a solution of the substance which decomposes the indican. The dried leaves of *Indigofera galegoïdes*, as also some other kinds of leaves with which experiments were made, were incapable of producing the decomposition, so that it appears to be a specific property of some indigo yielding plants. These researches, which proceed slowly, will be continued, as also those on the substance which on oxidation gives rise to indigo; this substance may also be extracted by carbon tetrachloride."

Finally in the recent "Verslag" for 1898:

"Investigations on the composition and properties of a red compound, which is obtained by evaporation of the chloroform solution of the liquid decompositionproduct of indican from Indigoferas which yields indigo, progress but little owing to lack of time. MARCHLEWSKI and RADCLIFFE (Chem. Centralbl. 1898, II, 204), consider indican to be the glucoside of indoxyl. The properties of the decomposition product which yields indigo on oxidation, and which has already been shown here not to be identical with indigowhite, agree, to some extent, well with those of indoxyl. Since Mr. HAZEWINKEL, Director of the Experimental Station at Klaten is occupied with this matter, I have not followed it further."

Physics. — Dr. E. VAN EVERDINGEN JR.: "*The HALL-effect and the increase of resistance of bismuth in the magnetic field at very low temperatures*" I (continued). (Communication N°. 53 (cont.) from the Physical Laboratory at Leiden, by Prof. H. KAMERLINGH ONNES.)

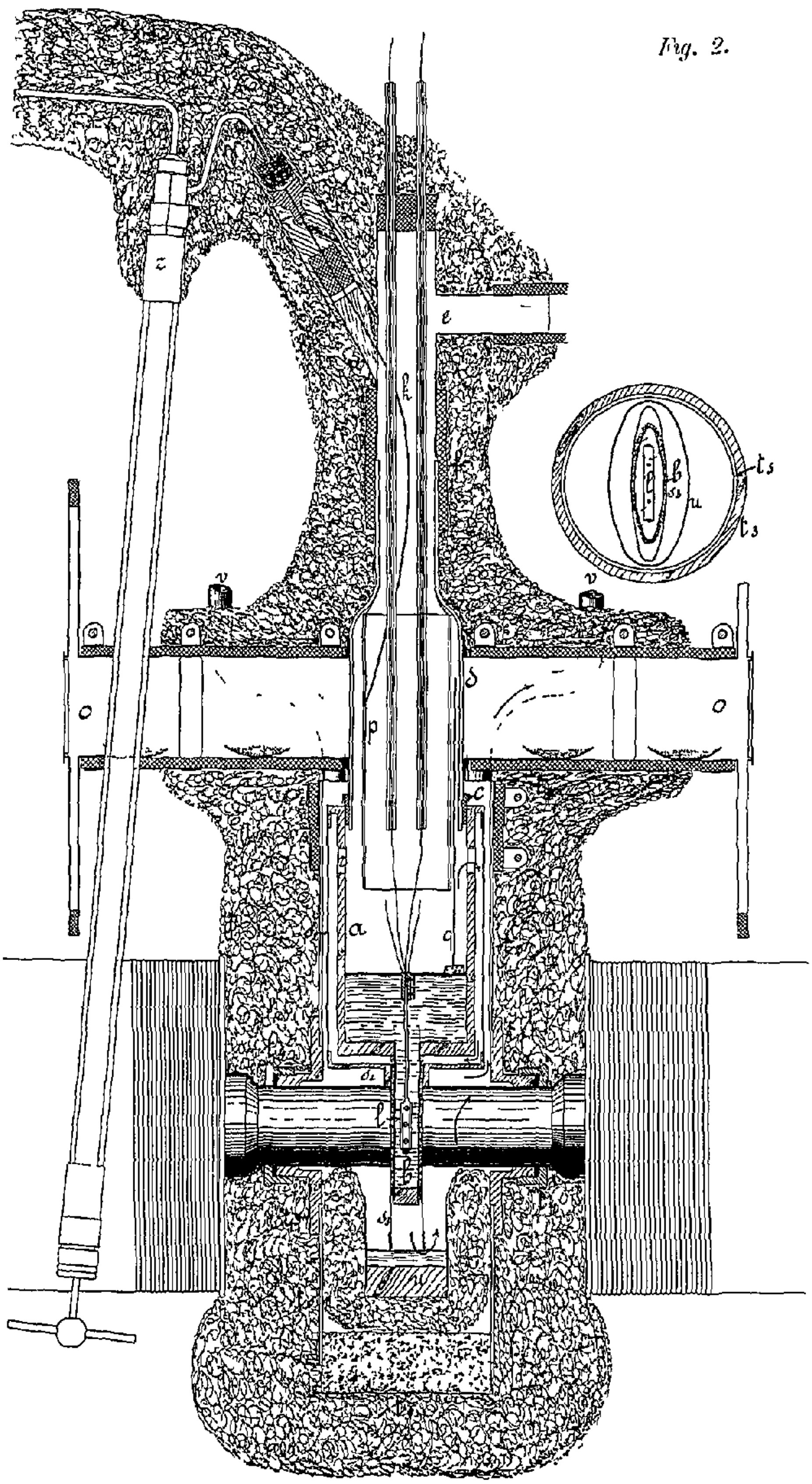
5. In the Proceedings of October 28, 1899, p. 221, I expressed the hope that the measurement of the HALL-effect at the boiling-point of liquid oxygen would yield a more decisive answer to the question as to whether or no this phenomenon has a maximum at low temperatures. This measurement has now been made, though as yet only for one strength of field, and the answer is certainly a decided negative, as will appear from § 7.

