

Molecular Dimensions of Celluloid.¹

RECENTLY we have had occasion to make thin films of celluloid by the previously known method of dissolving the celluloid in amyl acetate and allowing a single drop of the solution to fall on a clean water surface. With solutions sufficiently dilute, as the amyl acetate evaporates interference colours appear in practically uniform sheets of colour over the entire surface which change from red to violet and then the film becomes colourless. Some of these films were deposited on optically flat glass and their thickness determined by an interferometer method by C. G. Peters, of the Bureau of Standards' staff.

In this manner films so thin as 30 angstroms were measured. The solution from which these were deposited contained one gram of celluloid dissolved in four hundred grams of amyl acetate. Thinner films than these could not be measured directly, but those made from a solution containing one gram of celluloid in eight hundred grams of amyl acetate were sufficiently tenacious to hold together and adhere to the finger. With still further dilution—one gram of celluloid in twelve hundred grams of amyl acetate—as the last traces of the amyl acetate evaporated, a vibration or quiver was seen to pass over the surface of the water and the film simultaneously broke into minute particles of celluloid.

Assuming that the films decreased in thickness in proportion to the dilution of the solutions, since their area remained practically constant, this means that the films which were just too thin to hold together were approximately 10 angstroms thick. This value agrees with that calculated directly from the density of celluloid, the concentration of the celluloid solution and the area of the film on the water surface. Since the thinnest stable films must have been at least one molecule thick, these experiments indicate that the molecular complex of celluloid is not more than 10 angstroms in diameter. This value is in accord with similar results obtained on oil films² and other organic substances.³

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November 4.

Mercury and Helium.

It is known that under some conditions not clearly defined or understood, mercury and helium may become so intimately associated that the separation of the one from the other is difficult. According to prevalent views, helium is a highly inert gas, and is therefore incapable of combining with other elements; hence it appears that helium can in some way not known act as a "carrier" of mercury.

For some years past I have been experimenting with mercury and various gases, including hydrogen and nitrogen. The results obtained led me to try similar experiments with mercury and helium; these last are now almost concluded. Briefly, the findings are as follows. Under certain conditions and in the presence of an electric glow discharge, mercury and helium combine to form mercury helide. The helide is a stable compound, and is not readily decomposed except at or above a bright red heat. As the formation of the helide progresses, a corresponding decrease in the volume of the helium employed takes place. On heating the mixed gases (helium and helide) to the required temperature, the original volume of the helium is restored. The helide

is but slightly absorbed by charcoal cooled in liquid air. The refractive index of the mixture of helium and helide, as observed by a Jamin interferometer, increases continuously during the formation of the compound. When used in a vacuum tube of the form employed for spectrum analysis, mercury helide is gradually resolved into its elements. At the moment of activating the coil, the mercury green line (W.L. 5460.7) is invisible; then as the coil is worked, the line, at first faint, steadily increases in strength, and in some cases ultimately becomes quite bright.

Judging from these results, it appears almost certain that the associated mercury detected by earlier observers, has been present as helide, the conditions having been those under which that compound could be formed.

I have not yet carried out a quantitative analysis of the mercury helide, but a plan for doing so has been made, and is now being perfected. I hope shortly to give a detailed account of my work and conclusions.

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November 19.

Optical Separations and Atomic Numbers.

It has been recently shown (Millikan and Bowen, *Phys. Rev.*, 24, 1924) that in optical spectra due to atoms having similar electronic configurations, the doublet and triplet separations vary according to the relativity X-ray formula:

$$\Delta\nu = K(Z - s)^4$$

where $\Delta\nu$ is the doublet (or triplet) separation, K is $(0.365 \times 2^3)/n^3$, n being the total quantum number appropriate to the orbits giving rise to the separation, Z the atomic number, and s the screening constant, which varies, becoming smaller, for example, in passing through Li I, BeII, BIII, CIV.

This formula has been applied to doublets and triplets generally, and the values of s obtained tabulated. On plotting curves it is found that the values of s within the same group are directly proportional to the atomic number, this proportionality holding also for the ionised elements. Moreover, the slopes of the graphs are very nearly the same for all groups. So far, straight lines have been obtained for groups Ia, IIa, IIb, IIIb, IIa spark, IIb spark; others are being investigated. This linear relationship should be of importance in assigning spectral series; and it is being applied in this way. The matter will appear shortly in more detail.

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November 19.

Eolithic Ornament and Art.

In the English translation of Prof. Hugo Obermaier's book "Fossil Man in Spain" (Yale University Press), just published, there appears, on page 9, the following statement. "But some—among them Boucher de Perthes, Dharvent, . . . and J. R. Moir, went further, and proclaimed the existence of Eolithic ornament, and art."

This, so far as I am concerned, is entirely incorrect. I have never "proclaimed" a belief in the existence, in any form, of Eolithic ornament and art, nor do I believe that evidence which would make such a belief inevitable has, as yet, been discovered.

As Prof. Obermaier's book will, in all probability, be widely read by English readers, I regard it as necessary to make the above correction.

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¹ Published by permission of the Director of the Bureau of Standards of the U.S. Department of Commerce.

² Lord Rayleigh, *Phil. Mag.*, 48, 331 (1899).

³ Langmuir, *Irving, Journ., Am. Chem. Soc.* vol. 39, p. 1858 (1917).