remains to be done in order that perfect certainty may be attained, nevertheless the outcome must be regarded as promising in pointing toward an adequate and convenient method of separating gallium from other metals.

Three fractional samples of the chloride discussed in the previous section were analyzed, using the usual methods employed in Harvard University in order to make a preliminary determination of the atomic weight. The samples were small and for various reasons the results cannot be considered as anything more than preliminary, but the outcome is, nevertheless, worth recounting. In the last and best determination 0.43947 gram of gallium chloride (weighed in vacuo in a sealed glass tube) yielded 1.07087 grams of silver chloride having required 0.80587 gram of silver for complete precipitation. The atomic weight of gallium computed from these two sets of data are respectively 70.09 and 70.11—concordant results indicating a value somewhat higher than that usually accepted for gallium, but near enough to show that the chloride was at least not far from being pure, and that the whole proceeding is capable, when employed with larger quantities of material and with the experience already gained, of affording an accurate evaluation of this atomic weight. Of course such meagre data as those thus far secured furnish no worthy evidence concerning it; they are as merely preliminary as the data of Lecoq de Boisbandrau. At the conclusion of the war it is hoped that the joint investigation (which was stopped by the departure of W. M. Craig into War Service) may be continued and completed.

The principle of this method has since been published by Dennis and Bridgman, although the details o' their treatment differed from ours. Their work was entirely independent of ours (which was brought to a close in March, 1918) and was entirely unknown to us. J. Amer. Chem. Soc., Easton, Pa., 40, 1918, (1540).

THE PURIFICATION OF GALLIUM BY ELECTROLYSIS, AND THE COMPRESSIBILITY AND DENSITY OF GALLIUM

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The method of separating gallium from indium by means of the different solubilities of the hydroxides in caustic alkali, recommended by various authorities, was tested without success. The separation was found to be so incomplete that several per cent of indium remained in the gallium, at least under the conditions used in our work, and it seemed clear that this difference in solubility is not enough to effect a complete separation. Much more promising results were obtained by the electrolytic method. Gallium occupies a place in the electrolytic series between indium and zinc. It is far less easy to deposit than indium, but, on the other hand, much more easy to deposit than zinc. By carefully regulating the hydrogen-ion concentration
and current density it was possible to deposit practically all of the indium with only a little gallium; and thereafter most of the gallium could be separated in a slightly acid solution without the appearance of an important amount of zinc. Gallium obtained in this way from material which had previously been purified by the hydroxide method, melted at a temperature as high as 30.8°, a higher melting point (indicating a purer substance) than is recorded anywhere in the literature. The metal obtained by the hydroxide process, without electrolysis, melted at a temperature as low as 26.9°. Time has as yet been lacking for making complete spectroscopic and other tests of this material in order to confirm its complete purity, but enough has been done to show that this method is a very satisfactory and convenient one. Because of its obvious advantages it must have been employed before by others, but no mention has as yet been found of it.¹

Having thus prepared gallium of substantial purity, we proceeded to determine its compressibility, both in the solid and in the liquid condition. This was an interesting problem since comparatively few substances have been measured in both states. However, gallium has the remarkable and rare property of occupying more volume in the solid than in the liquid condition. The determination of the compressibility was desirable in order to add to the long list of elements already determined at Harvard. The apparatus and principle of the method was essentially similar to that employed in other cases, but a new difficulty was encountered. As in the case of other metals, the gallium could not, of course, be allowed to come in contact with the mercury in the piezometer, but on the other hand, it could not be conveniently solidified in any tube under such an inert liquid as toluene without bursting the tube. After many more or less satisfactory devices had been tried, the best results were obtained by solidifying gallium in the first place, and then placing a cylinder of the solidified metal in a slightly larger short test tube, just fitting it, and capping this with another similar slightly larger test tube under the inert liquid. Twenty-three grams of pure gallium were used in this work, and the compressibility was found to be 2.09 × 10⁻⁶, placing gallium precisely on the curve joining the other compressibilities in the graph representing the periodic relation of this property to atomic weight. The compressibility of gallium containing several per cent of indium as obtained by the hydroxide method was found to be somewhat less (1.97 × 10⁻⁶). Liquid gallium was determined not only in this apparatus but also in one similar to that used for caesium (Publication of the Carnegie Institution of Washington, No. 76, p. 20). The liquid was thus found to have a compressibility of 3.97 × 10⁻⁶, a value almost exactly identical with that for mercury, and nearly twice as great as that of solid gallium, although its volume is less. The determination was made at 30°. This confirms the universal experience that solids have compressibilities distinctly less than the same substances as liquids, entirely irrespective of the volumes which they occupy. ² The most marked case of this kind thus far observed is that of ice.
The densities also of solid and liquid gallium were determined,—data which have especial interest because the expansion of gallium on freezing has been attributed by some investigators to impurity. In the first place careful determinations were made by means of a pycnometer for solids\(^3\) of the density of the impure material containing some indium in the solid and liquid condition, the values found being respectively 5.975 and 6.166. Subsequently when the purest material had been obtained, the determinations were repeated with equal care, giving values 5.885 and 6.081 respectively. Evidently indium had produced no essential effect upon the expansion on freezing and even if the more carefully prepared gallium was not absolutely pure, it is evident from the outcome, by extrapolation, that the purest gallium must still possess this unusual property.

\(^1\)This method also has since been published by Dennis and Bridgman in their interesting article on Gallium.


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**THE GROWTH-RATE OF SAMOAN CORAL REEFS**

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In April, 1917, reef corals from Pago Pago Harbor, American Samoa, were measured, photographed, weighed, marked by numbered brass tags and replaced in favorable situations upon the reef-flats either by tying them with wire to iron stakes or imbedding their bases in concrete.

In July, 1918, these corals were again studied in order to ascertain their growth-rate, and as the specimens selected were of average size it was hoped that an approximate determination of the average growth-rate for each species might be determined. It was our object to calculate the weight of stony matter which coral heads of average size add to the reef per annum. In order to do this, the weight of the living coral was ascertained both in 1917 and in 1918. Then, in 1918, the coral was killed and its animal substance dissolved in KOH, after which the fresh water was largely abstracted by washing the skeleton in 90\% ethyl alcohol; and finally the coral was dried in the sun, and then weighed.

This showed that the weight of the dried stony substance in various species of reef corals is on an average about 0.8 that of the same coral heads when alive. Various *Acropora* ranged from 0.7 to 0.9, while branched *Porites* were about 0.8, and large massive *Porites* slightly above 0.9.

Applying this correction, we find that on these Samoan reefs the gain in