ter and Starkweather.[1] This value has been accepted by the International Committee on Atomic Weights.

In conclusion I wish to express my gratitude to The Bohemian Academy of Arts and Sciences in Prague, with whose financial support this work was carried out. I am also obliged to Professors Dr. B. Brauner and Dr. Sterba-Böhn for their valuable advice as well as to Dr. Sveda for his kind assistance.

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[Contribution from the Wolcott Gibbs Memorial Laboratory of Harvard University.]

THE ATOMIC WEIGHT OF LEAD FROM A JAPANESE RADIOACTIVE MINERAL.

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The lead used in this work came from Hokuto, Formosa, Japan, and was separated from a crystalline mineral crust containing lead and barium[2] which had been formed in the bottom of a hot spring. According to Hayakawa and Nakano[3] this mixture of minerals contains (besides cerium and lanthanum) some radioactive elements, namely, ionium, polonium and radium, but no uranium. With their apparatus, however, they were unable to discover radioactivity in the lead chloride obtained from it.

About 10 g. of metallic lead obtained from this specimen was dissolved in pure nitric acid and the lead nitrate was recrystallized several times and then converted into chloride by freshly distilled pure hydrochloric acid. The lead chloride was recrystallized 4 times by dissolving the crystals in hot water in a quartz dish and adding hydrochloric acid. Before the last crystallization the hot solution of chloride was filtered through a Gooch-Munroe crucible. Owing to the small amount of material, no further purification was attempted. This lead chloride was then used for the determination of the atomic weight of lead.

The ordinary lead used for comparison was obtained from lead acetate, converted into chloride and recrystallized 5 times in the same manner as the Japanese lead.

The method of analysis was similar to that already often described[4] in other papers. Moist crystals of lead chloride (after washing the last crop with pure water) were transferred directly into a platinum boat which

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[1] *Proc. Nat. Acad. Sci.*, **2**, 718 (1916).

[2] Okamoto, *Beitr. Mineral. Japan*, **4**, 178 (1912).

[3] Okamoto, *J. Geol. Soc. Tokyo*, **18**, 19 (1911); Hayakawa and Nakano, *Z. anorg. Chem.*, **78**, 183 (1912).

[4] Baxter and Wilson, *Proc. Am. Acad.*, **43**, 363 (1907); Richards and Lembert, This Journal, **36**, 1335 (1914); Richards and Wadsworth, *ibid.*, **38**, 2613 (1916); Richards and Hall, *ibid.*, **39**, 536 (1917).

had been previously weighed. By this procedure handling and danger of accidental introduction of dust were minimized. The boat was kept in a desiccator until the crystals were dry, then brought into the tube of the "bottling apparatus," fused in a current of pure dry hydrogen chloride and weighed. The salt was dissolved in water containing a drop of pure nitric acid, and no black insoluble residue remained suspended in the solution.

The chlorine contained in this solution was precipitated in the usual manner by its approximately calculated equivalent of silver. The attainment of the exact equivalence between the silver and the chlorine was effected by the addition of one or the other and tested in the nephelometer in the customary way.

All the weighings were reduced to the vacuum standard, the correction for which was calculated from the density of the substances and that of the brass weights. All precautions usual in this sort of work were maintained.

Because of the small amount of the material, the same specimen of Japanese lead salt was used in each analysis. After the first determination was finished, a slight excess of hydrochloric acid was added to the filtrate from the silver chloride in order to remove the last traces of silver; and the supernatent liquid was filtered, evaporated in a quartz dish to small volume and filtered again. This solution was mixed with the purest mother liquor from which the previously used crystals of lead chloride had been deposited, and evaporation was continued until most of the chloride was deposited as crystals. The product was recrystallized from hot water, and then used for the second determination of the atomic weight. A similar treatment intervened between the second and third experiments. One analysis, being defective in execution, was rejected. The parallel determinations made with ordinary lead show that the details of procedure had been adequate, since the result agrees sufficiently well with the more extended and elaborate work of others.

The results obtained were as follows: (The atomic weights of silver and chlorine being taken as 107.88 and 35.46, respectively):

THE ATOMIC WEIGHT OF LEAD.

From the Ratio, 2 Ag : $PbCl_2$.

	Corrected wt. of fused $PbCl_2$.	Corrected wt. Equivalent Ag.	Ratio $PbCl_2$: Ag.	Atomic weight.
Ordinary lead	3.13929	2.43553	1.28895	207.185
	3.09476	2.40100	1.28894	207.183
			Average,	207.184
Japanese lead First determination	2.16756	1.68212	1.28859	207.11
	1.14536	0.88881	1.28864	207.12
	1.34496	1.04358	1.28879	207.15
			Average,	207.13

The fact that the latter 3 analyses show a progressive increase in the value of the atomic weight suggests the possibility that the degree of purity of the 3 preparations might have progressively changed. Nevertheless, since from the method of crystallization they should have been essentially alike, the appearance of a march in the figures is probably fortuitous. In any case no claim can be made for great accuracy in the result, because the amount of crude material was not sufficient for work of the highest precision. In spite of this lack, the outcome serves its purpose, for it shows that the atomic weight of this lead from a Japanese radioactive spring is not far from that of ordinary lead. Probably it is chiefly ordinary lead, with perhaps not over 5 % of isotope of lower atomic weight. The result coincides well with the fact, reported by Hayakawa and Nakano,[1] that the lead chloride shows but little if any radioactivity. The quantity of the metallic lead obtained was too small to determine a trustworthy value for its density.

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[CONTRIBUTION FROM THE KENT CHEMICAL LABORATORY OF THE UNIVERSITY OF CHICAGO.]

TRIATOMIC HYDROGEN.

BY GERALD L. WENDT AND ROBERT S. LANDAUER.

Received March 2, 1920.

Many years ago Osann[2] published a series of papers on a reactive variety of hydrogen produced by the electrolysis of dil. sulfuric acid. To this he gave the name of "*Ozonwasserstoff*" on account of its analogy to Schönbein's ozone which had just been discovered, but without knowledge of its molecular formula. After protracted arguments Löwenthal[3] seems to have proved that the reducing action of Osann's gas was due to sulfur dioxide produced from the sulfuric acid. In any case, Osann's work has never been confirmed, though G. Magnus[4] made persistent efforts to do so. All other known forms of active hydrogen are undoubtedly monatomic, including the ordinary nascent hydrogen and Langmuir's modification[5] which is produced when a metallic filament is heated in hydrogen at very low pressures.

In 1913, however, Sir J. J. Thomson[6] published photographs of the

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[1] *Loc. cit.*

[2] *J. prakt. Chem.*, **58**, 385 (1853); **61**, 500 (1854); **69**, 1 (1856); **71**, 355 (1857); Verh. Würzburger phys.-med. Ges., Bd. VI; *J. prakt. Chem.*, **66**, 102 (1855); **78**, 93 (1859); **81**, 20 (1860); **92**, 210 (1864); *Pogg. Ann.*, **95**, 315 (1855); **95**, 311 (1855); **97**, 327 (1856); **98**, 181 (1858); **106**, 326 (1859).

[3] *J. prakt. Chem.*, **73**, 116 (1858).

[4] *Pogg. Ann.*, **104**, 555, Par., 98–110 (1858).

[5] THIS JOURNAL, **34**, 1310 (1912); **36**, 1708 (1914); **37**, 417 (1915).

[6] *Proc. Roy. Soc. A.*, **89**, 1 (1913); "Rays of Positive Electricity," Longmans, Green & Co., 1913.