

*The Permeability of Balloon Fabrics to Hydrogen and to Helium*<sup>1</sup>

By R. T. ELWOPHY, B.Sc., and V. F. MURRAY, M.A., B.Sc.

Presented by PROFESSOR J. C. McLENNAN, F.R.S.

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INTRODUCTION

In view of the proposed use of helium in place of hydrogen for filling airship envelopes, it became necessary to investigate the permeability of fabrics to this gas; and more especially to obtain the ratio of the permeabilities to helium and to hydrogen of typical airship fabrics.

If it be assumed that the phenomenon of leakage through a fabric can be classified as effusion, a leakage of helium 0.71 times by volume that of hydrogen would be expected. If this ratio be calculated by the Hugoniot-Reynolds formula for the adiabatic efflux of a monatomic and a diatomic gas a value 0.75 is obtained.

The passage of a gas through a rubbered or a skin-lined fabric is not, however, a case of simple effusion, but is a more complex phenomenon. The solubility of the gas in the material may be a factor of importance<sup>2</sup>.

Recently, Dewar<sup>3</sup> repeated the classical work of Graham on the diffusion of gases through rubber membranes. Gases at varying pressures and temperatures were allowed to diffuse through Para rubber membranes 0.01 mm. thick into a vacuum. Relative rates of diffusion were determined and are given in this paper as well as absolute rates expressed in cubic centimetre per day per square centimetre. Dewar found that the relative rates differed for different temperatures and he states that "the order of diffusibility is difficult to associate with any chemical or physical property." From his data the ratio of the diffusibility of helium to that of hydrogen is 0.43 at 15.5°.

<sup>1</sup> Communicated by Professor J. C. McLennan, F.R.S., by permission of the Admiralty.

<sup>2</sup> Barr. Advisory Committee for Aeronautics. Permeability of Balloon Fabrics by Helium. 1915.

Edwards. U.S. Bureau of Standards. Tech. Paper 113. The Determination of Permeability of Balloon Fabrics. 1918.

<sup>3</sup> Dewar. Proc. Roy. Inst., pp. 813-5. 1918.