6. *The liquid oxygen bath.* For pouring out the liquid oxygen we used the vessel without a vacuum-wall, described and drawn in § 2 of this communication, but somewhat altered for this purpose after the manner of Prof. KAMERLINGH ONNES' cryostat [1]). Besides

[1]) See Communication N°. 51, Proc. 30 Sept. '99. p. 126. Comm. Phys. Lab. Leiden N°. 51, p. 3.

E. VAN EVERDINGEN Jr. The HALL-effect and the increase of resistance of bismuth in the magnetic field at very low temperatures. (I) continued.

Fig. 2.



lengthening the wooden receptacle *a* and the glass tube *d*, a double jacket was added to lead off the cold vapours, which in this manner largely screen the liquid from heat. Moreover observing-glasses were used to watch the liquid streaming out.

The whole apparatus is drawn in fig. 2, whilst fig. 1 may serve to further elucidate it. The lengthened wooden receptacle *a*, the paper vessel *b* the caoutchouc-ring *c*, the glass-tube *d*, the T-piece *e*, the caoutchouc-tube *f* and the plate carrier *l* were mentioned in § 2 of this paper. The steel capillary tube *k* is now introduced into the T-piece through the oblique side tube *w*, from which it is wholly insulated by means of wood and caoutchouc, the horizontal side-tube now leading towards a safety-tube immersed in mercury. The supply of liquid oxygen from the oxygen-spiral in the ethylene boiling flask [1]) can be shut off by the cock [2]) *z*, by means of a long wooden stem; before entering the capillary tube the liquid passes through a small filter. The tube *k* ends in front of the observing-tubes [3]) *o*, which are fastened by means of a copper case and sealing-wax to the tube *d*; the jet of liquid meets a jet-catcher [4]) *p* suspended by means of fiddle strings to *d*, and spreads out in a fan over this tube. In order to indicate the level of liquid in *a*, a float *q* with a stem was used, which latter ends at the level of the observing-glasses.

The cold vapours leave *a* through the holes *r*, six in number, and stream downwards in the annular space between *a* and *b* on one side and the jacket s_1—s_3 on the other side. s_1 is a circular cylinder of compressed paper, fastened to the border of *a*, s_2 a wooden bottom with an oval hole, into which an oval cylinder of paper s_3 has been glued; the minor axis of this is only a little wider than *b*, but sufficient space is left along the major axis for the vapour to escape [5]). The latter then rises in the space limited by the jacket $t_1 \ldots t_6$. t_1 is a copper rim, joined to the case of the observing-tubes and fitting on the glass-cylinder t_2, to which it is fastened by means of a caoutchouc-tube and brass tightening bands. t_3 is a wooden cylinder with holes provided with flanges to admit the pole-pieces; a tight fit is obtained here by means of a leather washer, screwed on by the wooden nuts t_4. t_5 is again a glass-cylinder and t_6 a cork stopper. In order to prevent the cold vapours

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1) Proc 29 Dec. '94, p. 172. Comm. N°. 14, p. 17.
2) See Communication N°. 51. Proc. 30 Sept. '99, p. 129, Comm. N°. 51, p. 9.
3) ib. p. 130. Comm. N°. 51, p. 10.
4) ib. p. 127, glass *C*. Comm. N°. 51, p. 5.
5) See transverse section, drawn in the figure on the right hand side of *e*.

from flowing immediately to the bottom and to diminish the conduction of heat from below, another little vessel u of compressed paper with a wooden bottom has been placed under and around s_3. The space left beneath the pole pieces has been filled up with wool. In the rim t_1 six holes have been made, connected with the copper tubes v, four of which lead off the gaseous oxygen, whilst two have been shut with a stopper and serve as a safety arrangement.

In order to obtain the room wanted for these jackets between the coils of the electromagnet, it was necessary to considerably lengthen the pole-pieces. For weak currents this did not much diminish the strength of the field; for strong currents the loss was considerable.

During the experiment all parts of the apparatus except the observing-glasses were wrapped in wool. The receptacle a was completely filled with liquid oxygen, and as an additional precaution liquid was even allowed to flow out until a considerable quantity had passed through the holes r and had collected in u. The apparatus stood this well; especially the compressed paper, which appears to be a very suitable material for this work.

