacuum and a correction of 0·001% for adsorbed air and of 0·0023% for retained moisture are applied to the weights of iodine pentoxide.

The Ratio of Iodine Pentoxide to Sodium Carbonate.

Wt. of Na_2CO_3.	Wt. of I_2O_5.	Ratio $I_2O_5 : Na_2CO_3$.	Wt. of Na_2CO_3.	Wt. of I_2O_5.	Ratio $I_2O_5 : Na_2CO_3$.
8·98436	28·29617	3·14949	9·29771	29·28312	3·14950
9·56078	30·11314	3·14965	9·70811	30·57533	3·14946
7·55451	23·79256	3·14945	8·42645	26·53892	3·14948
9·33412	29·39833	3·14956	8·81736	27·76915	3·14937
8·46160	26·65025	3·14955		Average	3·14950

In the following tables the atomic weights of iodine, carbon, and sodium are computed individually on the basis of various assumed atomic weights for the other two elements.

The Atomic Weight of Iodine.

	C = 12·000.	C = 12·005.	C = 12·010.
Na = 22·997	126·914	126·922	126·930
Na = 22·994	126·905	126·913	126·920

The Atomic Weight of Carbon.

	I = 126·915.	I = 126·917.	I = 126·920.	I = 126·925.
Na = 22·997	12·001	12·002	12·004	12·007
Na = 22·994	12·007	12·008	12·010	12·013

The Atomic Weight of Sodium.

	I = 126·915.	I = 126·917.	I = 126·920.	I = 126·925.
C = 12·000	22·997	22·998	22·999	23·000
C = 12·005	22·995	22·995	22·996	22·998
C = 12·010	22·993	22·993	22·994	22·995

CÆSIUM.—Baxter and Thomas (*J. Amer. Chem. Soc.*, 1934, **56**, 1108) have continued their work on the analysis of cæsium chloride, the preliminary results of which were included in the report of this Committee for 1933. Nearly four kilograms of cæsium nitrate were fractionally crystallised. The nine less soluble fractions of the last (seventeenth) series, amounting to 80% of the total material, when tested spectroscopically showed no evidence of the presence of potassium or rubidium. A portion of the combined fourth and fifth fractions was converted into perchlorate and recrystallised. The perchlorate was then converted into chloride, which was recrystallised (Sample A). The mother-liquors of Sample A were converted into dichloroiodide and after recrystallisation this salt was converted into chloride and purified as before (Sample B). Sample C was prepared from the next to least soluble of the nitrate fractions by several crystallisations as perchlorate and one as chloride. The least soluble of the nitrate fractions was recrystallised three times as perchlorate, and converted into chloride (Sample D).

The Atomic Weight of Cæsium.

Sample.	Fusion atmosphere.	Wt. of CsCl.	Wt. of Ag.	Ratio CsCl : Ag.	At. wt. Cs.
A	N_2	8·96291	5·74296	1·56068	132·909
A	N_2	9·60983	6·15731	1·56072	132·913
A	H_2 + 25% HCl	9·70288	6·21686	1·56074	132·916
A	H_2 + 25% HCl	9·53125	6·10698	1·56071	132·912
A	H_2	7·52304	4·82025	1·56072	132·913
B	H_2 + 75% HCl	9·38363	6·01254	1·56068	132·909
B	H_2 + 20% HCl	9·33593	5·98207	1·56065	132·906
B	H_2 + trace HCl	10·83528	6·94414	1·56035	132·874
B	N_2	7·70022	4·93415	1·56060	132·901
B	H_2 + trace HCl	7·78342	4·98770	1·56052	132·892
B	H_2 + 50% HCl	7·83724	5·02201	1·56058	132·898
C	H_2 + 35% HCl	5·78546	3·70748	1·56048	132·888
D	H_2 + 20% HCl	2·16882	1·38968	1·56066	132·907
C	H_2 + 35% HCl	4·02114	2·57655	1·56067	132·908
			Average	1·56063	132·903
			Average, excluding analysis 8	1·56065	132·906
			Average of analyses 1—7	1·56070	132·911

To prepare the chloride for weighing, it was fused in a platinum boat in various atmospheres as indicated in the table. Analysis followed the conventional method of comparison with silver. Weights are corrected to vacuum.

