monovalent and colorless. When the third level or shell is incomplete, 2–8–17, it is bivalent and colored. Iron may have the kernel 2–8–13, or the kernel 2–8–14; both states are incomplete and the ions are colored. Possibly, the non-existence of color in elements with incomplete kernels is due to the fact that absorption bands lie outside the visible spectrum. This is known to be true for the rare earth gadolinium which has a number of bands in the extreme ultraviolet. The explanation of the source of color given by Stieglitz[5] accounts for the color of ions having a variable valence as "by the proximity of a strong reducing atom to a strong oxidizing atom," but makes no mention of the color of the rare earth ions which have, in most cases, a fixed valence.

Another interesting feature of the chart is that a fairly uniform curve may be drawn through the following bands: Nd 1606, Il 1719, Sm 1788, Eu 1902, Tb 2049, Dy 2103 and Ho 2198. Europium has only two bands, very close together, and terbium only one in the region covered by the chart. The most prominent band of illinium also lies close to the curve. The fact that these bands occur in such regularity and are of increasing frequency with increasing atomic numbers, as may be expected from analogy with X-ray and spark spectra, would indicate a basic similarity in the electron shift causing the band.

It is probably accidental that so many absorption bands do fall within the narrow limits of the explored spectrum. An extension of the study to the ultraviolet and the infra-red should, in many cases, reveal the presence of many more bands and aid in the study of atomic structure.

Summary

1. The presence of color in the rare earths and some common elements seems to be due to an incomplete kernel.

2. A relationship among the spectra of some of the rare earths is pointed out.

URBANA, ILLINOIS

NOTES

The Diffusion of Helium and Hydrogen through Quartz Glass at Room Temperature.[1]—The permeability of silica glass to helium and other gases at high temperatures has long been known[2] and its permeability to helium and hydrogen at room temperatures has been suspected, various observers[3] having reported the apparent loss of these gases from quartz glass bulbs

[5] Stieglitz, "A Theory of Color Production," The Franklin Institute, **1924.**

[1] Presented at the New Haven Meeting of the American Chemical Society, April, 1922.

[2] Jacquerod and Perrot, *Compt. rend.*, **139,** 789 (1904). Williams and Ferguson, THIS JOURNAL, **44,** 2160 (1922).

[3] Keyes and others, *J. Math. Phys.*, **1,** 289 (1922). Henning, *Z. Physik*, **5,** 264 (1921).

used in gas thermometers at room temperatures. It was thought worth while to see whether the gases could be detected after they had passed through the quartz glass.

A piece of clear quartz glass was drawn to an internal diameter of about 1.0 mm. and a wall thickness of about 0.5 mm. This tube was closed at one end and sealed by an internal seal into a second silica tube of about 5 to 6 mm. bore. The open end of the larger tube was then constricted; the whole tube was thoroughly heated, evacuated and sealed. On wrapping the two ends of the evacuated tube with tin foil, no discharge could be excited with a 25mm. induction coil.

The open end of the capillary tube was then sealed to a supply of helium under a pressure of 100 atmospheres. After a period of time varying with different tubes from two to four hours, the spark coil used above was able to excite a luminous discharge in the evacuated tube. At first, the discharge was greenish in color, characteristic of discharges in low pressure helium, but soon changed to the better known yellow color as the pressure presumably increased. The spectrum was photographed in several cases and no lines could be detected other than those of helium.

After finding the tubes permeable to helium, in most cases the evacuated tube was opened, re-evacuated, sealed as before and the capillary tube filled with hydrogen under 100 atmospheres' pressure. In no case was it possible to excite a discharge in the system when the capillary was filled with hydrogen. One tube, into which sufficient helium diffused in four hours to permit exciting a discharge, when tested with hydrogen showed no discharge after the hydrogen pressure had been maintained in the capillary for a period of 11 days.

Longer runs were not made with hydrogen because of the difficulty in keeping the apparatus tight. The special sealing wax used to join the quartz glass to the metal supply cylinder seemed to be affected by the hydrogen, and sooner or later the gas would work through and quickly release the pressure. Possibly, longer runs would be successful with hydrogen.

Conclusion.—Quartz glass is permeable to helium at room temperature under a pressure of 100 atmospheres.

Negative results were obtained for hydrogen under the same conditions.

Contribution from the Chemical Laboratory
University of Kansas
Lawrence, Kansas

Howard M. Elsey

Received December 24, 1925
Published June 5, 1926

McCulloch's Observations Regarding the Rapid Corrosion of Metals by Acids within Capillaries.—A recent Note in This Journal by McCulloch[1] records an instance of marked localized corrosion set up where a

[1] McCulloch, This Journal, **47**, 1940 (1925).