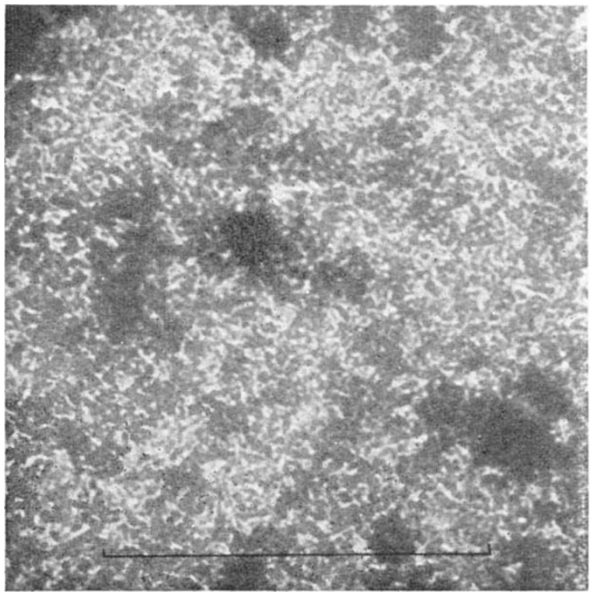

Fig. 3. Crystalline iron oxide. Scale, 1μ

apparent oxide at all. It is considered that the detailed structure of the oxide film is of importance in deciding where corrosion will start and how it will continue when the metal is exposed to air or water.

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Failure of Stainless Steel by Intergranular Decohesion during Creep

In an experiment where some stainless-steel tubes had been ruptured by internal gas-pressure, failure was observed to have occurred by the nucleation, growth and impingement of intergranular cavities. An attempt has been made to relate this failure-mechanism with the observed dispersion in life-to-rupture. The tubes were of double vacuum-melted 20Cr–25Ni-niobium-stabilized stainless steel. Their nominal dimensions were 0·40 in. bore diam. × 0·015 in. wall thickness: they were made by extrusion and cold-drawing followed by external grinding. About 120 cap-ended lengths of the tubing were internally pressurized with 1,750 lb./in.^{2} argon ($\sigma_\Theta = 2\sigma_z$) at 650° C in an atmosphere of carbon dioxide + 10 per cent carbon monoxide and their lives-to-rupture measured. Optical metallography revealed that intergranular decohesion had been nucleated at many sites and had spread until rupture was complete. A process-rate model of decohesion was constructed and this led to the following equation:

$$F = 1 - \exp\left[\frac{-Kt^{m+1}}{m+1}\right] \qquad (1)$$

where F is the fractional area of non-coherent grain-boundary at time t, and m should be 1·33.

Equation (1) is a special solution of the differential equation:

$$\frac{dF}{dt} = Kt^m(1-F)^n \qquad (2)$$

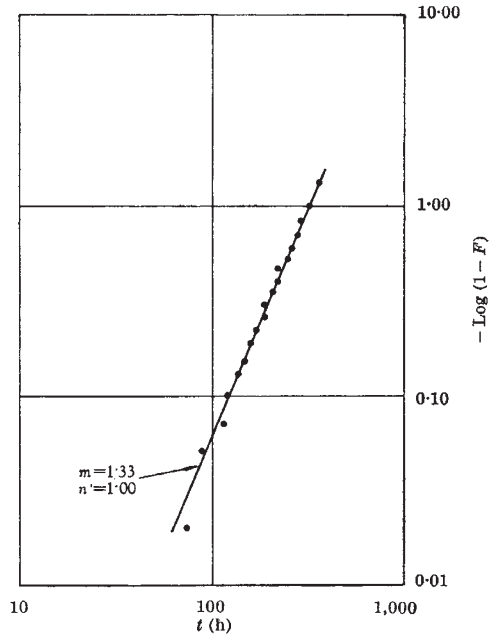

Fig. 1. Experimental points and the theoretical line

For $n > 1$, equation (2) has the alternative solution:

$$F = 1 - \left[\frac{K(n-1)t^{m+1}}{m+1} + 1\right]^{1/(1-n)} \qquad (3)$$

Taking F as equivalent to the fractional number of tubes which had failed up to a certain time in the experiment, the data were compared with equations (1) and (3): in the case of the latter values of K, n and m were established by plotting log $(1 - F)$ against log t for large t and log F against log t for small t. These tests revealed that the data correspond closely to the values of m and n deduced from the process-rate model. Fig. 1 illustrates this: here the data points are plotted together with the theoretical line for $m = 1{\cdot}33$ and $n = 1{\cdot}0$.

From a practical point of view the existence of a physically based distribution function is a valuable asset since it permits reasoned estimates of low failure-rates from necessarily limited experimental data. Arbitrary use, without theoretical justification, of a function (such as, for example, the log-normal distribution) which happens to fit the available data can produce serious errors of extrapolation.

The process-rate model which led to equation (1) also predicts the effects on F of variables such as stress, ambient pressure, temperature and grain-size. Preliminary comparisons of these predictions with experimental data have given encouraging results.

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CHEMISTRY

Preparation of Thiazyl Fluorides

The action of silver difluoride on tetrasulphur tetranitride has been shown to yield the thiazyl fluorides SNF and SNF_3[1], but little is known about the action of other fluorinating agents on sulphur nitride. We have examined the action of several liquid and gaseous fluorides on sulphur nitride, and also the reaction of sulphur tetrafluoride with ammonia.