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Physics. — "*Magnetic Researches. VIII. On the susceptibility of gaseous oxygen at low temperatures*". By H. KAMERLINGH ONNES and E. OOSTERHUIS. (Communication N°. 134*d* from the Physical Laboratory at Leiden.) Communisated by Prof. H. KAMERLINGH ONNES.

§ 1. *The susceptibility of compressed oxygen between* 17° C. *and temperatures near the critical temperature of oxygen.* In our last paper in connection with our investigations of various cases in which a molecular field of WEISS with opposite sign can be assumed with paramagnetic substances, we mentioned the continuation of the experiments by KAMERLINGH ONNES and PERRIER which have already been projected and the continuation of which may soon be expected, and which have for their object to investigate the influence, with oxygen, of bringing the molecules to various densities upon the deviations from CURIE's law. Working in the same direction, we have endeavoured to ascertain whether in gaseous oxygen below the ordinary temperature and above the critical temperature a Δ appears. For this purpose we have measured the susceptibility of oxygen between 17° C. and —126°.7 C. We used the attraction method in the same form as described for the paramagnetic salts in our previous paper. A copper tube, closed underneath, 10 cm. long, 8 mm. external and 6 mm. internal diameter, provided with a capillary tube above, by which it could be filled with oxygen under pressure, and closed, one time with a fine tap in which the capillary tube ended, another time by pinching this capillary, and then soldering up after it had served for filling, was filled with oxygen at ordinary temperature to 100 atmospheres. The experiment was then repeated with the evacuated tube in the same baths. For results. (see table I p. 1405).

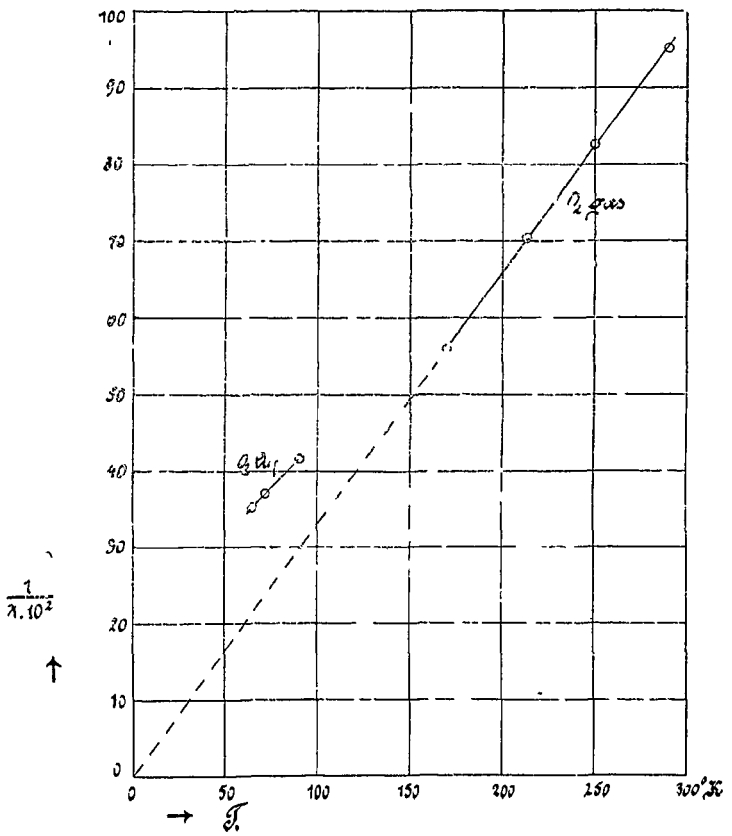
The experiments should be regarded as comparative for the question under consideration, but the absolute value of the susceptibility was also determined at 289°.9 K. It corresponds pretty well to that of WEISS and PICCARD. As manometer we used a metal manometer which was compared with a hydrogen manometer going to 120 atmospheres. The density of oxygen was taken from AMAGAT. χT appears to be constant, within the limits of accuracy (which is about 1 %) as far as the boiling-point of ethylene (169°.6 K.). The two points in ethylene, evaporating under reduced pressure, deviate a little, but this need not be considered as of much importance, as these temperatures were not accurately known. Moreover the proximity

of the critical temperature made the distribution of density in the tube uncertain.

We may draw the conclusion that within the limits of accuracy

TABLE I. Gaseous oxygen ($\rho_N = 100$)
$H = 10$ to 18 kilogauss.

T	$\rho . 10^6$	$\rho . T . 10^4$	Bath.
289°9 K.	105	304	In air.
249.7	121	302	Liquid methyl chloride.
212.1	142	301	
169.6	179	304	Liquid ethylene
[157.7	188	296]	
[146.6	201	295]	



in the measurements a Δ does not yet appear in oxygen above the critical temperature at densities which are 100 times the normal. From this it seems all the more probable that Δ only appears for oxygen at great densities, and in liquid oxygen can rise to the considerable value of 71° as the density rises to 1000 times the normal.

In the accompanying figure our observations concerning gaseous oxygen and those of KAMERLINGH ONNES and PERRIER which we confirmed in our last paper, are combined in a graphic representation; the uncertain points near the critical temperature are not given. The point of intersection of the line for gaseous oxygen with the production of the line for the liquid state, appears to have no physical meaning; as we supposed in our last paper, it is due to the value of the constants, that the temperature which indicates the intersection of these lines happens to be about the ordinary one, at which amongst others, the observations of WEISS and PICCARD fall, and below which as yet no observation had been made for gaseous oxygen.

(*To be continued.*)

Physics. — "*Further experiments with liquid helium.* H. *On the electrical resistance of pure metals etc.* VII. *The potential difference necessary for the electric current through mercury below* 4°.19 K." By Prof. H. KAMERLINGH ONNES. Communication N°. 133*a* and 133*b* from the Physical Laboratory at Leiden.

(Communicated in the meetings of February 22 and March 22, 1913).

§ 1. *Difficulties involved in the investigation of the galvanic phenomena below* 4°.19 K. In a previous Communication (No. 124*c* of Nov. 1911) we related that special phenomena appeared when an electric current of great density was passed through a mercury thread at a temperature below 4°.19 K., as was done to establish a higher limit at every temperature for the possible residual value of the resistance. Not until the experiments had been repeated many times with different mercury threads, which were provided with different leads chosen so as to exclude any possible disturbances, could we obtain a survey of these phenomena. They consist principally herein, that at every temperature below 4°.18 K. for a mercury thread inclosed in a glass capillary tube a "*threshold value*", of the current density can be given, such that at the crossing of the "threshold value" the phenomena change. At current density below the "threshold value" the electricity goes through without