as to the possibility of a chemical combination of the constituents of the mixture, both surface tension and specific cohesion show a distinct maximum in the case of phenol at 8.74% phenol, indicating a compound of the formula $C_6H_5OH.55H_2O$, while triethylamine-water mixtures lead to a maximum at 10%, or $(C_2H_5)_3N.50H_2O$. Both density and viscosity for phenol and water, using results from the literature, confirm the above value.

The water layer of such systems must then be considered as transformed completely into a compound, the other layer being the second pure liquid containing the compound in solution, and having its surface tension but little affected thereby. The critical solution point can only be, then, the point at which the compound is completely miscible in the second liquid. As the coexisting layers of such systems in general are now being studied, the further discussion of these points must be postponed.

IV. A theory is presented which at any rate can serve as an alternative to the usual adsorption theory of the exaggerated effect upon the surface tension of water by the addition to it of other liquids.

NEW YORK, N. Y.

[CONTRIBUTION FROM THE T. JEFFERSON COOLIDGE MEMORIAL LABORATORY OF HARVARD COLLEGE.]

A REVISION OF THE ATOMIC WEIGHT OF CADMIUM.

[FOURTH PAPER.]

THE ELECTROLYTIC DETERMINATION OF CADMIUM IN CADMIUM BROMIDE.

BY GREGORY PAUL BAXTER, MERRITT ROY GROSE, AND MINER LOUIS HARTMANN.

Received January 12, 1916.

Recently the atomic weight of cadmium has been redetermined by Baxter and Hartmann[1] in this laboratory by the electrolytic analysis of cadmium chloride. By using a glass electrolytic cell of special design it was found possible to deposit the metal in a mercury cathode directly from the solution of the salt. The results of this work fully substantiate the value for the atomic weight of cadmium previously established in the Harvard laboratory by Baxter, Hines, and Frevert[2] through comparison of the chloride and bromide of cadmium with silver. Both methods yielded the result 112.417 (Ag = 107.880). The electrolytic analysis of cadmium chloride was instigated by investigations by Perdue and Hulett,[3] Laird and Hulett,[4] and Quinn and Hulett,[5] who have recently obtained a considerably lower value,

---

[1] THIS JOURNAL, 37, 113 (1915); *Z. anorg. Chem.*, 92, 53.

[2] *Ibid.*, 27, 222 (1905); 28, 770 (1906); *Ibid.*, 44, 158; 49, 415.

[3] *J. Phys. Chem.*, 15, 1579 (1911).

[4] *Trans. Am. Electrochem. Soc.*, 22, 385 (1913).

[5] *J. Phys. Chem.*, 17, 780 (1913); THIS JOURNAL, 37, 1997 (1915).

112.3, by the electrolytic analysis of cadmium sulfate and cadmium chloride and cadmium bromide, and by the comparison of simultaneous deposits of silver and cadmium. In order to obtain further evidence on the subject, the analysis of cadmium bromide by an electrolytic method similar to that employed by Baxter and Hartmann has been carried out. The results of this work confirm very closely all the earlier work in the Harvard Laboratory. Just as the sum of the percentage of chlorine in cadmium chloride found by Baxter, Hines, and Frevert and the percentage of cadmium found by Baxter and Hartmann is 100.000, so the sum of the percentage of bromine in cadmium bromide found by Baxter, Hines, and Frevert, 58.708, and the percentage of cadmium as determined in the present research, 41.290, is 99.998. It is difficult to imagine more convincing evidence of the accuracy of the two methods of analysis.

Purification of Reagents.

Water, nitric acid, sulfuric acid, alcohol and mercury were purified as described by Baxter and Hartmann.[1] In a few experiments mercury, which had been not only three times distilled in vacuum, but also once at low pressure in a current of air, was used. No difference in the behavior of the two samples could be detected. Bromine was freed from impurities by the processes used by Baxter and Grover,[2] and from the pure bromine hydrobromic acid gas and its solution were prepared by synthesis with pure electrolytic hydrogen in the same way and with the identical apparatus employed by Baxter and Grover.