The value 132·91 was adopted for the International Table of 1933.

THE RARE EARTHS.—Aston (*Proc. Roy. Soc.*, 1934, **146**, 46) has determined the isotopic composition and atomic weights of the rare earths with the following results :

	Mass-spectrum values.	International values.	Difference.		Mass-spectrum values.	International values.	Difference.
Lanthanum ...	138·91	138·92	−0·01	Terbium	158·91	159·2	−0·3
Cerium	140·13	140·13	0·00	Dysprosium ...	162·5	162·46	0·0
Praseodymium...	140·91	140·92	−0·01	Holmium	164·91	163·5	+1·4
Neodymium ...	143·5	144·27	−0·8	Erbium	167·15	167·64	−0·5
Samarium	150·1	150·43	−0·3	Thulium	166·91	169·4	−0·5
Europium	151·90	152·0	−0·1	Ytterbium	173·2	173·04	+0·2
Gadolinium	156·9	157·3	−0·4	Lutecium	174·91	175·0	−0·1

While the agreement of the physical with the chemical value is in many cases as close as could be expected, in others the discrepancy is glaring. To explain the larger differences on the basis of impurity in the rare-earth material used in the chemical determinations, improbably large proportions of impurity would be required. The conventional chloride analysis used for a large proportion of the chemical determinations in many of the more favourable cases has given results agreeing closely with the physical results (lanthanum, cerium, praseodymium), so that there is no evidence against the analytical method. If the chemical result is in error, in certain cases, the difficulty may have been due to abnormal composition of the trichlorides analysed (dichlorides). It is noticeable that the discrepancies are large with many of the more complex elements (neodymium, samarium, gadolinium, and erbium), so that it seems far from certain that these determinations of mean mass with the mass spectrograph are free from error. The Committee feels that without further evidence it is impossible to decide where the difficulty lies and makes no changes in the values for this group of elements in the table.

TANTALUM.—Hönigschmid (*Naturwiss.*, 1934, **22**, 463) has analysed tantalum pentachloride, purified by sublimation in vacuum. The result for the atomic weight of tantalum, 180·89, agrees exactly with Aston's value, and is lower than the present International value. Details of this investigation were published too late for inclusion in the report for this year. Hönigschmid and Schlee (*Z. anorg. Chem.*, 1935, **221**, 129).

LEAD.—Marble (*J. Amer. Chem. Soc.*, 1934, **56**, 854) has determined the atomic weight of radiogenic lead extracted from pitchblende found near Great Bear Lake, North-West Territories, Canada. The lead was purified successively as sulphide, sulphate, sulphide, nitrate, and chloride, and the chloride was finally distilled in dry hydrogen chloride. Analysis by the conventional chloride method gave the following results. Weights are corrected to vacuum.

The Atomic Weight of Lead.

Wt. of $PbCl_2$.	Wt. of Ag.	Ratio $PbCl_2 : 2Ag$.	At. wt. Pb.
2·27721	1·77393	1·283709	206·059
2·22354	1·73219	1·283658	206·048
2·22397	1·73249	1·283684	206·054
	Average	1·283684	206·054

The value found by Aston from the isotopic constitution of this same lead, when corrected to the chemical scale, is 206·08. The difference is no greater than the present accuracy of the mass spectrograph, but is greater than the apparent uncertainty of the chemical method.

RADIUM AND PROTOACTINIUM.—Two investigations on radioactive elements were published too late for inclusion in this report. Hönigschmid and Sachtleben (*Z. anorg. Chem.*, 1935, **221**, 65), using 2·2—3·5 grams of radium bromide, from the ratio $RaBr_2 : RaCl_2$ find the atomic weight of radium to be 226·05, and v. Grosse (*J. Amer. Chem. Soc.*, 1934, **56**, 2501), from the ratio $2K_2PaF_7$ (0·07—0·09 g.) : Pa_2O_5, finds Pa = 230·6.