7. *The* HALL-*effect at the boiling point of liquid oxygen.*

For the HALL coefficient R in a magnetic field of 4400 C. G. S. units the value **41,4** was found. Hence the product RM is **182000**. Before, at a temperature of 10° C., R was found to be 11,0. This does not wholly agree with the value 10,15, which may be obtained by interpolation from the table given in § 3 of this paper for the field 4400 and the temperature 10° C. Recently PERROT [1]) has noticed, that the thermo-electric constants of crystalline bismuth showed irregular variations with time, which he at first was inclined to ascribe to the influence of repeated heating and cooling; this however appeared later [2]) not to be the case. In order to see whether perhaps something of that kind really happened in consequence of the strong cooling in my experiments, I repeated the determination of the HALL-coefficient R at 10° C. shortly after the experiment in liquid oxygen, and found 11,1. The difference from the value of R 11,0, determined immediately before the experiment is too small to be worth attention. As formerly I have also not noticed continuous variations with time in electrolytic bismuth, I think we

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1) Arch. d. Sc. phys. et nat. (4) 6 p. 105 and 229, 1898.

2) 〃 〃 〃 〃 〃 〃 (4) 7 p. 149, 1899.

must rather describe the difference between the values found now and formerly to an uncertainty in the knowledge of the resistance in the circuit of the HALL-current [3]), which is required for the calculation of R. For, as the variations of this resistance appeared only after some time, the resistance was not measured during the experiments of the first determinations in § 3. With the determinations now published the resistance was measured twice during the experiment and was found to be constant. Therefore we retain the value 11,0 for 10° C.

The value at — 90° C. for a magnetic field of 4400 is found by interpolation to be 17,1 and is for the same reason not quite certain.

T_{abs}	R	$\frac{C}{T}$	$C'r$
283	11,0	11,0	11,0
183	17,1	17,0	12,7
91	41,4	34,2	22,2

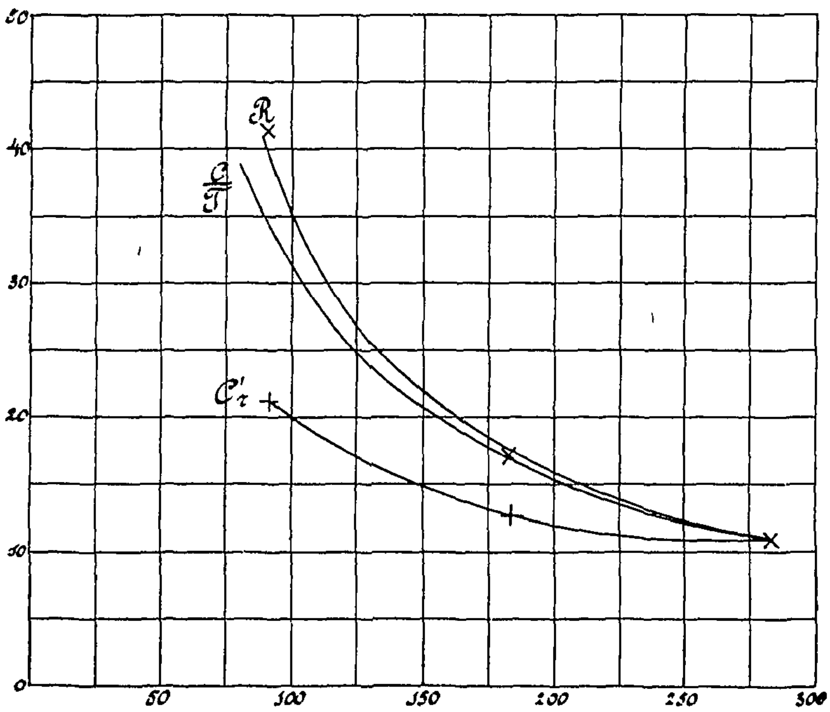

Fig. 3.

³) See § 3.

This however interferes little with the value of the following, in which for the sake of comparison besides the absolute temperatures T and the corresponding values of R the values $\frac{C}{T}$ are also given, where C has been chosen so as to make the value at 10° C. equal to 11,0. Further in the values $C'r$, where r represents the resistance of electrolytic bismuth in a field of 4400 C.G.S. units, taken from observations by FLEMING and DEWAR [1]), C' is likewise chosen to make the value 11,0 at 10° C.

Fig. 3 gives a graphical representation of these numbers. It is evident that the HALL-coefficient increases much more rapidly than the resistance and a little more rapidly than $\frac{C}{T}$. Hence no evidence of an approach towards a maximum can be found.

In order to give a clearer view of the meaning of a HALL-coefficient 41,4 we will calculate the tangent of the angle through which the equipotential lines were turned in this experiment. For this it is necessary to know the resistance of the bismuth at — 182° C. in the magnetic field. As this resistance has not yet been measured for the plate, we take as a preliminary value $2{,}46.10^5$, taken from FLEMING and DEWAR. We then find for the tangent the value **0,740.**

For the sake of comparison a list is appended of the values of this tangent for some of the metals with the largest HALL-coefficients, all of them for a magnetic field of 4400.

Bismuth	— 0,740
Nickel	— 0,083
Antimony	+ 0,021
Tellurium	+ 0,017
Iron	+ 0,004

As it may safely be assumed, that the HALL phenomenon has never been observed in a field of greater intensity, higher than 20.000 C. G. S. units, it appears that the value 0,740 is the largest ever obtained.

[1]) Proc. Roy. Soc. 60 p. 73, 1896.

(January 24, 1900.)