Vol. XXVII. [January, 1905.] No. 1.

THE JOURNAL

OF THE

American Chemical Society

REPORT OF THE INTERNATIONAL COMMITTEE ON ATOMIC WEIGHTS.

Received November 14, 1904.

The International Committee on Atomic Weights respectfully submits the following report, together with a table of atomic weights for use during 1905.

Most of the values recommended in our table are identical with those reported in former years, but a few changes seem to be needed. Other changes, which are suggested by recent investigations, are deferred until fuller information regarding their desirability shall have been received. During 1904 there has been great activity in the determination of atomic weights: and a summary of the more important researches may help to explain our reasons for changing or retaining hitherto accepted values. The researches to be considered are as follows:

Glucinum.—The atomic weight has been redetermined by Parsons.[1] Seven analyses of the acetylacetonate gave, in mean, Gl = 9.113. Nine analyses of the basic acetate gave exactly the same average. As the individual determinations range from 9.081 to 9.142, the figure 9.1 may evidently remain unchanged.

Indium.—The investigation by Thiel[2] shows that the atomic weight of indium is higher than had been supposed. Analyses of

[1] This Journal, **26**, 721.

[2] *Ztschr. anorg. Chem.*, **40**, 280.

the trichloride gave, in mean, In = 115.05. Analyses of the tribromide gave 114.81. With the oxide, unsatisfactory results were obtained. For present purposes the round number 115 may be adopted, although further investigation is promised by Thiel, and a research by Dennis and Geer is in progress.

Iodine.—In our former reports we have noted the uncertainty in the accepted atomic weight of iodine. Stas, by the synthesis of AgI, found I = 126.85. Scott, by the same general method, found I = 126.97, and Ladenburg, by measuring the ratio AgI : AgCl, obtained the value 126.96. Koethner and Aeuer,[1] from data given by several methods, including a repetition of Ladenburg's process, conclude that the atomic weight of iodine cannot be less than 126.963, but the full details of their investigation, at the date of writing this report, are unpublished. A more recent research by G. P. Baxter will soon appear,[2] in which the higher value for iodine is completely confirmed, both by Ladenburg's method and by that of Stas. Baxter's final value is I = 126.975, and there can now be no reasonable doubt that the Stas figure is too low. The number 126.97 is adopted in our table for O = 16, or 126.01 with hydrogen as unity.

Nitrogen.—The accepted value for the atomic weight of nitrogen, 14.04, is derived mainly from the work of Stas. Of late years, however, the study of gaseous densities has led several physicists, notably Rayleigh, Leduc, and Daniel Berthelot, to the belief that the true value is but little in excess of the round number 14. Guye[3] finds, from the density of nitrogen, the value 14.004. Still more recently, Guye and Bogdan,[4] by analysis of nitrous oxide, have found N = 14.007. Jaquerod and Bogdan[5] have also studied nitrous oxide volumetrically, and obtained the figure 14.019. In view of the discordance between the volumetric and the gravimetric data, it seems undesirable to make any change at present in the number assigned to nitrogen. Further investigation of this atomic weight is evidently needed.

Rubidium.—Atomic weight redetermined by Archibald[6] from

1 *Ber. d. chem. Ges.*, **37**, 2536.

2 Since writing the above, the paper referred to has been published in this Journal, **26**, 1577.

3 *Compt. Rend.*, **138**, 1213.

4 *Ibid.*, **138**, 1494.

5 *Ibid.*, **139**, 49.

6 *J. Chem. Soc.* (Lond.), **85**, 776.

analyses of the chloride and bromide. The final mean, derived from many concordant experiments, is Rb = 85.485. As some of the determinations are slightly higher than 85.5, that figure may be adopted as sufficiently accurate for all practical purposes.

Samarium.—Urbain and Lacombe,[1] by analyses of the octohydrated sulphate, find Sm = 150.34. A comparison of this figure with the older determinations justifies the use of 150.3 as the most probable value for this atomic weight. The same authors[2] have also determined the atomic weight of *europium,* and give the figure Eu = 151.79. It is desirable, however, to await more complete information about europium before recognizing it in the table.

Thorium.—Evidence as to the complex nature of ordinary "thorium" is steadily accumulating. According to Baskerville[3] it is a mixture of at least three elements, which he calls carolinium, thorium, and berzelium. Their approximate atomic weights are 256, 220, and 212.5, respectively, supposing them all to be tetrads. The value in our table is that of ordinary thorium, as it is found in mineral analyses, and no change can safely be made until our knowledge has become more definite.

