Physics. — *On the diffraction of Röntgen-rays in fused sodium and potassium.* By Prof. W. H. KEESOM. (Supplement No. 61*a* to the Communications from the Physical Laboratory at Leiden).

(Communicated at the meeting of December 18, 1926).

§ 1. *Introduction.* The communication of PRINS [1]) about the diffraction of Röntgen-rays in mercury acted as an inducement to me to publish the results of a similar investigation about sodium and potassium in the fused state. This piece of research was carried out by me in 1923 in the Laboratory of Physics and Physical Chemistry of the Veterinary College as a part of an investigation on the diffraction of Röntgen-rays in solutions of liquid-mixtures [2]). The latter however has not been continued because of my departure to Leiden [3]).

§ 2. *Method.* The fused metal to be radiated, was brought into a thinwalled glass tube, in vacuo, in order to prevent as far as possible the inevitable formation of oxide. This tube was put into the middle of a DEBIJE—SCHERRER-camera, as described in Comm. N⁰. 10 from the Laboratory of Physics and Physical Chemistry of the Veterinary College [4]). The lower part of the tube was immersed in a small beaker-glass filled with paraffine, which was kept, by means of an electrically heated resistance wire, at a temperature of about 25 degrees above the melting point of the metals (controlled with the aid of a thermoelement, brought into the paraffine). Separately we had made sure that then the whole mass of the metal present was molten. The metal was radiated (Cu-K-rays) some few millimeters above the part immersed in the paraffine. For K we worked with a HADDING tube for 23 hours with 22 mA; for Na $7^1/_2$ hours with 17 mA.

§ 3. *Results.* The results obtained are given in table I. Here φ

TABLE I.

Substance	Diameter diffractionring	φ	$\varphi_{corr.}$	a	δ	$1.33 \sqrt[3]{\frac{M}{\delta}}$
Na	27 mm.	28.6°	27.1°	4.04 Å	0.93 [5])	3.88 Å
K	21.5 „	22.8	21.2	5.13	0.83 [5])	4.80

[1]) J. A. PRINS. Physica **6**, 315, 1926.

[2]) Some data about this are communicated in § 5.

[3]) This investigation was already mentioned in Comm. Leiden, Suppl. N⁰. 53*b*, 1924, p. 17, note 2.

[4]) W. H. KEESOM and J. DE SMEDT, These Proc. **25**, 118.

[5]) VICENTINI and OMODEI 1888.

represents the half top angle of the cone formed by the diffracted Röntgen-rays, as this is found from the half diameter of the diffraction ring on the film and the radius of the cylinder inside which the film has been bent (27 mm). In $\varphi_{corr.}$ the correction for the thickness of the cylinder of molten metal (the tube had a diameter of 1.1 to 1.2 mm) has been applied after BIJL and KOLKMEIJER [1]). a is the distance of the diffracting particles, calculated after the formula of EHRENFEST [2]): $a = 7.72\ \lambda/4\pi \sin\frac{\varphi}{2}$; δ is the density of the liquid. The last column gives the distance of two neighbouring atoms, assuming that these are packed as closely as possible in the volume occupied by the liquid [3]).

§ 4. In the first place it appears from the approximating agreement of columns 5 and 7 of table I, that, just as in the cases of the liquids mentioned in the Communications N⁰. 10 and 12 from the Laboratory of Physics and Physical Chemistry of the Veterinary College [4]), also with Na and K the distance of each two diffracting particles agrees approximately with the distance of two neighbouring particles, arranged in closest packing; the distance of two diffracting particles being derived from the diameter of the diffraction rings with the formula of EHRENFEST.

As in my calculations for Na and K the atomic weight is taken for M, it follows that these elements, just as A and Hg, are monatomic liquids.

It is interesting to note that the two numbers of column 7 are smaller than the corresponding ones of column 5, and although the difference is hardly beyond the limits of experimental error, it is perhaps significant that the same is found in the case of argon when one applies the correction of BIJL and KOLKMEIJER to the observations of Comm. N⁰. 10 l.c. [5]) as is shown in the following table.

TABLE II.

Substance	Film N⁰.	Diameter diffractionring	φ	Diameter preparation	$\varphi_{corr.}$	a	$1.33 \sqrt[3]{\frac{M}{\delta}}$
A	37	26.75	28.4°	3.0 mm.	23.7°	4.61 Å	4.08
„	53	25.5	27.0	2.0 „	24.0	4.55	4.08

1) A. J. BIJL and N. H. KOLKMEIJER, Comm. N⁰. 2*a* from the Laboratory of Physics and Physical Chemistry of the Veterinary College; These Proc. **21**, 496, note 1; A. J. BIJL, Thesis for the Doctorate, Utrecht 1918.

2) P. EHRENFEST, These Proc. **17**, 1184.

3) Compare W. H. KEESOM and J. DE SMEDT, Comm. N⁰. 10, l.c.

4) These Proc. **25**, 118 and **26**, 112.

5) For the other substances investigated there, which show a much smaller absorption-power for the Röntgen-rays, this correction will be much less.

That difference can be partly ascribed to the influence (comparatively larger for argon than for sodium and potassium) of the dimensions of the atom (comp. § 5 of the mentioned Comm. N⁰. 10) but probably not completely.

§ 5. Though I will not connect conclusions with this, I may utilize the opportunity to communicate the results of another two Röntgenograms, namely those of a solution of NaCl in water, and of a mixture of water and aethylalcohol. The following table gives the half top angle of the cone formed by the diffracted Röntgen-rays for Cu-K-rays, with the liquids mentioned. To it are added the relative values for water and aethylalcohol as previously obtained (Comm. N⁰. 10 l.c.)

water	$\varphi = 29^\circ$, further blackening to $\varphi = 46^\circ$
alcohol	22°, „ „ „ $\pm 43.5^\circ$ (limits
30 gr. NaCl + 100 gr. H_2O	31° unclear)
18 gr. H_2O + 46 gr. C_2H_6O	23°, second ring 42°.

The ring of NaCl was (because of insufficient exposure) weak, but still clear; the film of the water-alcohol-mixture showed an intensive ring (extending itself from $\varphi = 20^\circ$ to $\varphi = 26^\circ$). Within and outside the ring there was a weak blackening, the last ending into a weak second ring at $\varphi = 42^\circ$.