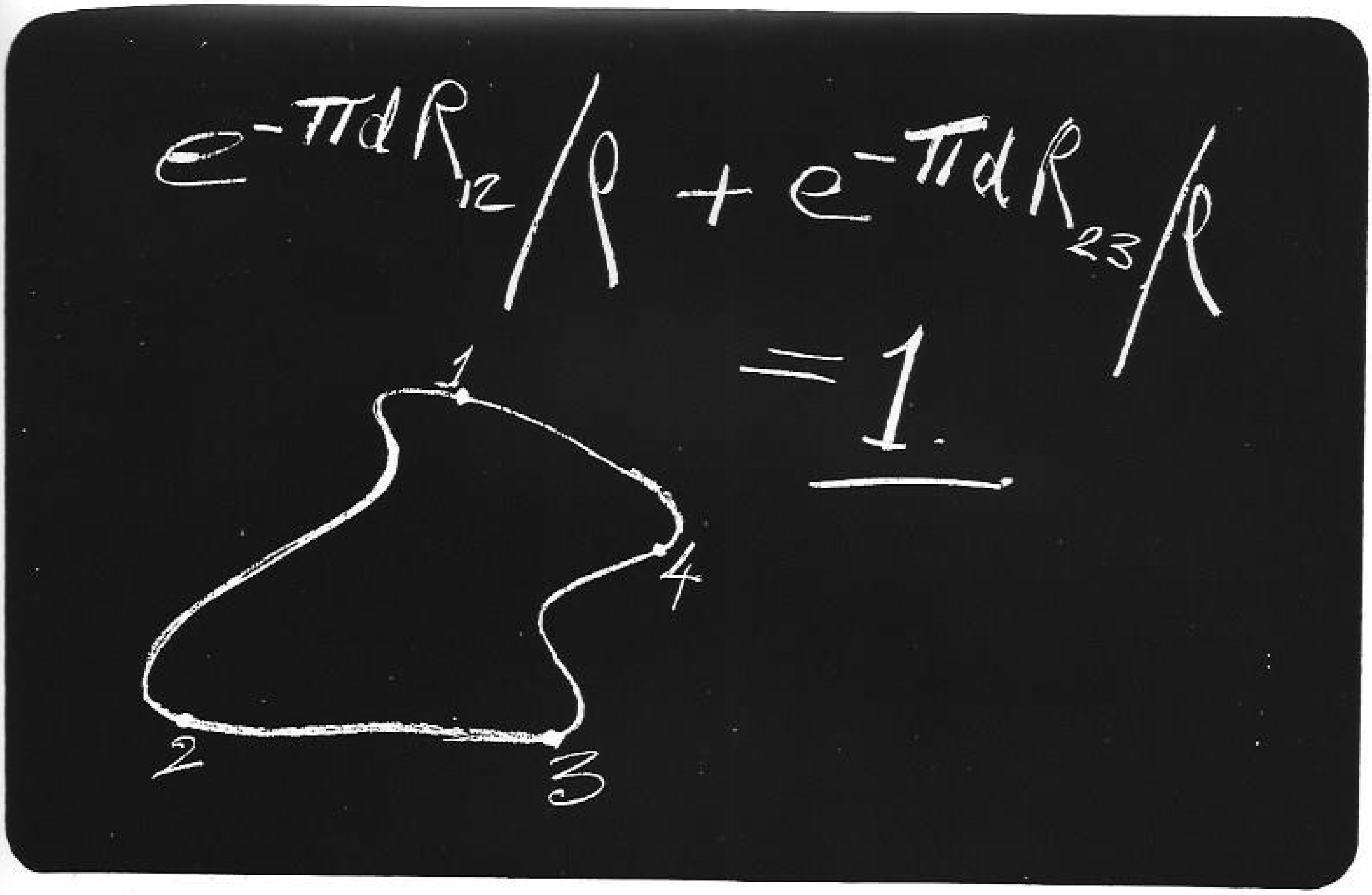

Ohm's Law - 1966

It's called van der Pauw's theorem. And in my opinion, it is a most striking example of how a rather sophisticated piece of mathematics led to an extremely practical result. Why? Because of its outstanding elegance and simplicity. Before van der Pauw came along, the determination of specific resistivity - especially in the case of semi-conductors - while not exactly difficult, was a time-consuming and lengthy procedure. The best procedure available was to grind cylindrical or prismatic rods and to determine accurately both length and cross section.

Van der Pauw, on the other hand, showed that it is possible to measure the specific resistivity of a flat sample of constant thickness but otherwise arbitrary shape merely by placing four small contacts (1, 2, 3, 4) on the circumference. Then if we define R_{12} as the ratio of the voltage between 1 and 2, and the current between 3 and 4, and similarly R_{23}, we have:

$$e^{-\pi d R_{12}/\varrho} + e^{-\pi d R_{23}/\varrho} = 1 .$$

where d is the thickness of the sample.

Let me indicate the proof. First take an infinite half plane. Then all potentials are logarithmic and the proof is elementary. Next map conformly to obtain the desired contour and remember that resistance is a conformal invariant. That's all. Very simple once you begin to think about it - which apparently no one did before van der Pauw. And very useful; one measures two resistance values and reads ϱ/d from a set of curves. We not only apply this in the research laboratories, but also in our factories to test specific resistance.
Incidentally, if you would like the complete proof of van der Pauw's work, send for Philips Technical Review vol. 13, No. 1. It's called "A Method of measuring specific resistivity and Hall Effect of discs of arbitrary shape". I think you'll enjoy it.

Part of a talk given by
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