On the distribution of temperature in the conducting-wire of a galvanic current

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doubtless be very mediocre, especially on account of the sparks given by the commutators. We constantly employ here, as a source of electricity, an excellent Gramme machine moved by steam-power. This machine consumes only one horse-power, and produces a light equal to 100 Carcel burners, quite sufficient for all lecture-experiments.—*Comptes Rendus de l'Académie des Sciences*, May 14, 1877, tome lxxiv. pp. 1084, 1085.

ON THE DISTRIBUTION OF TEMPERATURE IN THE CONDUCTING-WIRE OF A GALVANIC CURRENT. BY HEINRICH STREINTZ.

If a galvanic current is led through a wire, the temperature of the wire rises until the stationary condition enters—until, namely, in every corporeal element of the wire exactly as much heat is excited as is carried off through the surrounding particles to the surface and through this into the environing medium.

Leaving out of consideration the ends of the wire, the calculation is a problem of the plane. If k denotes the conducting-power for heat, u the temperature at any point of the cross section, the expression

$$k \left(\frac{d^2 u}{dx^2} + \frac{d^2 u}{dy^2} \right) dx dy dt$$

represents the amount by which the heat brought to a surface-element from the circumjacent elements exceeds that which is carried away.

According to Joule's law, the quantity excited during the same time by the galvanic current is

$$wi^2 dx dy dt.$$

For the stationary state the sum of the two expressions must be equal to *nil*; hence

$$\frac{du^2}{dx^2} + \frac{d^2 u}{dy^2} + J = 0; \quad J = \frac{wi^2}{k}.$$

As integral of the equation, we obtain

$$u = A - \frac{J}{4} r^2 + B \log nr.$$

Since, for obvious physical reasons, B must be $= 0$, only A remains to be determined. Given the surface-temperature τ of the wire, and calling its radius a , then

$$u = \tau + \frac{J}{4} (a^2 - r^2). \quad \dots\dots\dots (I.)$$

But if for τ the coefficient of the *external* heat-conducting power H be substituted, the condition-equation

$$\left(\frac{du}{dr} \right)_{r=a} + h(u - U)_{r=a} = 0, \quad h = \frac{H}{a},$$

is added, in which U denotes the temperature of the surrounding medium, and we obtain

$$u = U + \frac{J}{2h} a + \frac{J}{4} (a^2 - r^2). \quad \dots\dots\dots (II.)$$

For the numerical calculation, h and J must be known. But J , originally expressed by resistance, current-intensity, and conducting-power, can also be expressed by h and the surface-temperature attained; for from the comparison of equations I. and II. it follows that

$$J = \frac{2h}{a}(\tau - U).$$

I determined h by experiment thus: through a thick-walled brass tube I caused hot water of a known temperature to flow, and observed the temperature on the outer surface of the mantle. Theory gives for this case

$$h = \frac{\tau_2 - \tau_1}{c_1(\tau_1 - U)(\log \text{nat } c_1 - \log \text{nat } c_2)},$$

in which τ_1 and τ_2 denote the temperatures, c_1 and c_2 the radii, of the outer and inner circumferences; and then the result of the observations is

$$h = 0.00078.$$

For a brass wire it can now be calculated how much the temperature at the centre is higher than that at the surface; and when $a = 0.25$ millim., $\tau = 55^\circ.5$ C., $U = 18^\circ$ C., we get

$$u_c - \tau = 0^\circ.0037 \text{ C.}$$

Without making further observations, the temperature-difference can now be calculated for other wires also.

In conclusion, I must not omit to mention that Edlund, in the May Number of Poggendorff's *Annalen*, has also given a calculation of the distribution of temperature in a galvanically heated wire; his deduction, however, proceeds quite differently from that here given; the equations obtained are not so general, and the numerical data are based on experiments of another kind than those I have employed; so that I had no hesitation in making public my investigations, which were ready before the appearance of Edlund's memoir.—*Auszug aus dem am 12. Aug. 1876 der Redaction von Pogg. Ann. d. Phys. u. Chemie eingesandten Manuscripte.*

ON THE SPECIFIC HEATS OF GASES.

To the Editors of the Philosophical Magazine and Journal,

GENTLEMEN,

Mr. Burbury has pointed out to me a mistake in my paper on dissociation in the June number of the *Philosophical Magazine* which is important. On page 415, the sign of I should be changed. This will affect the ratio of the specific heats given on p. 417; in the first case $\frac{c'}{c}$ will be 1.585 instead of 1.609, and in the second 1.338 instead of 1.423. Consequently the reasoning at the end of § 20, which depends on these ratios, will be invalidated. If the quantity I were positive, as in the paper, we should get gases cooling when they combine, or passing from one state into a less stable state.

I am, Gentlemen,

Yours truly,

W. M. HICKS.