Physics. — *"Some remarks on the expansion of platinum at low temperatures"*. By Prof. H. KAMERLINGH ONNES and J. CLAY. Supplement N°. 17 to the Communications from the Physical Laboratory at Leiden.

(Communicated in the meeting of September 28, 1907).

The communication from the "Physikalisch-technische Reichsanstalt" by K. SCHEEL in the meeting of Jan. 11, 1907 of the "Deutsche physikalische Gesellschaft" led us to make a remark already in the Meeting of June 29, 1907 (These Proc. Sept. 1907 p. 200). In Communication N°. 95^b (These Proc. Sept. '06 p. 199) we had given a quadratic formula for the expansion of platinum *below* 0°, from which followed that, as was remarked in the Introduction of that Communication, a formula of the third degree is required if we wish to represent the expansion of platinum from —180° to +100° by one polynomial with increasing powers of *t*, and if we have to deal with observations which if repeated a sufficient number of times, allow us to reach an accuracy (comp. § 1 of Comm. N°. 85, June '03, These Proc. April '05) of $^1/_{200}$ in the expansion. We found this confirmed by the measurements of SCHEEL, who arrived at the same result by determining a quadratic formula for the expansion of platinum *above* 0°, and by measuring the length at —190°.

We now consider the striking difference of the expansion at low temperatures according to the formula given by us, and that according to SCHEEL's formula, viz.: 43 μ for the expansion of a bar of 1 meter between —183° and +16°, (cf. SCHEEL loc. cit. p. 19, note 1), a difference much greater than could be accounted for by the inaccuracy of the observations.

For an explanation of this discrepancy we call attention to the difference of the observations of Dec. 16 1904 and Febr. 3, 1905 in Table II of Comm. N°. 95^b, which give as length of the platinum bar provided with the two glass extremities, at 16° [1]) before it had ever been reduced to low temperature, 1027.460 m.m., and a long time after it had been reduced to low temperature for the last time, 1027.457 m.m., mean 1027.458 m.m., with that of Dec.19, 21 and 23 in the same table which yield the mean value 1027.441 mm. (from 1027.441, 1027.442 and 1027.440) for the length at 16°, which was observed on return to the ordinary temperature a day after

1) In Table II of this communication under $L_{16°}$ for the ordinary temperatures the length of the bar at 16° reduced on the measuring rod *at 16°* has been given and not the length at ϑ as in the tables of Comm. N°. 85.

the cooling. Indeed this former mean value is 17 μ larger than the latter.

Now this difference of 17 μ, which refers to a bar of platinum of 840 mm. (for a bar of 1 M. it would be 20 μ) exceeds the errors which may be ascribed to the inaccuracy of the observation by about half the difference which exists between SCHEEL's formula and our formula of June 1906.

As basis for the calculation of our formula the mean [1], of the two lengths has been taken. We arrive at values for the expansion nearer to those of SCHEEL when for the length at the ordinary temperature we take that which was found immediately after cooling, instead of the mean of this length and the length which was found long before and after the cooling, as was done in the calculation of our formula of June 1907. If we now make use of the first-mentioned length, that which was found immediately after cooling, in order to find the coefficients now distinguished by (a) and (b) from the former a and b in the formula:

$$l_t = l_o \left(1 + \left\{(a)\left(\frac{t}{100}\right) + (b)\left(\frac{t}{100}\right)^2\right\} 10^{-6}\right)$$

we find:

Platinum (— 183° to + 16°)	**(a)**	**877.7**	KAMERLINGH ONNES and CLAY (1905)
	(b)	**35.7**	
			whereas
	(a)	**861.5**	SCHEEL (1906)
	(b)	**37.0**	

It is true that the now remaining difference of 34 μ per M. with an expansion of — 183° to + 16° remains considerably larger than the accuracy of the observations would lead us to expect, but it is considerably smaller than that found originally, and taking into consideration the different sources of uncertainty whether we observe really what we think we observe, the small number of measurements, and the difference of the methods applied at low temperatures for the first time, it is not great.

We had hoped to obtain further information on the difference in length of our bar at ordinary temperature immediately after the cooling and long after it, but have not yet been able to do so.

Differences as the one discussed now have more occurred in our measurements. We have pointed this out in Comm. N°. 95^b and

1) In the calculations for the glass the values of the length immediately after the cooling, Dec. 23 in Table I, and April 15 and 16 in Table III, have been left out of account in connection with the further observations.

for glass we have expressly investigated the possibility of thermical hysteresis on cooling to the lowest temperatures. In connection with what has been said in Comm. N°. 95*b* we fear that for the above treated difference an irregularity in the behaviour of the place of fusion of the glass points to the platinum bar has played a part, to prevent which further experiments ought to be made with still greater care. If what we now think probable, is verified, observations in which a difference as the one considered just now, manifests itself, should be rejected.

Besides the formula of the second degree for temperatures below 0°, we have also calculated a formula of the third degree

$$l_t = l_0 \left[(1 + \left\{ (a') \frac{t}{100} + (b') \left(\frac{t}{100}\right)^2 + (c') \left(\frac{t}{100}\right)^3 \right\} 10^{-6} \right]$$

for the expansion of platinum between —183° and + 80° by the aid of BENOIT's observations from 0° to + 80°, in which formula (a'), (b'), (c') refer to the length at the ordinary temperature immediately after the cooling.

The agreement of

Platinum	+ 80° — 183°	(a′)	**875.3**	BENOIT and KAMERLINGH ONNES and CLAY (1905)
		(b′)	**31.6**	
		(c′)	**— 1.49**	
	+ 100° — 190°	(a′)	**874.9**	SCHEEL (1906)
		(b′)	**31.41**	
		(c′)	**— 6.94**	

is pretty satisfactory. Substitution of SCHEEL's values for those of BENOIT would bring about only a slight change in the first group of coefficients.

Anatomy. — "*On the Development of the Corpus callosum in the human Brain.*" By Prof. J. W. LANGELAAN. (Communicated by Prof. T. PLACE).

The points that at this moment seem of interest in the history of the development of the corpus callosum have been clearly formulated by RETZIUS [1]) in the form of questions. Two of these are: 1. Where does the corpus callosum originate? 2. Of what

[1]) RETZIUS. Das Menschenhirn. Stockholm 1896. p. 6.