Tungsten.—The figure commonly assigned to tungsten, W = 184, has been verified by Smith and Exner.[4] From 27 measurements of the ratio $WCl_6 : WO_3$, W = 184.04. From 23 syntheses of WO_3, W = 184.065. The individual determinations range from 183.94 to 184.14, which is a fair degree of concordance for so high an atomic weight.

Changes, then, are recommended in the cases of indium, iodine, rubidium and samarium. The column of atomic weights which referred to the hydrogen unit has also been carefully recalculated, and in it some small alterations appear. The latter modifications, however, are unimportant, except in so far as they help to bring the two tables into greater harmony.

During the year there has been a revival of the agitation over the question of standards, and the policy of this committee, or rather sub-committee of the larger international body, in publishing a double table, has encountered some criticism. That criticism is perfectly legitimate, and we are glad to say that it has been ex-

1 *Compt. Rend.*, **138**, 1166.
2 *Ibid.*, **138**, 627.
3 This Journal, **26**, 922.
4 *Proc. Am. Phil. Soc.*, **43**, 123; This Journal, **26**, 1082.

pressed courteously, and in a truly scientific spirit. Professors Sakurai and Ikeda[1] have published an open letter upon the subject,[2] and in response to a demand within the German Chemical Society, the committee representing that body issued a circular to the members of the larger International Committee, asking for an expression of opinion as to our procedure. We are not yet informed regarding the responses to that circular, and we therefore cannot base any action upon it. The Council of the American Chemical Society has also, by a formal vote, requested this committee to ask for instructions from the larger body, both as to the use of a double standard, and as to the nomenclature and symbols of glucinum or beryllium, and columbium or niobium. With this request we now comply, and hope that every member of the larger International Committee on Atomic Weights will send us his opinion upon the questions thus raised. Shall we continue to issue a double table? Can uniformity in symbols and nomenclature be obtained? And which names are preferable, in the light of history, evidence, and international usage for the two elements under discussion?

That a single standard for atomic weights is most desirable, every chemist will admit; but two standards actually exist, and each one is represented by earnest advocates who are unwilling to give way. Each side of the controversy is supported by eminent authorities in nearly equal numbers, and no agreement seems to be possible either at present or within the near future. This condition of affairs the present committee has been compelled to face, and to deal with things as they are instead of as we should like them to be. Two tables of atomic weight are current and it has therefore seemed wisest to recognize the needs of both parties in the controversy, and to furnish each with trustworthy data for practical use. It is surely better to have one committee prepare both tables, than to leave this work to be done in accordance with individual preferences. That there are difficulties in adjusting one table to the other is perfectly evident, but the resulting confusion is, we think, less serious than some of our critics would have us believe. The confusion is certainly less than it would be, were the individual advocates of either standard to attempt the adjustment of one to the other independently. In short, the real question now

1 *Chem. News*, **89**, 505.

2 See reply by F. W. Clarke in *Chem. News*, **90**, 56, July 29, 1904.

before us seems to be this Shall the present committee act in a quasi-judicial manner, recognizing both parties in controversy, or shall it assume a partisan position and represent one alone?

(Signed).
F. W. CLARKE,
T. E. THORPE,
KARL SEUBERT,
HENRI MOISSAN,
Committee.

INTERNATIONAL ATOMIC WEIGHTS.

		O = 16.	H = 1.
Aluminum	Al	27.1	26.9
Antimony	Sb	120.2	119.3
Argon	A	39.9	39.6
Arsenic	As	75.0	74.4
Barium	Ba	137.4	136.4
Bismuth	Bi	208.5	206.9
Boron	B	11.0	10.9
Bromine	Br	79.96	79.36
Cadmium	Cd	112.4	111.6
Caesium	Cs	132.9	131.9
Calcium	Ca	40.1	39.7
Carbon	C	12.00	11.91
Cerium	Ce	140.25	139.2
Chlorine	Cl	35.45	35.18
Chromium	Cr	52.1	51.7
Cobalt	Co	59.0	58.55
Columbium	Cb	94.	93.3
Copper	Cu	63.6	63.1
Erbium	Er	166.	164.8
Fluorine	F	19.	18.9
Gadolinium	Gd	156.	154.8
Gallium	Ga	70.	69.5
Germanium	Ge	72.5	72.
Glucinum	Gl	9.1	9.03
Gold	Au	197.2	195.7
Helium	He	4.	4.
Hydrogen	H	1.008	1.000
Indium	In	115.	114.1
Iodine	I	126.97	126.01
Iridium	Ir	193.0	191.5
Iron	Fe	55.9	55.5
Krypton	Kr	81.8	81.2
Lanthanum	La	138.9	137.9
Lead	Pb	206.9	205.35
Lithium	Li	7.03	6.98

