Physics. — *"Isotherms of monatomic substances and their binary mixtures. II. Isotherms of helium at* — 253° C. *and* — 259° C.", by Prof. H. KAMERLINGH ONNES. Communication N°. 102^c from the Physical Laboratory at Leiden.

§ 1. *Survey of the determinations.* The measurements were made in the same way as those of Comm. N°. 102^a (Dec. '07). The whole of the piezometer had a four times larger content, viz. about 2 liters, the piezometer reservoir on the other hand was more than four times smaller, it was, namely, somewhat more than 2 cm^3. Accordingly the densities to which the measurements refer, are considerably larger, and lie between 591 and 794 times the normal one. The temperatures at which the determinations were made, are measured on the hydrogen thermometer of Comm. N°. 95^c.

$$t = -252°.84 \text{ C. and } t = -258°.94 \text{ C.}$$

from which by extrapolation by means of table XXV of Comm. N°. 101^b (Dec. '07) see § 3 of Comm. N°. 102^b follows for the temperatures below 0° C. measured on the absolute scale

$$\theta = -252°.84 + 0°.12 = -252°.72$$
$$\text{and } \theta = -258\ .94 + 0°.12 = -258°.82$$

The determination of the mean temperature of the gas in the capillary stem of the piezometer reservoir, with regard to the part that extends above the bath in the cryostate, required here greater accuracy than before, because compared with the quantity of the gas in the smaller reservoir that in the stem was of more importance. With a view to the determination of this mean temperature a cylindric reservoir of the same height as the capillary was placed by the side of and on a level with the capillary, which reservoir was filled with helium, and provided with an appliance to read the pressure in it [1]). By means of this pressure it is easy to derive with the required accuracy what mean density for the gas in the capillary of the piezometer must be taken. At 0° the pressure in this auxiliary apparatus was 118.3 cm. of mercury. With the measurement at — 253° C. it varied between 33.1 and 51.1 cm., at — 259° C. between 31.8 and 48.1 cm.

[1]) A similar contrivance has been applied by different observers in the determination of the mean temperature of the capillary of a gas thermometer (TRAVERS, SENTER and JACQUEROD, Ph. Tr. Royal Soc. London Ser. A. vol. 200 p. 143 (1902)).

§ 2. *Results for* pv_A.

The subjoined table contains the results of the determinations in the same way as table I of Comm. N°. 102ª.

TABLE I. Helium. Values of pv_A.

N°.	θ	p	pv_A	d_A
1	— 252°.72	53.848	0.09120	591 53
2		60.716	0 09533	636 92
3		65.997	0 09867	668.87
4	— 258°.82	40 012	0.06150	650.65
5		46.222	0.06559	704 71
6		53.326	0.07063	754.97
7		59.797	0.07531	794.00

The corresponding values for $pv_{A,d=0}$ are:

for — 252°.72 $pv_A = 0.07455$

for — 258°.82 $pv_A = 0.05222$

§ 3. *Further results.* The number of points on every isotherm is too small, and the densities are too large to allow already now the derivation of the first individual virial coefficients of the polynomial of state (cf. § 4 of Comm. N°. 102ª). If, however, we give a graphical representation, it shows that the isotherm pv_A for — 259° must exhibit a minimum and hence B_A must be negative at this temperature. Further follows from the isotherm of — 253°, that the intersection of this line with the axis $d = 0$ lies near the BOYLE-point. Probably B_A is also already negative at — 253° though only slightly. All this agrees very well with what was derived in § 5 of Comm. N°. 102ª, and speaks for the validity of the extrapolation applied there with a view to the calculation of the critical temperature of the helium.

In conclusion I gladly express my thanks to Mr. C. BRAAK for his assistance in this investigation.