$$\alpha(V)\,\alpha(-V) = 1 - V^2/c^2.$$

The simplest values of α are $(1 + V/c)$, $(1 - V/c)$ and $(1 - V^2/c^2)^{1/2}$. The Lorentz–Einstein relative velocity formula is independent of α, and so experiments which are interpreted on this formula cannot be used to choose a suitable value of α. As a preliminary, however, phenomena requiring simple kinematics have been treated. A direct explanation of the Doppler effect gives $\alpha = 1 \pm V/c$ rather than $(1 - V^2/c^2)^{1/2}$.

With this value for α the formula for stellar aberration is derived. Instead of the usual $\sin \delta\theta = \frac{V}{c} \sin \theta$, it is found that

$$\sin \delta\theta = \frac{V}{c} \sin \theta\,(1 + \cos \theta).$$

There is a large discrepancy in these formulæ when θ is near $\pi/3$, and it is suggested that an experimental check should be made.

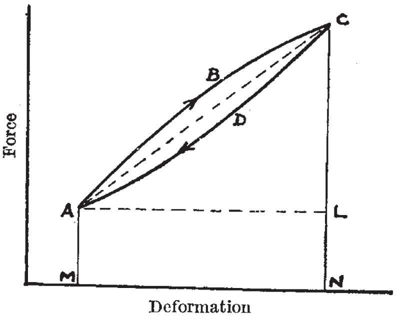
The transformation equations can be generalized without much difficulty and give at once the general Doppler formula.

R. Capildeo

University College,
London, W.C.1.
May 26.

Hysteresis in Rubber

In the discussion following a recent series of lectures given in the University of Nottingham on the dynamic properties of rubber, it became evident that the methods of specifying and measuring the amount of hysteresis in rubber are subjects of controversy. Two terms in current use for specifying hysteresis are 'percentage damping' and 'resilience', as defined in the accompanying diagram.



$$\text{Percentage damping} = \frac{\text{area } ABCD}{\text{area } ABCL} \times 100$$

$$\text{Resilience} = \frac{\text{area } ADCNM}{\text{area } ABCNM} \times 100$$

Resilience is thus the ratio of energy output to energy input during one complete cycle, but the physical significance of the term percentage damping is more obscure. The two terms are complementary only if the loop starts from zero strain. Resilience is generally measured by means of a rebound pendulum in which the cycle starts from zero strain, and as a result resilience and percentage damping are almost universally considered to be complementary. It should be stressed, therefore, that when a cycle is superimposed on a static strain, the terms are no longer complementary. Such cycles can be recorded on a Roelig machine[1] and also on the machine in use at this University, details of which are in course of publication. Investigations carried out with this machine show that the hysteresis loop changes in slope and area as the static strain is varied. This means that resilience at zero static strain cannot be converted to resilience at some finite static strain simply by including an additional area such as *ALNM*. Resilience or percentage damping must therefore be measured under the conditions in which the rubber is to be used.

It has also been found that resilience is very much a function of both frequency and amplitude. The latter result means that the use of a rebound pendulum to measure resilience is fundamentally unsound, though the figure obtained from such an instrument may not be much in error.

As to the relative merits of the two terms resilience and percentage damping, the former gives a figure of considerable practical importance, and is therefore likely to appeal to the rubber user. One unfortunate feature, however, is that the rubber technologist has given the term resilience a meaning different from that given by engineers. The latter consider resilience as the energy stored in a material in the strained state.

For comparing the mechanical behaviour of two rubbers, or of one rubber under different conditions, the term percentage damping is better, since it will reveal small differences which would be masked by using resilience. That is, a small change in the area of the hysteresis loop results in a much smaller percentage change in resilience than in the term percentage damping. It should be stressed, however, that the term percentage damping as defined by Roelig[2] is the ratio of the area of the loop to the area *ABCL* and not to the area of the triangle *ACL*. Roelig, in his earlier paper[1], used the area of the triangle, and many investigators since have followed this practice. The use of the triangle has several drawbacks and can lead to much ambiguity when the ends of the loops are very rounded or when the major axis of the loop is curved.

D. M. Davies

Engineering Department,
University of Nottingham.
May 12.

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[1] Roelig, H., Proc. Rubber Tech. Conf., 821 (1938).

[2] Roelig, H., *Rubber Chem. and Tech.*, **18**, 62 (1945).

'Detectivity': the Reciprocal of Noise Equivalent Input of Radiation

There is a perfectly sound and well-known way of stating the ability of a radiation detector to detect weak signals. One simply states the amount of input radiation that produces a steady electrical output equal to the root-mean-square noise voltage, under conditions of measurement that are stated adequately. But unfortunately the noise equivalent input suffers from a crippling psychological defect: it is upside down—the better detector has a lower noise equivalent input.

Because of this psychological defect, one frequently hears the relative performance of detectors described by a statement such as: 'Detector *A* has a better signal-to-noise ratio than detector *B*'. This use of