Purification of Cadmium Bromide.

Since in the earlier work Baxter and Hartmann found that crystallization of cadmium bromide is a very rapid and convenient method of freeing cadmium from metallic impurities, this method of purification was used in preparing the salt for the present purpose. Nonmetallic impurities, such as silica and organic matter, were eliminated both by crystallization and by fusion of the salt in an atmosphere of nitrogen charged with hydrobromic acid gas.

Sample A was prepared from crude cadmium, containing lead and traces of copper and thallium, by cleansing the metal superficially and dissolving it by treatment with the purest bromine under dilute hydrobromic acid solution in a Jena flask. The excess of bromine was removed by boiling, and after filtration through platinum sponge, the solution was evaporated in a platinum dish to crystallization. The salt was five times recrystallized. Since even then the salt, upon fusion, yielded a small amount of black insoluble matter which has been shown elsewhere[3]

---

[1] *Loc. cit.*

[2] THIS JOURNAL, 37, 1029 (1915).

[3] Baxter and Hartmann, *Ibid.*, 37, 121 (1915); Baxter and Grover, *Ibid.*, 37, 1040 (1915).

to consist chiefly of carbon and silica, the whole was fused in platinum boats contained in a quartz tube in an atmosphere charged with hydrobromic acid gas, in the fashion described later. The insoluble matter was removed by solution and filtration through platinum sponge and the salt was twice more crystallized in platinum vessels. The product, when fused, yielded little, if any, of the black residue.

In all the crystallizations the salt was centrifugally drained in platinum Gooch crucibles,[1] and the evaporation of the solutions was carried out upon electric stoves, in order to avoid contamination from the products of combustion of illuminating gas. Sample A was used in Analyses 1 and 3.

To prepare Sample B the metal was first transported electrically from an anode of commercial cadmium through an electrolyte of very concentrated cadmium bromide solution to a platinum wire cathode, where it was deposited in the form of a crystalline mass. In this way carbon and other nonmetallic impurities were very largely eliminated. Since, however, it is impossible to wash clean an electrolytic deposit of the nature of that obtained in this process, the precaution was taken of using for the electrolyte cadmium bromide which was free from chloride. As a matter of fact, the electrolyte was prepared from the mother liquors of Sample A. The mass of crystals was washed by decantation as thoroughly as possible by prolonged treatment with pure water, and then was converted into bromide by covering it with very dilute hydrobromic acid solution in a quartz flask, and adding freshly distilled bromine. The resulting solution of bromide was then boiled for several hours in contact with a small amount of the purified metal, in order to precipitate as far as possible the more highly electropositive metals. Next, the solution was filtered through a platinum-sponge crucible, held in a platinum funnel, into a platinum dish, and was evaporated to crystallization. After the product had been once recrystallized from pure water in platinum, it was fused in platinum boats in a quartz tube in an atmosphere of nitrogen highly charged with hydrobromic acid gas. Since the fused salt contained a small amount of the black insoluble material, it was now dissolved in water and the solution was again filtered through platinum sponge. Then the solution was evaporated to crystallization, and the product was three times more recrystallized from the purest water, all in platinum vessels with the utmost care to avoid the introduction of dust. The product was perfectly white, and gave after fusion in an atmosphere containing hydrobromic acid only a trace of the black residue.

In order to find out whether foreign metals had been successfully eliminated, a portion of the salt was dissolved in a minimum amount of water and metal deposited from it upon a platinum cathode as completely as

---

[1] Baxter, THIS JOURNAL, 30, 286 (1908).

possible, with the use of a platinum anode also. The crystals were washed very thoroughly and dried in a vacuum desiccator. Then the metal was fused in a hard glass tube in a current of hydrogen gas, and while still fused drawn up into capillary tubes of hard glass. In order to prevent the metal from sticking to the capillary tube, the inside of the capillary was lightly coated with soot by drawing a luminous flame into the tube. If this is done, the glass is very easily cracked from the metal wire thus formed. The spark spectrum was then produced from these electrodes, and photographed in a Féry quartz spectrograph, in which the range $\lambda 2100$–$\lambda 6000$ is covered. The spectrum showed no lines other than those usually associated with cadmium, and was identical in every way with the spectrum of the purest material prepared by Baxter and Hartmann.

