

## A Thermal Method for the Separation of Isotopes

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When a mercury/solution interface is formed from a mercury/gas and a gas/solution interface, the resulting potential drop in the absence of any ionic exchange is thus shifted to more negative values as compared with the sum of the original potential differences. This could be caused by a more pronounced orientation of the negative ends of the water molecules towards mercury as compared with their orientation towards the gas phase—an assumption which appears very probable, as a similar effect is really observed in the case of various organic molecules dissolved in water.<sup>4</sup>

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<sup>1</sup> W. Latimer, K. Pitzer and C. Slansky, *J. Chem. Phys.* **7**, 108 (1939).  
<sup>2</sup> O. Klein and E. Lange, *Zeits. f. Elektrochem.* **43**, 570 (1937); **44**, 562 (1938). An earlier rough measurement of the Volta potential mercury/solution was carried out by A. Frumkin and A. Donde, *Zeits. f. physik. Chemie* **123**, 339 (1926).

<sup>3</sup> J. Bernal and R. Fowler, *J. Chem. Phys.* **1**, 538 (1933).

<sup>4</sup> A. Frumkin, *Coll. Symp. Ann.* **7**, 96 (1930).

### The Raman Effect of Dibromo-Difluoromethane and Dibromo-Chloromethane

Nine Raman lines have been observed for both dibromo-difluoromethane and dibromo-chloromethane using our usual equipment.<sup>1</sup> A sodium nitrite filter was used with the former substance and it was kept cold during exposures by means of a jacket through which cold water circulated. There was no perceptible photochemical action under these conditions.

The dibromo-chloromethane, which was run without a filter or cooling, showed slight photochemical decomposition under the mercury lamps and was redistilled in a current of nitrogen between successive exposures.

The results obtained are shown in the Tables I and II.

Three faint sharp lines were also observed on the dibromo-chloromethane plates at 155, 222 and 541  $\text{cm}^{-1}$  as Stokes lines from 4358. They can be attributed to bromoform present as an impurity. The line reported at 658.7, even though it nearly coincides with the bromoform line at 655, is too intense relative to the other bromoform lines to be due to bromoform alone.

The dibromo-chloromethane was synthesized from chloro-acetal according to the method of Jacobsen and Neumeister.<sup>2</sup> (Boiling range 119–120° at 748 mm. Density 2.462 at 15°.)

TABLE I. *Raman lines of dibromo-difluoromethane.*  
 $a=4046$ ;  $b=4077$ ;  $c=4358\text{A}$ .

$\Delta\gamma \text{ cm}^{-1}$	% MEAN DEVIATION	EXCITING LINES		NO. OF READINGS	RELATIVE INTENSITIES
165.3	0.48	<i>a</i>	<i>c</i>	9	7
282.2	.32		<i>c</i>	4	3
330.1	.30		<i>c</i>	4	3
340.0	.26	<i>a</i>	<i>b</i>	10	10
367.4	.49		<i>c</i>	2	2
622.9	.24	<i>a</i>	<i>c</i>	9	6
815.8	.06		<i>c</i>	3	4 (broad)
1076.7	.06		<i>c</i>	3	4 (broad)
1142.0	.03		<i>c</i>	2	1 (diff.)

TABLE II. *Raman lines of dibromo-chloromethane.*  
 $a=4046$ ;  $b=4077$ ;  $c=4358\text{A}$ .

$\Delta\gamma \text{ cm}^{-1}$	% MEAN DEVIATION	EXCITING LINES		NO OF READINGS	RELATIVE INTENSITIES
168.3	0.53	<i>a</i>	<i>c</i>	8	8
201.1	.50	<i>a</i>	<i>c</i>	8	7
279.4	.43	<i>a</i>	<i>b</i>	10	10
568.9	.28	<i>a</i>	<i>c</i>	7	8
658.7	.27	<i>a</i>	<i>c</i>	6	5 (broad)
749.5	.32	<i>a</i>	<i>c</i>	3	3 (diff.)
1145.5	.14		<i>c</i>	2	1
1193.8	.24		<i>c</i>	2	1
3022.6	.03	<i>a</i>	<i>c</i>	6	7

The dibromo-difluoromethane was furnished by the E. I. duPont de Nemours Company and was laboratory fractionated with a boiling range of about 0.5°. We wish to thank Dr. A. F. Benning of the Jackson Laboratory for the loan of this substance. Further consideration of these results will appear in a later publication.

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<sup>1</sup> G. Glockler and C. E. Morrell, *J. Chem. Phys.* **4**, 15 (1936).  
<sup>2</sup> O. Jacobsen and R. Neumeister, *Berichte* **15**, 600 (1882).

### A Thermal Method for the Separation of Isotopes

Various experiments have been carried out in this laboratory to determine the final efficiency that can be obtained with the thermal method for the separation of isotopes and gases.<sup>1</sup> The separation chambers used in these tests were of the concentric glass tube design, the diameter of the inner tube being one cm and the wall separation seven mm. Chambers one and three meters in length were studied. A 50–50 ammonia-methane mixture at 25 cm pressure was chosen for convenience of analysis.

The results obtained so far can be summarized as follows.

(1) The change in the separation factor (ratio of initial to final concentrations) for a definite time interval is independent of the height of the tube, provided the separation has not reached a value greater than 90 percent of the final equilibrium concentration.

(2) The final equilibrium value for the separation factor varies directly as the height of the tubes within wide limits.

(3) Measurements for the variation of the separation in samples of gas drawn from different heights within the tubes show that, for the three-meter tube, the relative concentration of the two components is very nearly constant for a distance of several centimeters from the bottom of the tube; for greater distances the separation factor changes appreciably.

(4) The mass speed appears independent of the length of the tube. At least 8 cc of gas (NTP) can be withdrawn per hour without changing the separation factor. For the one-meter tube the separation factor was 1.3 and for the three-meter tube 2.0.

(5) The efficiency of separation of a component of low concentration can be improved by the addition of sufficient

inert gas of the same mass to give an initial 50-50 mass mixture. In the methane-ammonia mixture,  $C^{13}H_4$  had the same separation factor as  $N^{14}H_3$ .

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<sup>1</sup> Brewer and Bramley, *Phys. Rev.* **55**, 590(A) (1939); Bramley and Brewer, Baltimore meeting, Am. Chem. Soc.

### Raman Spectrum of Antimony Trimethyl

As a start in an investigation of the Raman spectra of the metal methyls undertaken by one of us (E. J. R.), the Raman spectrum of  $Sb(CH_3)_3$  has been observed.<sup>1</sup> This compound was prepared in an inert atmosphere by the

Grignard reaction between  $SbCl_3$  and  $CH_3I$ , and was fractionated under vacuum. The exposure time was approximately eight hours without a filter. Intensities were estimated visually. The results are as follows:

188(8 $vd$ ) ( $-k, \pm e$ ), 513(10) ( $k, i, \pm e, f$ ), 813(1 $vd$ ) ( $k, e$ ), 1194(5) ( $k, i, e$ ), 1213(6) ( $k, i, e$ ), 2905(8) ( $q, p, k, i, e$ ), 2987(3) ( $q, p, i, e$ ). (The letters  $k, e$ , etc. are the Kohlrausch symbols for the Hg exciting lines, and  $vd$  stands for very diffuse.)

Application will be made of these data in a future publication. We wish to thank Mr. H. F. Jacobson for assistance in photographing and evaluating this spectrum.

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<sup>1</sup> The other compounds studied so far include the methyl derivatives of zinc, germanium, arsenic and aluminum.