Batuecas (*J. Chim. Phys.*, **1934**, **31**, 65) takes exception to the conclusions of Cawood and Patterson concerning the densities of certain gases and their coefficients of deviation from Boyle's law. His own figures, based on average values obtained by several experimenters, are :

	Density.	$1 + \lambda$.	*M.*	
C_2H_4	1·2605(4)	1·0076(6)	28·040	C = 12·004
CO_2	1·9766(5)	1·0068(4)	44·005	C = 12·005
$(CH_3)_2O$....................	2·1099	1·0270	46·050	C = 12·001(5)
N_2O	1·9780	1·0073(5)	44·013	N = 14·0065
SO_2	2·9263	1·0239	64·061	S = 32·061

ATOMIC WEIGHTS, 1935.

	Symbol.	At. No.	At. wt.		Symbol.	At. No.	At. wt.
Aluminium	Al	13	26·97	Neodymium	Nd	60	144·27
Antimony	Sb	51	121·76	Neon	Ne	10	20·183
Argon	A	18	39·944	Nickel	Ni	28	58·69
Arsenic	As	33	74·91	Niobium	Nb		
Barium	Ba	56	137·36	(Columbium) ...	(Cb)	41	92·91
Beryllium	Be	4	9·02	Nitrogen	N	7	14·008
Bismuth	Bi	83	209·00	Osmium	Os	76	191·5
Boron	B	5	10·82	Oxygen	O	8	16·0000
Bromine	Br	35	79·916	Palladium	Pd	46	106·7
Cadmium	Cd	48	112·41	Phosphorus	P	15	31·02
Cæsium	Cs	55	132·91	Platinum	Pt	78	195·23
Calcium...............	Ca	20	40·08	Potassium............	K	19	39·096
Carbon	C	6	12·00	Praseodymium......	Pr	59	140·92
Cerium	Ce	58	140·13	Radium...............	Ra	88	225·97
Chlorine	Cl	17	35·457	Radon	Rn	86	222
Chromium	Cr	24	52·01	Rhenium	Re	75	186·31
Cobalt	Co	27	58·94	Rhodium	Rh	45	102·91
Copper	Cu	29	63·57	Rubidium	Rb	37	85·44
Dysprosium	Dy	66	162·46	Ruthenium	Ru	44	101·7
Erbium	Er	68	167·64	Samarium	Sm	62	150·43
Europium	Eu	63	152·0	Scandium	Sc	21	45·10
Fluorine	F	9	19·00	Selenium	Se	34	78·96
Gadolinium	Gd	64	157·3	Silicon	Si	14	28·06
Gallium	Ga	31	69·72	Silver..................	Ag	47	107·880
Germanium	Ge	32	72·60	Sodium	Na	11	22·997
Gold	Au	79	197·2	Strontium............	Sr	38	87·63
Hafnium	Hf	72	178·6	Sulphur...............	S	16	32·06
Helium	He	2	4·002	Tantalum	Ta	73	181·4
Holmium	Ho	67	163·5	Tellurium	Te	52	127·61
Hydrogen	H	1	1·0078	Terbium	Tb	65	159·2
Indium	In	49	114·76	Thallium	Tl	81	204·39
Iodine	I	53	126·92	Thorium	Th	90	232·12
Iridium	Ir	77	193·1	Thulium	Tm	69	169·4
Iron	Fe	26	55·84	Tin.....................	Sn	50	118·70
Krypton	Kr	36	83·7	Titanium	Ti	22	47·90
Lanthanum	La	57	138·92	Tungsten	W	74	184·0
Lead	Pb	82	207·22	Uranium	U	92	238·14
Lithium	Li	3	6·940	Vanadium............	V	23	50·95
Lutecium	Lu	71	175·0	Xenon	Xe	54	131·3
Magnesium	Mg	12	24·32	Ytterbium	Yb	70	173·04
Manganese	Mn	25	54·93	Yttrium	Y	39	88·92
Mercury	Hg	80	200·61	Zinc	Zn	30	65·38
Molybdenum	Mo	42	96·0	Zirconium............	Zr	40	91·22