Sample C of cadmium bromide was prepared in essentially the same manner as Sample B. Sample C was probably purer than any of the others, for upon fusion it yielded least of the black residue, some of the specimens being entirely free from any visible matter of this kind. Sample B was used in Analyses 2 and 4, Sample C in Analyses 5 and 11.

By good fortune a small amount of cadmium bromide remaining from the earlier research by Baxter, Hines and Frevert had been preserved in a dry state in a sealed glass tube. This material is designated in the earlier research, Samples II and III. On fusion in hydrobromic acid this material yielded a small amount of the black residue of carbon and silica, but no more, judging from the appearance and recent experience in this laboratory, than 0.001–0.002%. This is designated Sample D in the table of results. Some of the sulfate from which this bromide had been prepared, also remained. Metal prepared from this sulfate gave a spectrum free from the lines of foreign metals.

Preparation of the Cadmium Bromide for Analysis.

To prepare the cadmium bromide for weighing it was fused in a dry atmosphere charged with pure hydrobromic acid gas. The salt was contained in a quartz boat, and this in turn was placed in a transparent quartz tube, which formed part of a "Bottling apparatus"[1] such as is usually employed in this laboratory for transferring a boat to a weighing bottle without exposure to moisture. The hydrobromic acid gas was prepared by synthesis from pure bromine and hydrogen in the same apparatus and in exactly the same way as in a research upon lead bromide by Baxter and Grover.[2] In the earlier experiments the fusion atmosphere was prepared by passing pure nitrogen through fuming hydrobromic acid solution, and then, in order to remove moisture, over fused calcium bromide. In many of the final series of experiments the fusion atmos-

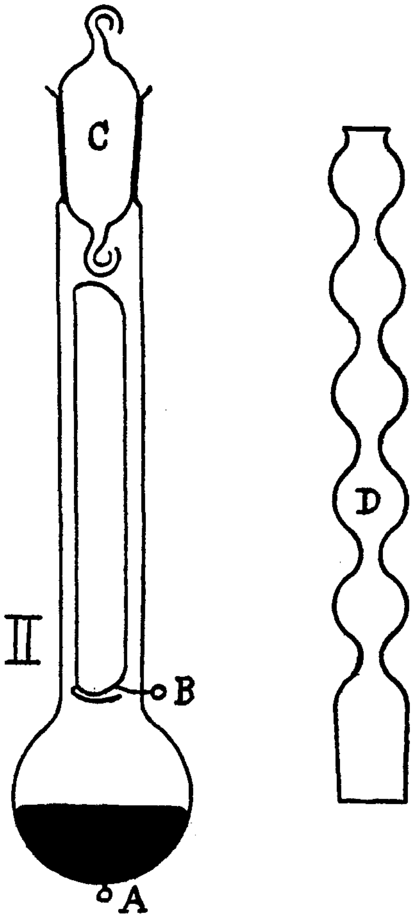
---

[1] Richards and Parker, *Proc. Am. Acad.*, 32, 59 (1896); *Z. anorg. Chem.*, 13, 85.

[2] THIS JOURNAL, 37, 1035 (1915).

phere consisted of hydrogen which had been charged with hydrobromic acid in the same way. No difference in the appearance or the composition of salt fused in the two atmospheres could be detected.