		O = 16.	H = 1.
Magnesium	Mg	24.36	24.18
Manganese	Mn	55.0	54.6
Mercury	Hg	200.0	198.5
Molybdenum	Mo	96.0	95.3
Neodymium	Nd	143.6	142.5
Neon	Ne	20.	19.9
Nickel	Ni	58.7	58.3
Nitrogen	N	14.04	13.93
Osmium	Os	191.	189.6
Oxygen	O	16.00	15.88
Palladium	Pd	106.5	105.7
Phosphorus	P	31.0	30.77
Platinum	Pt	194.8	193.3
Potassium	K	39.15	38.85
Praseodymium	Pr	140.5	139.4
Radium	Ra	225.	223.3
Rhodium	Rh	103.0	102.2
Rubidium	Rb	85.5	84.9
Ruthenium	Ru	101.7	100.9
Samarium	Sm	150.3	149.2
Scandium	Sc	44.1	43.8
Selenium	Se	79.2	78.6
Silicon	Si	28.4	28.2
Silver	Ag	107.93	107.11
Sodium	Na	23.05	22.88
Strontium	Sr	87.6	86.94
Sulphur	S	32.06	31.82
Tantalum	Ta	183.	181.6
Tellurium	Te	127.6	126.6
Terbium	Tb	160.	158.8
Thallium	Tl	204.1	202.6
Thorium	Th	232.5	230.8
Thulium	Tm	171.	169.7
Tin	Sn	119.0	118.1
Titanium	Ti	48.1	47.7
Tungsten	W	184.	182.6
Uranium	U	238.5	236.7
Vanadium	V	51.2	50.8
Xenon	Xe	128.	127.
Ytterbium	Yb	173.0	171.7
Yttrium	Yt	89.0	88.3
Zinc	Zn	65.4	64.9
Zirconium	Zr	90.6	89.9

Addendum.—Since the foregoing report was written, signed, and sent in for publication, the vote of the larger committee, as solicited by the Committee of the German Chemical Society, has been received. Fifty-nine members of the larger committee are therein recognized. Thirty-one voted for a table based upon O = 16 exclusively; two for H = 1 exclusively; and five for the simultaneous use of both standards. To the last vote should be added that of the four members of the smaller committee, making nine in all for the double table. Seventeen members refrained from voting. The vote, then, gives one more than a majority of the entire committee in favor of the oxygen standard alone, although the committee appointed by the Chemical Society of Paris in 1900 seems not to have been consulted.

Copies of the report as drawn and agreed to were sent to England, France, Germany, Italy and Japan for simultaneous publication. It is therefore, in the opinion of Professors Thorpe, Seubert, and myself, too late to attempt any change for the current year. To withdraw, rewrite, and re-sign the report would involve too great a delay. We therefore ask for patience on the part of the larger committee, whose wishes will receive due consideration next year.

F. W. CLARKE.

TRIBROMPHENOLBROMIDE: ITS DETECTION, ESTIMATION, RATE OF FORMATION, AND REACTION WITH HYDRIODIC ACID.

BY S. J. LLOYD.

Received October 27, 1904.

THE following experiments form part of an investigation of the reaction between bromine and phenol, which was undertaken with the object of improving Koppeschaar's method of determining the latter substance.

The tribromphenolbromide used was prepared by Werner's[1] recipe, recrystallized three times from chloroform, and dried for three days over sulphuric acid in a vacuum; it formed golden-yellow crystals, melting-point 119°.

DETECTION.

When searching for a distinctive qualitative test for tribromphenolbromide, I found that ammonia, and chloroform solutions of many of the organic bases react with it to form colored products, as follows:

[1] *Bull. Soc. Chim.*, **43**, 572 (1885).