The derivation and a fuller discussion of the erosion equation will be given elsewhere.

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Heat Treatment of Sodium Chloride Windows to Increase Resistance to Atmospheric Action

INFORMATION has recently been obtained from Germany regarding a process used there for heat treatment of optical components made of sodium chloride.

The process consisted in heating the finished components for a few hours at 500° C. The firm believed that the treatment caused a surface flow, resulting in the removal of microscopic scratches left by the polishing process. The resulting smoother surface offered less opportunity for the etching action of water vapour when the components were exposed to a damp atmosphere in the laboratory. It was stated by the firm, however, that the optical perfection of figure was in some degree spoilt, but that it remained good enough, for example, for prisms used in infra-red spectroscopy.

The above information has been verified by simple experiments carried out here. These experiments indicate a substantial improvement in resistance to atmospheric corrosion. No attempt has been made to work out in detail the best conditions of heat treatment to get a suitable compromise between resistance and loss of figure, but the method is believed to be valuable. Attention is directed to the phenomenon in case it should be thought worthy of further investigation.

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Determination of the Frequency of Flexural Vibrations of Reeds by a Lissajous Figures Method

IN a recent paper[1], I described a method for determining the frequency of lateral vibrations of thin rods by measuring the time for one quarter of an oscillation. The application of the method is limited to hard metals. A more simple, more accurate and more general method of measuring the frequency of transverse vibrations of any material obtainable in the form of a wire or a thin strip can now be described.

A short filament of the material is clamped horizontally from one end and placed close to a thick sonometer wire carrying at its mid-point a small lens facing the free end of the filament, which can vibrate in a plane at right angles to the plane of vibration of the lens. A bright point at the tip of the test material is viewed through the lens. The filament is excited by a gentle touch on the massive clamp, and at the same time the sonometer wire is excited by plucking. Lissajous' figures will be observed. The length and/or the tension of the sonometer wire is adjusted until a practically stationary pattern is seen, from which the frequency ratio is determined. If the figure is a loop (which must not be confused with the loop traced by the free end of a vibrating wire having a circular cross-section), the ratio is 1 : 1. The frequency of the sonometer wire is then measured in the usual acoustical way with the aid of an auxiliary wire and a known tuning fork. An accuracy of 1 per cent can be easily obtained.

As the frequency of the adjustable vibrator approaches the natural frequency of the filament, the latter may be thrown into resonant vibrations if the damping is small, and at this stage independent excitation of the filament is usually unnecessary. At exact resonance, the Lissajous' pattern is most stationary. From a knowledge of the frequency, the density and the dimensions, Young's modulus can be evaluated for a length of about 1 cm. of a glass fibre or a phosphor-bronze suspension strip.

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Soap Bubbles in Reverse

WHEN sulphuric acid sodium sulphate solution containing surface-active material is dropped into water, bubbles approximately 5 mm. in diameter sinking through water may be observed. Such bubbles are spherical shells of air, with a sphere of acid sodium sulphate within and water outside. They are, in fact, soap bubbles in reverse. Instead of a two-surfaced film of soapy solution in air, these have a two-surfaced film of air in soapy solution. Moreover, like the ordinary soap bubble, they show interference colours.

In a typical case, the bubble forms, but may or may not sink; it depends on the density of the entering liquid, which has to be sufficient to overcome the buoyancy of the air shell, if the bubble is to sink. If the density is sufficient and the bubble sinks, it can be seen to burst on reaching the bottom. When this happens, there is a swirl of liquid as the two dissimilar liquids mix, and a tiny true bubble, a mere fraction of the original size, shoots up to the surface.

The conditions which allow these bubbles to form are those which cause sessile droplet formation[1]. It is believed that these reversed soap bubbles are sessile droplets which have penetrated the surface film, so that air closes around the drop. If this be true, it may be possible to calculate the dimensions of the air film between a sessile droplet and the under-layer, either by measuring rates of fall of these special bubbles, or by measurements involving the bubble colours.