Previous to fusion the cadmium bromide was freed from a portion of its crystal water in a vacuum desiccator containing fused potassium hydroxide. Then, after the greater part of the residual water had been expelled at a low temperature by heating the salt in the hydrobromic acid atmosphere, the temperature was gradually raised by means of an electrically heated sleeve until the salt was fused. As soon as the salt had solidified, the fusion atmosphere was displaced with pure nitrogen and this finally with pure, dry air,[1] and the boat and contents were transferred to the weighing bottle in which they were to be weighed, without exposure to the outside air.



The quartz boats with their weighing bottles were found to remain unaltered in weight by the treatment during fusion. This confirms earlier experience in this laboratory and elsewhere.

Method of Analysis.

For all the electrolyses a cell of the form II, as shown in the earlier paper by Baxter and Hartmann, was employed. In order that the cell might be subjected as far as possible to the same influences before the initial weighing as before the final weighing, it was carefully cleaned and provided with suitable charge, usually about one hundred grams, of the purest mercury, and the mercury was then made the cathode during the electrolysis of dilute sulfuric acid for several hours. Then the cell was rinsed first with water, then with alcohol. The outside also was cleaned and wiped with a clean, lintless cloth. In order to dry the cell and contents, it was placed in a tubular desiccator containing fused potassium

---

[1] The air and nitrogen were purified and dried as described by Baxter and Grover, *Loc. cit.*

hydroxide and the pressure was reduced as far as possible with a Geryk oil pump. When the alcohol had evaporated, the cell and its counterpoise were placed in a second vacuum desiccator containing fused potassium hydroxide, and allowed to stand for several hours before being weighed.

Next the quartz boat with its content of cadmium bromide was introduced bodily into the cell and the salt was dissolved in the rinsings of the weighing bottle. The column of bulbs to catch spray formed during electrolysis was inserted and electrolysis was begun, usually with current strength of about one-half ampere. A strong current at the start was found to delay the completion of the electrolysis. The cell was partly immersed in the purest water in order to avoid undue heating during electrolysis. By experiment this water was proved to exert no appreciable solvent effect upon the glass of the cell.

One of the chief difficulties met in the work was the removal of the bromine liberated at the anode, which, owing to its considerable solubility, nearly all dissolved in the bromide solution, and was only slowly eliminated by evaporation into the small volume of gases produced at the electrodes. This dissolved bromine, by its action on the amalgam, greatly retarded the deposition of the cadmium. Various means of hastening the evaporation of the bromine were tried, including the addition of sulfuric acid before electrolysis was begun, varying the current strength and the concentration of the solution, as well as the temperature, but the only one which was at all successful was to cause as stream of very small bubbles of pure electrolytic hydrogen to pass through the electrolyte through a small glass tube which extended nearly to the surface of the mercury. Even with this device a small amount of bromine remained in the solution after electrolysis for eighteen hours. By that time, however, nearly all the cadmium was deposited and it was safe to remove the electrolyte and eliminate all bromine and bromide by conversion to sulfate.

Before doing this the column of bulbs was rinsed into the cell and the current strength was increased to a maximum by applying the full potential of the battery (seventeen volts) across the electrodes. Next the electrolyte was removed by suction as completely as possible, and the amalgam was washed with a few portions of water and left standing under a very dilute solution of sulfuric acid. The electrolyte was transferred to a quartz dish and evaporated with a few drops of distilled sulfuric and nitric acids, until the bromine and nitric acid had been expelled, and the sulfuric acid was fuming. The residue, which amounted to only a few milligrams, was dissolved in water and returned to the cell, and the electrolysis was continued over another period, usually of sixteen hours, with a current strength of between half and one ampere. The electrolyte was now replaced with very pure water, the full potential being maintained between the electrodes, and great care being taken not to break the electrolytic circuit. Then the water was removed as completely as possible, and the amalgam was rinsed with two small portions of chilled water which had been saturated with hydrogen, and two small portions of the purest alcohol, the amalgam being rolled round gently so as to bring the surface in thorough contact with each washing portion. The outside of the cell was then carefully cleaned and wiped dry, and the amalgam was freed from alcohol exactly as the mercury originally was treated. In accordance with the earlier experience of Baxter and Hartmann we found the amalgams to remain constant in weight when preserved in vacuum.

