



The phenomenon called the “cry of tin”

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does in the circuit in a time t , is $C^2(R_1 + R_2)t$; of which an amount C^2R_1t is done inside the cell, and the balance C^2R_2t outside. This latter amount is necessarily equal to the product of the quantity of electricity passing, Ct , into the difference of potential between the ends of the external resistance, which latter quantity is E_2 ; that is,

$$C^2R_2t = E_2Ct.$$

Hence

$$E_2 = CR_2 = \frac{R_2}{R_1 + R_2} E_1;$$

or, E_2 is less than E_1 by an amount which is the greater the larger is R_1 in reference to R_2 : if $R_1 = R_2$, $E_2 = \frac{1}{2} E_1$. In Mr. Shida's experiments R_1 was 2.02 ohms, whilst R_2 was successively 80.86, 110.86, and 130.86 ohms, averaging 107.53 ohms. The mean electrostatic value obtained by Mr. Shida was consequently nearly 2 per cent. too small; so that the value of v finally deduced by dividing the electromagnetic value by the electrostatic value must have been just as much in excess of the truth.

THE PHENOMENON CALLED THE "CRY OF TIN."

BY J. C. DOUGLAS.

If a piece of tin be bent it emits a sound; this, being regarded as a property peculiar to tin, has been termed "the cry of tin." This phenomenon is explained by the peculiar crystalline structure of the metal. If the explanation be the true one, then other metals which are obviously crystalline in structure should also exhibit the phenomenon under favourable conditions. But it is exceedingly difficult to place other metals in a crystalline state under proper conditions; *e. g.* cast iron and cast zinc in thin rods break before they can be bent sufficiently to emit audible sounds, while rolled zinc has had its crystalline structure destroyed by rolling, and so is not in a condition to emit sound when bent. Rolled zinc is very tough as compared with cast zinc; and its fracture is not crystalline, but of an even fine-grained bluish tint destitute of the brilliant lustre presented by this metal in a crystalline state. If, however, a piece of rolled zinc be heated for a few minutes to a temperature somewhat below its melting-point, the metal becomes much less tough, and its fracture is decidedly crystalline. On bending a piece of zinc so treated it emits a sound weaker than, but of the same nature as, the sound emitted by tin. Cast zinc cannot be bent readily; but if it be pinched between the teeth or with pliers it emits the sound distinctly.

It appears, therefore, that the cry of tin is due to crystalline structure, that it is not characteristic of tin as generally accepted, but may be emitted by zinc and probably by other metals when crystalline in structure; that rolling in the case of tin and zinc, and probably in other cases, destroys the property with the alteration of texture; that, in the case of zinc which has been rolled, the crystalline texture may be produced without melting the metal but by merely heating it, and this is so readily done that it affords a ready illustration of the effects of high temperature on rolled

metal. If, as supposed, this sound is characteristic of the crystalline structure of metals, it may afford a means of great practical use, whereby, by the sound a metal emits, we may draw conclusions as to its texture, and hence its fitness for certain purposes; or by the sound emitted by a beam when bent we may draw conclusions as to its safety, the microphone or other appliance being called in to aid us where the sounds are exceedingly weak.—*Proceedings, Asiatic Society of Bengal, February 1881, communicated by the Author.*

DISCUSSION OF THE THEORY OF THE THREE FUNDAMENTAL
COLOUR-SENSATIONS. BY A. ROSENSTIEHL.

The notion of the three fundamental colour-sensations arose from the study of the properties of the eye which is imperfectly organized in regard to the perception of colours. The theory which connects the observed phenomena leads to an hypothesis on the structure of the normal eye.

But since Maxwell's experiments* on the solar spectrum, more than twenty years since, this subject has not again been the object of any investigation, the experimental method for studying the laws of colour-vision upon the normal eye being wanting. By determining, with the aid of rotating disks, the distribution of the complementary colours in a chromatic circle, I believe I have supplied that deficiency. The position of the three colours corresponding to Young's fundamental sensations has been thereby determined with much more precision than was hitherto possible. Young's theory receiving from this fact a support which takes it out of the domain of hypothesis, it has appeared to me useful to discuss its consequences, and to point out those which are susceptible of exact experimental verification. It will follow from this discussion, on the one hand, that certain properties attributed to the primary colours do not belong to them exclusively, and, on the other, that their true distinctive character has not yet been enunciated.

The primary colours (that is, those corresponding to the fundamental sensations) possess, by their very definition, the following properties :—

1. *On being mixed two by two, they produce all the colours perceptible to our eye.*

This property belongs to all the colours which are not complementary; but at the same time the sensation of white will be produced; so that the following limiting condition must be added :—

They produce at the same time the sensation of white in a less degree than the other colours.

I have already, indirectly, made use of this very important character†. Its experimental verification, however, presents great practical difficulties, because the quantity of white light emitted by a coloured surface cannot be measured with precision. It would be necessary to execute a chromatic circle with all its colours of

* Proc. Royal. Soc. vol. x. pp. 404-409 (1860).

† *Comptes Rendus*, t. xcii. p. 357; *Phil. Mag.* April 1881, p. 305.