an angle θ, and the ionization chamber through 2θ, where θ is the grazing angle of incidence on the cell. The intensity of the reflected x-rays from an empty cell was less than 15 percent of the intensity observed at the same angle when the cell was filled. Soller slit sets were used to collimate both the incident and reflected beams. The reflection curves obtained for benzene and nitrobenzene were found to be practically the same as the corresponding liquid diffraction curves obtained by other methods.

The Kerr effect is most strongly shown by nitrobenzene when a rapid succession of practically instantaneous sparks are passed through it. Since full-wave rectification was used in obtaining the high potential for the x-ray tube it was thought desirable to synchronize the electric impulses across the cell with the peaks of the x-ray pulses. This was done by connecting a water rheostat in parallel with the tube, and connecting the aluminum leaf of the cell to this rheostat. In order to sharpen the electric impulse across the cell a spark gap was inserted between the rheostat and the cell, and a jet of air was blown between the balls of this gap. The other end of this cell was covered with a grounded brass plate.

All observations of the effect of the electric field were made with the cell at the grazing angle corresponding to maximum reflected intensity. Readings were taken alternately with and without a field of 13 K.V. per cm across the cell. Four groups of readings of 25 pairs each were obtained for nitrobenzene, the increases in intensity being 1.8, 2.5, 2.1, and 2.9 percent respectively for each of the four groups. The average increase with the field was thus found to be 2.3 percent, with a probable error of 0.5 percent. The effect thus observed is between four and five times the probable error.

With a field applied to the cell in the manner described above benzene shows little or no Kerr effect. Hence, if the Kerr effect is due to partial molecular alignment, benzene —under the field applied to nitrobenzene— would not be expected to show a change in intensity of the peak maximum. Four groups of readings of 25 pairs each, taken alternately with and without the field in precisely the same manner as nitrobenzene, showed for benzene changes in intensity of -0.4, $+0.3$, -0.3, and -0.6 percent. The negative sign is used to indicate the variations in the opposite direction to that of nitrobenzene. The average change in intensity for all readings is -0.3 percent which is well within the probable error. This lack of any definite shift in intensity with the field rules out the possibility that the effect observed for nitrobenzene might be due to a slight bending of the cellophane window as a result of electrostatic forces of attraction.

The results here given show for nitrobenzene an increase in intensity of the peak maximum of an amount that is approximately five times the probable error, while for benzene any change observed lies not only well within the probable error but also is, for the most part, in a direction opposite to that of nitrobenzene. It would thus seem that for nitrobenzene there occurs, when the proper type of electric field is present, a small but detectable tendency of the molecules to align themselves in a common direction.

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A Comparison of the Reflection Spectra of $SmCl_3 \cdot 6H_2O$ at Room Temperature and at that of Liquid Air with its Absorption Spectra at Low Temperatures

In a communication to Nature[1] we discussed a change which we observed in the absorption spectrum of a single crystal of $SmCl_3 \cdot 6H_2O$ as we lowered the temperature to that of liquid hydrogen. Many lines or bands which were prominent in the spectrum at room temperature practically disappeared at the temperature of liquid hydrogen and others which were extremely faint increased in intensity as the temperature was lowered. We ascribed this change in relative intensity to the presence of different electronic configurations of Sm^{+++} in the solid state in thermal equilibrium. (This interpretation is in accord with the magnetic behavior of Sm^{+++}.)

At present we wish to report the most general features of the reflection spectra

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[1] Freed and Spedding, Nature, April 6 1929).

obtained by reflecting a continuous spectrum from the surfaces of many small crystals of the same salt. The reflected spectrum has the characteristics of an absorption spectrum. The lines which we attribute to the electronic modification stable at the low temperature, that is those which are prominent only at the *low* temperatures in absorption are found relatively much more intense at *room temperature* in reflection. In addition, the lines in the reflection spectra are accompanied by satellites about 160 cm^{-1} toward the red. The reflection spectrum at room temperature also contains narrow diffuse bands which were not observed in absorption.

At the temperature of liquid air, these bands sharpen and become resolved into multiplets consisting of very narrow lines. At this temperature, many new lines make their appearance and they tend to cluster on both sides of the lines which are found in the absorption spectrum. Satellites accompany the prominent lines at intervals of about 160 cm^{-1} at the temperature of liquid air also.

Our method of photographing the reflection spectra does not exclude the simultaneous appearance of the absorption spectrum. (We intend to eliminate this spectrum in our future work.) However, the astonishing intensification of the "low temperature" lines in the reflection spectrum at room temperature cannot be ascribed to any spurious experimental influence because we are considering relative intensities only.

A fluorescence or an unusual reflecting power appears to take place on the violet side of a number of the lines in the reflection spectrum at the temperature of liquid air which do not occur in absorption.

The force fields in the surface are definitely different from those within the crystal. It is conceivable that in the surface there is a higher concentration of the "low temperature modification" than corresponds to an equilibrium distribution within the crystal. It is also possible that the absorption coefficient of this particular modification may be greater under these conditions.

The large number of entirely new lines which occur in the reflection spectrum may possibly be due to the fact that the electrostatic fields to which the Sm^{+++} ions within the crystal are exposed are no longer regular in direction and in magnitude in the surface so that any "forbidden" electronic jumps within the crystal are no longer "forbidden" in the surface. In other words, the probability of transition between certain states has been increased. We are investigating this phenomenon further.

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An Observed Periodicity in the Packing Fraction

It is found that a single oscillatory curve can be fitted to the packing fraction data taken by Aston, eliminating the necessity of the two branches at the small mass number end (Proc. Roy. Soc. **A115,** 487 (1927)). Points of maxima are located at mass numbers 6, 10, 13, 17, 21, 25, $\cdots$, and minima are found for the elements whose mass number is an integral multiple of four.

The mass number of the atom was assumed to be given by the expression $4n+x$, where $n=0, 1, 2, 3, \cdots$ and $x=1, 2, 3$ or 4. Since the packing fraction represents an average mass defect per proton it is evident that in the $4n+1$ type of atom, the one proton is loosely connected to the core of the nucleus probably existing as a satellite in the form of a neutron. In the $4n+2$ type the two protons are a little more tightly bound to the core. Similarly for the $4n+3$ atom. And finally for the $4n+4$ type of atom we find maximum packing, the four protons probably forming an alpha-particle which goes into the center of the nucleus. These conclusions were arrived at after a calculation of the change in packing fraction per proton produced by the "x" portion of the atom had been made wherever possible. Curves were plotted showing the effect of the value of "x" on this change in the packing fraction, these being used to determine the points of maxima and minima.

The fact that the packing becomes greater for the $4n+4$ atoms with an increase in mass number indicates that the alpha-particle actually goes into the center of the nucleus each time "x" becomes equal to four. This