The electrolyte and washings were evaporated nearly to dryness in a quartz dish over an electric stove. After transference to a weighed platinum crucible, evaporation was continued at a gradually increasing temperature until finally the sulfuric acid had been expelled. Eventually the residue was heated to very dull redness, before being cooled and weighed. While this residue was always small, in no case was it negligible, and occasionally weighed several milligrams. After being weighed it was in many cases dissolved in very dilute sulfuric acid and the solution tested for cadmium with hydrogen sulfide. Cadmium was always found, usually in amounts corresponding very nearly to the weight of the sulfate. Undoubtedly, however, a small proportion of the residue consisted of sulfates of alkalies extracted from the glass of the cell. Since the residue is always multiplied by the proportion of cadmium in cadmium sulfate, 0.54, before the correction is applied, no serious error could have been introduced in this way. That this is the case is indicated by the fact that the total weight of cadmium computed from amalgam and residue eventually became constant upon repeated electrolysis, while the residue seldom changed in weight materially, and frequently decreased.

In the earlier analyses the percentage of cadmium in the bromide was found to be even higher than corresponds to the atomic weight 112.42. The results for the atomic weight of cadmium varied somewhat, the highest being 112.477 and the lowest 112.387, with an average of 112.43. The amalgams, while not badly rusted, were, however, not quite so bright in appearance as in the earlier electrolyses of cadmium chloride. In Analysis 1, in Table I, in which the initial result was somewhat higher than usual, the experiment was tried of repeatedly dissolving the residue of cadmium sulfate in dilute sulfuric acid, returning it to the cell and continuing the electrolysis for another period of several hours. The result of these experiments was to diminish the total weight of cadmium found in the amalgam and residue by about two milligrams, the change falling chiefly upon the weight of the amalgam. Ultimately, a point was reached where repeated electrolysis produced no further alteration in the weight of cadmium recovered. These additional electrolyses, besides lowering the total weight of cadmium, also improved the appearance of the amalgam perceptibly, the final product being as bright and silvery in appearance as could be desired. While we are not certain as to the exact cause of this diminution in weight, we are strongly inclined to the belief that it is due to a small amount of mercurous bromide on the surface of the amalgam, which is only gradually reduced to the metallic state by prolonged electrolysis. This mercurous bromide might very well be formed through the action of the free bromine always present during the first stage of the electrolysis. After this experience, in every analysis the residue was dissolved in dilute sulfuric acid, returned to the cell and the electrolysis repeated until the cadmium recovered in the form of amalgam and as sulfate reached a constant minimum value. This required from three to five electrolyses. The ultimate result of this change in procedure was to lower slightly the average percentage of cadmium in the bromide from that obtained in the first series of experiments.

In order to make certain that the final weight of cadmium found in this way is the correct one, two experiments, Analyses 10 and 11, were carried out by converting the bromide completely to sulfate before electrolysis was begun. This is the method employed by Quinn and Hulett for the analysis of cadmium bromide. The boat with the fused salt was transferred to the quartz dish and the salt was dissolved in water. The boat was carefully removed with rinsing, and the solution was slowly evaporated on an electric stove with a slight excess of redistilled sulfuric and nitric acids, until the bromine and excess of nitric acid had been expelled. The greatest pains was taken toward the end of the evaporation to avoid spattering. The residue of cadmium sulfate and sulfuric acid was dissolved in water and the solution quantitatively transferred to the cell and electrolyzed. The amalgam was treated as above preparatory to weighing, and the residual electrolyte was evaporated in quartz and finally in a platinum crucible, and the residue of sulfate was weighed. The residue was dissolved in dilute sulfuric acid, returned to the cell and electrolysis was repeated. In Analysis 10 the change in weight when electrolysis was repeated was 0.01 mg. In Analysis 11 during the first repetition the loss was one milligram, owing apparently to the fact that some undecomposed bromide was left in the sulfate, but in the second repetition a gain of 0.06 mg. occurred. The agreement of the results of these two experiments with those of experiments where the bromide was electrolyzed directly is strong evidence that no serious error affected the latter.

