types of plant: the stomatal aperture of both groups may be controlled by internal CO_2 concentration. Observations have also been made on the effect of ambient CO_2 concentration on the opening of the stomata of normal plants in the dark[15].

Experiments on the effect of CO_2 concentration on stomatal aperture refer to the ambient CO_2 concentration, and not to that inside the leaf which the guard cells experience, which will be less than ambient in conditions of CO_2 influx, due to the boundary air layer and stomatal resistance, which are large in xerophyte plants[1,14,16,17]. The available values of the CO_2 concentration in the air spaces of photosynthesizing leaves are estimates derived from the application of a Fick's law model to the gaseous exchange of leaves[7] (page 337). Estimates of this internal CO_2 concentration have also been made[18] by the forced ventilation of the internal air spaces of leaves with an airflow of known CO_2 content. It is therefore most desirable that direct measurements should be made of the rhythm, in light and dark, of the actual CO_2 concentration inside leaf air spaces, and that these should be correlated with observed stomatal aperture changes. For example, the rapid closure of the stomata, on transfer of plants of *Agave americana* and pineapple from dark to light[1], may be related to internal "light decarboxylations"[3] that occur in Crassulacean-type plants on exposure to light after dark and which may manifest itself as a CO_2 efflux[19].

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GENERAL

Improved Impregnation Technique for the Preservation of Stone Statuary

ATMOSPHERIC attack on stone statuary has increased considerably during the past few decades because of the presence of increasing amounts of gaseous pollutants such as SO_2 and CO_2 (ref. 1). There are two types of technique[2] for the preservation of stone: those which provide, by means of impregnation, both a protective coating and a cement between dislodged grains; and those which change the chemistry of the stone so that the resultant substance is more resistant to attack.

Success of impregnation is impeded by several factors; for example, the difficulty of removing occluded impurities, the shallow penetration of the preservatives and the complete sealing of the pores (which prevents the essential "breathing" of the stone). I wish to describe a method which overcomes these difficulties. Although developed for marbles, the method can be applied to most porous materials.

The stone is first immersed in a 1 : 1 mixture of acetone (or any other solvent in which the resin to be used is completely miscible) and water. It is then transferred through increasing concentrations of acetone and finally put into pure acetone. This process removes occluded impurities, and the acetone penetrates to considerable depths for three reasons. First, the surface tension of the water and acetone mixture is larger than that of acetone alone. Second, the introduction of the water and acetone into the capillaries of the stone results in the condensation of occluded water vapour and the dissolution of gases and soluble salts. Third, as the concentration of acetone increases, the water containing the dissolved impurities is gradually displaced by diffusion.

The specimen, saturated with acetone, is then treated with a resin and acetone mixture. The concentration of the resin is increased until the final treatment with a mixture of 95 per cent resin and 5 per cent acetone. By this means the less viscous solution penetrates to a greater depth while denser resin cements weathered rim.

Non-polymerized resins with viscosities up to 10 $N\,s\,m^{-2}$, mixed with curing agents, are used for impregnation, so that polymerization occurs within the stone. Plasticizers are added to the resins to decrease stresses on expanding calcite crystals. If the pores are very large, inert materials, such as silica gel, are mixed in the resin before impregnation to prevent outward diffusion by the resin.

Penetration of several centimetres has been achieved routinely in marble, and the results of permeability studies suggest that the walls of the capillaries were coated without complete closure. Furthermore, impregnated and unimpregnated specimens have been subjected for 3 months to water-vapour-saturated atmospheres containing as much as $7\cdot5\times10^2$ p.p.m. of SO_2 and 2×10^5 p.p.m. of CO_2. X-ray diffraction has shown that only untreated specimens were changed chemically.

Sharp boundaries between treated and untreated regions are avoided because of the deep penetration and a decrease in the density of the preservative toward the centre of the stone sample.

This method has been applied *in situ* to 100 yr old tombstones using plastic bags or saturated cloth to soak the specimens. The technique is therefore applicable outside the laboratory.

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