Citation:

E. Cohen & Wolff, S., The allotropy of Potassium. I, in:
KNAW, Proceedings, 17 III, 1914-1915, Amsterdam, 1915, pp. 1115-1118

is formed; the liquid contains then 22 °/₀ As_2O_3 and 2.87 °/₀ NH_3. On further addition of NH_3 the solution keeps the composition b as long as the complex remains within the threephasetriangle $b \,.\, D_{211} \,.\, As_2O_3$, and we have the complex: $As_2O_3 + NH_4AsO_2 +$ solution b. The only thing that happens on addition of NH_3 is the conversion of As_2O_3 into NH_4AsO_2. When all the As_2O_3 has disappeared and has been converted into NH_4AsO_2, then on further addition of NH_3 the solution follows curve *bcd*, in which case its content of As_2O_3 decreases continuously.

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Chemistry. — *"The allotropy of potassium."* I. By Prof. ERNST COHEN and Dr. S. WOLFF.

1. We have in view to investigate here whether potassium as it has been known hitherto is a metastable system in consequence of the simultaneous presence of two or more allotropic forms of this metal.

It will become evident from the following lines that the literature already contains very accurate data for solving this problem.

2. As long as thirty years ago ERNST HAGEN[1]) published his very careful experiments on the determination of the coefficient of expansion of potassium, which were carried out with the dilatometer.

Contrarily to many other physicists he bestowed much care on the purity of the material used. The specimen of potassium experimented with contained only a *trace* of sodium (in 6 or 7 grams).

3. For a description of the details of the measurements the reader is referred to the original paper, but it may be pointed out here that the agreement between the determinations made with two different dilatometers (containing $\pm$ 40 grams of potassium each) was exceedingly satisfactory.

The measurements are summarized in the Tables I and II, where t indicates the temperatures at which the experiments were made, while v indicates the volume (in ccm.) of 1 gram of the metal.

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1) Wied. Ann. **19**, 436 (1883).

TABLE I.
Dilatometer 1.

t	v	t	v
0°	1.15665	59°.8	1.19170
17.3	1.16148	59.8	1.19457
40.5	1.16823	60	1.19643 tot
50.1	1.17108	60.1	1.19719
50.2	1.17110	60	1.19734
19.6	1.16238	59.7	1.19593
31.2	1.16542	59.6	1.19353
41.1	1.16829	64.6	1.20480 (liquid)
49.7	1.17097	54.25	1.17452 (solid)
55.1	1.17607		
58.2	1.18611		
19.7	1.16199		
0	1.15650		
52.7	1.17277		
52.8	1.17258		
52.85	1.17259		

TABLE II.
Dilatometer 2.

t	v	t	v
0°	1.15692	59°.8	1.19348
17.35	1.16168	59.8	1.19693
40.7	1.16843	60	1.19877
49.9	1.17125	60.1	1.19949
50.2	1.17137	60	1.19976
50.1	1.17134	59.7	1.19918
18.2	1.16211	59.6	1.19575
31.3	1.16587	64.6	1.20495 (liquid)
41.1	1.16863	54.25	1.17611 (solid)
49.7	1.17129		
55.1	1.17712		
58.2	1.18755		
19.7	1.16223		
0	1.15680		
52.7	1.17341		
52.8	1.17312		
52.85	1.17317		

4. In order to calculate the coefficients of expansion, HAGEN only used the observations between 0° and 50° C. He found that the coefficient increases rapidly above 50° C.; there is between this temperature and the melting point an increase of volume of 0.5 per cent which is followed by a sudden increase of 2.5 per cent at the melting point (62°.1).

5. In order to get a clear survey of the phenomena the results of those determinations which were carried out with *both* dilatometers at the *same* temperatures are summarized in Table III. The fourth column contains the differences of volume (in hundredths of a mm^3) of 1 gram of potassium which is found with the two instruments at the same temperature.

TABLE III.

Temperature	Volume of 1 gr. of potassium in Dilatometer 1	Volume of 1 gr. of potassium in Dilatometer 2	Difference (hundredths of mm.³)
0°	1.15665	1.15692	27
50.2	1.17110	1.17137	27
50.1	1.17108	1.17134	26
41.1	1.16829	1.16863	34
49.7	1.17097	1.17129	30
55.1	1.17607	1.17712	105
58.2	1.18611	1.18755	144
.19.7	1.16199	1.16223	24
0	1.15650	1.15680	30
52 7	1 17277	1.17341	64
52.8	1.17258	1.17312	54
52.85	1.17259	1.17317	58
59.8	1 19170	1.19348	178
59.8	1.19457	1.19693	236
60	1.19643	1.19877	234
60	1.19734	1.19976	242
59.7	1.19593	1.19918	325
59.6	1.19353	1.19575	322
64.6	1.20480 (liquid)	1.20495 (liquid)	15
54.25	1.17452 (solid)	1.17611 (solid)	159

6. As long as the dilatometers have not been exposed to temperatures higher than 53°, the differences remain small and nearly constant (24—34 units). At higher temperatures they become large (up to 325 units). However, if we go back to 0° C., the difference has become the same (30 units) as it was before at the same temperature. From these data it follows that there has occurred in one dilatometer or in both a *reversible* transformation. That it has taken place in the *solid* metal, is evident from the fact that the difference is again very small (15 units) after the metal has been melted (at 64°.6 C.). If the metal is now cooled to 54°.25 (at which

temperature it is solid), the large differences (159 units) are observed again [1]).

7. If we consider the phenomena with one of the dilatometers (for example with N°. 1) it is evident that at the *constant* temperature of 59°.8 C. there occurs an increase of volume (287 units). Some time later the volume at 59°.6 C. is 183 units greater than before at 59°.8 C. although the temperature is lower (0°.2).

8. Considering that in the second dilatometer also the same phenomena occurred at 59°.8 C. [the volume increases at constant temperature (345 units) and is afterwards at 59°.6 C. greater (227 units) than before at a temperature which is 0°.2 lower] we may conclude that the transformation has taken place in *both* dilatometers. (Comp. § 6).

9. These experiments consequently prove that potassium can undergo transformation into a second modification (β-Potassium) and that the metal as it has hitherto been known is at ordinary temperatures a metastable system in consequence of the presence of both forms at the same time.

10. The indications found in the earlier literature that this metal is able to crystallize as well in the regular as in the tetragonal systems [2]), gains more importance in the light of these results.

11. R. W. and R. C. DUNCAN [3]) found that there existed a large difference between the indices of refraction of two mirrors which had been formed from molten potassium. Fresh experiments are wanted in order to decide whether these discrepancies are to be attributed to the presence of different quantities of the two modifications in the mirrors experimented with.

12. As the change of volume which accompanies the transformation mentioned, is considerable, it will be possible to investigate these phenomena by dilatometric measurements more closely than can be done at present from the data given by HAGEN. We hope to report shortly on this point.

Utrecht, January 1915. VAN 'T HOFF-*Laboratory.*

1) If the phenomena were to be ascribed to the melting process, the difference at 54°.25 C. at which temperature the metal is solid, would have been small (30 units), which is really not the case.

2) ABEGG's Handbuch der anorg. Chemie **2**, (1) 338—339 (Leipzig 1908); LONG. Journ. Chem. Soc. **13**, 122 (1860).

3) Phys. Rev. (2) **1**, 294 (1913).