A question raised by the gradual loss in weight of the cadmium amalgam during continued electrolysis of the bromide is whether in the earlier analyses of cadmium chloride a similar process might not have been under way but not detected. Therefore, in order to determine whether in the analysis of the chloride it is necessary to continue electrolysis to constant weight, several experiments were carried out, in as nearly as possible the same fashion as in the work by Baxter and Hartmann, except that the residue was dissolved, returned to the cell and electrolysis repeated one or more times after the initial weight had been obtained. The material was made from Sample C of cadmium bromide used in the present work by converting it to chloride in a stream of chlorine and hydrochloric acid. The latter process was carried out exactly as described in the earlier paper on the analysis of the chloride.[1] In no one of the three analyses in which electrolysis was repeated could a change in the total weight of cadmium as large as a 0.1 mg. be detected. One analysis in which an obvious loss of material occurred is not given in the table. The final average of the three determinations is essentially the same as that found before. We therefore feel reassured that no difficulty such as was experienced with the bromide could have affected the chloride analyses. It is not surprising to find this to be the case, however, since the free chlorine, being more volatile and less soluble in the electrolyte, is far more rapidly removed during electrolysis than the free bromine.

The weights were standardized to hundredths of a milligram by the substitution method described by Richards.[2] All weighings were made upon a No. 10 Troemner balance. With the heavier objects, such as the weighing bottle, and the cell containing mercury or amalgam, the balance beam was left down some minutes before making observations in order to allow the slight bending of the beam to occur. A small amount of crude radium bromide was kept in the balance case to prevent the objects weighed from retaining electrostatic charges. The weighing bottle and cell were always compared with counterpoises of very nearly the same shape, size and volume in order to avoid variations from changes in atmospheric conditions.

Vacuum corrections of +0.000086 g. per gram of cadmium bromide and of +0.000152 g. per gram of cadmium chloride were applied, the densities of the weights and the salts being assumed to be 8.3, 5.192 and 4.047, respectively. The vacuum correction of cadmium dissolved in mercury computed in the earlier paper, —0.000016 g., was applied for every apparent gram of dissolved cadmium. In a few analyses the amalgam was so concentrated that a small amount of solid amalgam separated, but not in amonnt large enough to produce uncertainty in the vacuum correction.

---

[1] Baxter and Hartmann, *Loc. cit.*, p. 130.

[2] THIS JOURNAL, 22, 144 (1900).

The Atomic Weight of Cadmium.[1]

$Cd:Br_2$. Br = 79.916.

Number of analysis.	Sample of $CdBr_2$.	Wt. of $CdBr_2$ in vacuum. Grams.	Wt. of Cd from amalgam in vacuum. Grams.	Wt. of residue from electrolyte. Gram.	Total of Cd in vacuum. Grams.	Ratio $Cd:Br_2$.	Atomic wt. of Cd.
1	A	16.55663	6.83503	0.00133	6.83575	0.703203	112.395
2	B	6.83764	2.82293	0.00090	2.82342	0.703355	112.419
3	A	7.16223	2.95618	0.00144	2.95696	0.703155	112.387
4	B	6.71886	2.77347	0.00124	2.77414	0.703255	112.402
5	C	10.31855	4.26065	0.00087	4.26112	0.703453	112.434
6	C	9.40020	3.88027	0.00213	3.88142	0.703311	112.412
7	C	8.21123	3.38976	0.00115	3.39038	0.703274	112.406
8	C	10.51504	4.33980	0.00323	4.34154	0.703254	112.403
9	C	10.22411	4.22110	0.00087	4.22157	0.703297	112.409
10	C	10.99613	4.53953	0.00112	4.54013	0.703242	112.401
11	C	11.05166	4.56258	0.00109	4.56317	0.703271	112.405
12	D	19.67134	8.12101	0.00266	8.12244	0.703309	112.411
					Average,	0.703282	112.407
	Total,	127.66362	...	...	52.71204	0.703281	112.407

The Atomic Weight of Cadmium.

