# Letters to the Editor

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NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 37.

## Passage of Helium through apparently Compact Solids

IT has been known for some time that helium can pass at the ordinary temperature through silica glass, and also, to a less extent, through pyrex glass. Common glasses, however, are not known to be sensibly permeable.

It was thought of interest to search for other solid materials which might have the property of passing helium far more readily than air.

I have found, in fact, that sheet gelatine, celluloid and cellophane, all behave somewhat like silica glass.

Silica glass and celluloid, when carefully examined in the polariscope, are found to be of the nature of crystalline mosaics, and it is likely that the helium finds its way between the crystals. The same probably applies to gelatine.

There is, however, an interesting field of work in examining whether helium can pass through various crystal lattices (single crystals). A few preliminary experiments have been made. I have confirmed the known result that helium cannot pass through crystalline quartz, and have found further that it cannot get through mica. The case of beryl is of special interest. According to the analysis of W. L. Bragg and J. West[1] the structure of this crystal is exceptionally open, having unobstructed tunnels parallel to the optic axis, each tunnel being about the same diameter as an oxygen atom in the crystal. It seemed worthy of investigation whether helium would go through. I had a slice cut 0·6 mm. thick perpendicular to the axis of a clear and apparently flawless aquamarine. This did in fact transmit helium as indicated in the table below. It is not yet certain whether the helium really passed through the lattice, or merely through flaws or cracks in it. No flaws could be seen, however. The test of whether air would pass through has been applied, but for technical reasons it is more difficult to be sure about the non-passage of air than about the passage of helium. In any case, helium would be expected to pass through more quickly, even if the transmission were through flaws. More severe tests are in progress. It will be important to determine the behaviour of a slice cut parallel to the axis.

| Material | Transmission in c.mm. per day Helium | Air | Ratio Helium/Air |
|---|---|---|---|
| Fused silica | $4 \times 10^{-1}$ | — | — |
| Gelatine | $9{\cdot}23 \times 10^{-1}$ | $5{\cdot}02 \times 10^{-3}$ | 185 |
| Celluloid | 39·5 | 1·94 | 20 |
| Cellophane | $1{\cdot}36 \times 10^{-1}$ | $3{\cdot}23 \times 10^{-3}$ | 42 |
| Quartz cut ⊥ to axis | $< 1{\cdot}01 \times 10^{-4}$ | — | — |
| Mica | $< 2{\cdot}5 \times 10^{-5}$ | — | — |
| Beryl cut ⊥ to axis | $1{\cdot}34 \times 10^{-1}$ | $< 2.0 \times 10^{-2}$ | > 7 |

The accompanying table gives the main results so far. The transmission has been taken provisionally to be inversely proportional to the thickness, and the results are reduced to 1 mm. thickness and 1 sq. cm. area. The gas passes from atmospheric pressure on one side to vacuum on the other.

It should be mentioned that the actual figures for the organic materials are provisional, there being some evidence that the rate falls off with time. This may be the effect of continued mechanical stress due to the gas pressures.

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Dec. 17.

[1] *Proc. Roy. Soc.*, A, **111**, 691; 1926.

## Penetration of a Magnetic Field into Supra-Conductive Alloys

USING the same method as in our work on tin[1], we have investigated the behaviour of supra-conductive alloys in a magnetic field. We studied a carefully prepared sample of $Bi_5Tl_3$ and a lead-thallium alloy containing approximately 65 per cent thallium.

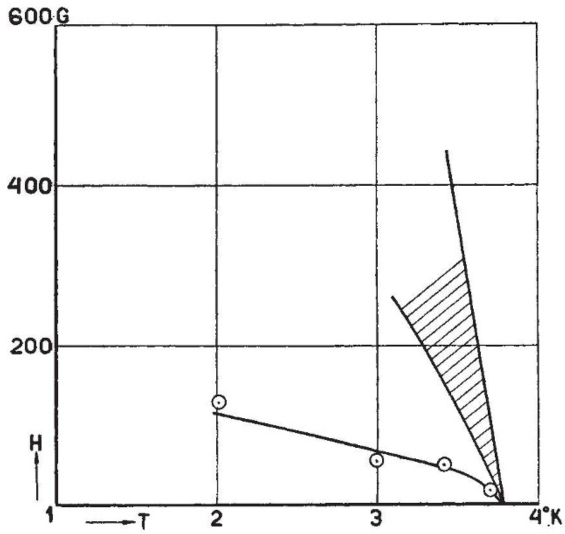


FIG. 1.

A cylindrical rod with a channel along its axis was made of each material, and a thin bismuth wire with current and potential wires was fitted inside this channel; we measured the change of resistance of the bismuth wire as a function of a transverse magnetic field (that is, of a field perpendicular to the axis of the cylinder). At a temperature below the transition point of the alloys, the bismuth wires did not show any change of resistance when a weak magnetic field was applied. When the strength of the field exceeded a certain critical value, a change of resistance was produced, though the alloy itself remained supra-conductive.

The value of the critical field is different for the two alloys and depends on the temperature. Fig. 1 shows the value of the critical field as a function of the temperature; in the shaded region the resistance