The following conditions are suitable: a solution of 10 per cent sulphuric acid, 20 per cent sodium sulphate, 0·50 per cent cetyl pyridinium bromide. This is dropped from a height of 18 in. into water, in the form of coarse drops. At first few bubbles form, which may mean that it is necessary to have surface active material in both liquids. After a time they become fairly frequent. The largest bubble I have observed has been 10 mm., but most are 1–5 mm.

Other surface active materials may be used as well. In addition to the one given, which is a cation-surface-active substance, isopropyl naphthalene sulphonic acid (anionic), and cetyl polyglycol ether (non-ionogenic), have been used with success.

I believe that this phenomenon is more widespread than might be thought. The accident of using a high-density solution, causing the bubbles to sink, directed my attention to them. Since then, I have seen bubbles in different circumstances which appear to rise more slowly than their size warrants. Perhaps the 'soap bubble in reverse' is as common as its more obvious congener.

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Interpolation Schedule for the Lagrange Formula

THE Lagrange interpolation formula is particularly valuable when it is desired to interpolate (or extrapolate to a moderate extent) into a series in which the independent variable moves in unequal steps. The formula takes the form

$$Y = \frac{(X - x_2)(X - x_3)\ \ldots\ (X - x_n)}{(x_1 - x_2)(x_1 - x_3)\ \ldots\ (x_1 - x_n)}\, y_1 + \frac{(X - x_1)(X - x_3)\ \ldots\ (X - x_n)}{(x_2 - x_1)(x_2 - x_3)\ \ldots\ (x_2 - x_n)}\, y_2 + \ldots$$

where y takes on values $y_1, y_2, y_3 \ldots y_n$ for values of x of $x_1, x_2, x_3 \ldots x_n$ and the value of $y = Y$ for $x = X$ is desired to be interpolated.

This formula is rather formidable, the main difficulty being in computing the coefficients of $y_1, y_2 \ldots y_n$, in that, when handling the large number of subtractions involved, it is particularly easy to introduce errors.

An interpolation schedule described by Dale S. Davis[1] goes a long way towards systematizing the operations involved, but still leaves room for error, since the numerator and denominator units of the coefficients are computed from separate tables, the coefficient formed and finally multiplied by the appropriate value of y. There is thus some risk of incorrectly selecting the numerator, denominator and y-values. A slight modification of the Davis schedule has been devised which may be of value to those employing this interpolation formula and is particularly suitable for use with a slide rule.

Let y take on the values y_1, y_2, y_3 and y_4 for values of x of x_1, x_2, x_3 and x_4. It is desired to find the value of $y = Y$ when $x = X$. A table is drawn up as shown herewith.

y	x	x_1	x_2	x_3	x_4	+	−
y_1	x_1		$X-x_2$ / x_1-x_2	$X-x_3$ / x_1-x_3	$X-x_4$ / x_1-x_4		
y_2	x_2	$X-x_1$ / x_2-x_1		$X-x_3$ / x_2-x_3	$X-x_4$ / x_2-x_4		
y_3	x_3	$X-x_1$ / x_3-x_1	$X-x_2$ / x_3-x_2		$X-x_4$ / x_3-x_4		
y_4	x_4	$X-x_1$ / x_4-x_1	$X-x_2$ / x_4-x_2	$X-x_3$ / x_4-x_3			

First come two columns representing the values of y and x respectively. Then come four columns headed by the values of x respectively. Finally come two columns headed by the signs '+' and '−' respectively. The 16 cells formed by the values x_1, x_2, x_3 and x_4 occurring as columns and rows are divided diagonally from left up to right, and the single main diagonal from left down to right is also inserted. The method of filling in each half-cell will be clear from the table—in the upper half of each cell is placed the difference between X and the values of x occurring as column headings, while the lower halves contain the difference between the values of x occurring as row headings and the value of x occurring as column headings. Cells containing both diagonals are left blank. The slide rule is now set at the value y_1, multiplied by $X - x_2$, divided by $x_1 - x_2$ (first cell in the y_1 row), multiplied by $X - x_3$, divided by $x_1 - x_3$ (second