line. If, however, the spacings, instead of being constant, vary sinusoidally with an amplitude a_1, and with a fixed period, false images appear on each side of the parent spectrum line. These false lines are called Rowland ghosts. Professor Rowland showed that the intensities of the parent line and of the 1st, 2nd, 3rd, etc., ghosts may be calculated from the Bessel functions of $(2\pi N \frac{a_1}{a_0})$ of order zero, 1, 2, 3, etc., respectively. The new ruling engine performs so consistently that it has been possible to confirm Rowland's theory experimentally. An experimental comparison has also been made of the relative sensitiveness of knife-edge and interference tests of optical surfaces, and they have been found to be about equally sensitive. Both methods have been applied in testing concave and plane diffraction gratings. Knife-edge tests are very convenient and sensitive for testing the error of run in concave gratings, and interferometer tests are simple and convenient in testing the periodic error in plane gratings. Knife-edge tests may be used to detect departures from straightness in the rulings, when these departures are too minute to affect the definition. In ruling gratings on speculum metal, minute particles of speculum sometimes stick to the diamond point and cause it to fail to rule, often for a good many lines. This difficulty has been overcome for several years by covering the surface with a layer of oil a few millimeters thick. The oil keeps the diamond point washed clear of speculum particles.

Absorption spectra of the rare earths in crystals: Simon Freed and Raymond J. Mesirow (introduced by W. D. Harkins). The absorption spectra of salts of ytterbium (the chloride $YbCl_3 \cdot 6\,H_2O$, the acetate $Yb(C_2H_3O_2)_3 \cdot 4\,H_2O$ and the ethylsulfate $Yb(C_2H_5SO_4)_3 \cdot 9\,H_2O$) were found to resemble those of cerium very closely, especially in their diffuseness even at low temperatures. This is in marked contrast with the sharp spectra of the other rare earths. The resemblance was anticipated on the supposition that the 13 electrons in the 4f shell of Yb^{+++}, one short of the maximum the shell can hold, would give rise to but one term ${}^2F$, the same term as the electron of Ce^{+++} in the same shell gives rise to. That is, activations aside from fine structure are impossible when the 13 electrons remain in the 4f shell. This prohibition is derived from the Pauli exclusion principle as it is applied to gases. The lattice, however, may possibly modify the application of this principle. It was thought likely that the activated states of these ions in crystals would respond to any change in the application of the principle the lattice might impose. The spectra show that the principle holds for these ions in crystals in exactly the same way as it does in gases. Strong confirmation is obtained that the sharp spectra of the other rare earths consist of "forbidden transitions," arising from a change in coupling among the electrons of the 4f shell.

Electronic structures of molecules: Robert S. Mulliken. Work of the writer on the electronic structures and spectra of molecules is illustrated by some examples. Comparing isoelectronic molecules, analogous energy levels and spectra can be traced, but the energy order and degree of degeneracy of the levels, and the locations of corresponding spectra, vary greatly with the symmetry and the chemical constitution. Among isoelectronic sets which have been studied are: N_2, CO, C_2H_2, HCN; B_2H_6, O_2, C_2H_4, CH_2O; F_2, H_2O_2, NH_2OH, N_2H_4, CH_3OH, CH_3NH_2, C_2H_6; CH_3, NH_3^+, NH_2, H_2O^+, OH; BeF_2, BOF, BO_2^-, NCF, NCO^-, CO_2, N_2O, N_3^+. Another type of comparison is between a molecule and its chemical homologues (*e.g.*, O_2, SO, S_2; or H_2CO, H_2CS); or between a molecule and its chemical derivatives (*e.g.*, C_2H_4, C_2H_3Cl, $C_2H_2Cl_2$, etc.; CH_4, CH_3Cl, CH_3Br, CH_3I, CH_2Cl_2, etc.; H_2CO, Cl_2CO, etc.). By making comparisons of these various kinds, including cross-comparisons, and trying to fit the available data into a (qualitative or partially quantitative) theoretical framework based on quantum mechanics, it has been possible to arrive at rather definite conclusions in many cases as to the natures of the electronic structures, energy levels and spectra, including continuous spectra. The results can be rather well expressed by assigning electron configurations to the various molecules and molecular states, and giving ionization energies for the various types of orbital (*i.e.*, one-electron orbital wave function) which appear in these configurations. Also, comparison of molecular ionization potentials with one another and with related atomic potentials gives information about charge-distribution or polarity in molecules (example, the $p\pi$ potential in I, HI, CH_3I, C_2H_5I, etc.).

(*To be continued*)

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