$Cd:Cl_2$. Cl = 35.457.

Number of analysis.	Wt. of $CdCl_2$ in vacuum. Grams.	Wt. of Cd from amalgam in vacuum. Grams.	Wt. of residue from electrolyte. Gram.	Total wt. of Cd in vacuum. Grams.	Ratio $Cd:Cl_2$.	Atomic wt. of Cd.
13	6.49746	3.98314	0.00216	3.98430	1.58537	112.425
14	6.62682	4.06323	0.00047	4.06348	1.58523	112.415
15	7.35812	4.51120	0.00084	4.51165	1.58500	112.399
				Average,	1.58520	112.413
Total,	20.48240	...	...	12.55943	1.58519	112.412

One analysis is omitted from the table of bromide experiments because the stopper blew out of the cell during the drying of the amalgam, and one because of the presence of a relatively large amount of readily volatile solid residue when the electrolyte was evaporated to dryness. The amalgam in Analysis 2 was re-electrolyzed only once, and lost in the process 0.00062 g. This may account for the fact that the result of this experiment is slightly higher than the average. In Analysis 7 constant weight of the cadmium was not secured because of accident to the residue after the third electrolysis. In the second electrolysis the loss in weight was 0.00055 g.; in the third 0.00024 g. It is unlikely, that an appreciable further loss would have occurred. In Analysis 5, a very slight black ring, presumably of mercury sulfide, formed on the glass

---

[1] Some of the preliminary analyses of cadmium bromide were made by Dr. Hartmann. The final analyses given in the tables were all made by Mr. Grose.

of the cell at the surface of the mercury, during the electrolysis with sulfuric acid.

In connection with the table it is worth noting that if the weight of residue obtained from the electrolyte is entirely neglected, the atomic weight of cadmium becomes 112.37. But this value is surely too low, first, because the residues always contained cadmium and second, because of material dissolved from the cell walls.

The average result, 112.407, confirms all the earlier work in the Harvard Laboratories upon the analysis of the cadmium halides. The average percentage of cadmium in cadmium bromide found here is 41.290, while Baxter, Hines, and Frevert by comparing the same salt with silver found the percentage of bromine to be 58.708. The sum is 99.998%, a satisfactory outcome.

The following table summarizes the work upon the atomic weight of cadmium carried out in the Harvard Laboratories:

	Ratio.	Atomic weight of cadmium.
Baxter and Hines	$CdCl_2:2Ag:2AgCl$	112.418
Baxter, Hines and Frevert	$CdBr_2:2Ag:2AgBr$	112.417
Baxter and Hartmann	$CdCl_2:Cd$	112.417
Baxter, Grose and Hartmann	$CdBr_2:Cd$	112.407
	Average,	112.415

It is difficult to believe that constant errors could have affected all four series of results to an equal extent.

Summary.

1. A procedure for the direct electrolysis of bromides with the use of a special form of cell and a mercury cathode is described.

2. Further evidence is presented in support of the analyses of cadmium chloride by Baxter and Hartmann.

3. The percentage of cadmium in anhydrous cadmium bromide is found to be 41.290, while Quinn and Hulett found only 41.257%. The former percentage corresponds to an atomic weight of cadmium of 112.407 (Br = 79.916), a value which agrees satisfactorily with the results obtained earlier by Baxter, Hines, and Frevert, and Baxter and Hartmann, 112.417 (Cl = 35.457). The average of the four series of results is 112.415 (Ag = 107.880).

We are greatly indebted to both the Carnegie Institution of Washington and the Elizabeth Thompson Science Fund for very generous assistance in this investigation

CAMBRIDGE, MASS.