we select a few illustrations which give some notion of the power and versatility of the techniques.

The energy states of an electron on a free atom or ion can be described in terms of its four quantum numbers. The lowest of these states is the ground state. These states are determined experimentally either by measuring the absorption of (usually electromagnetic) energy or by the emission of energy as an excited electron returns to the ground state. In this discussion we shall be concerned only with outer electrons generally called valence electrons because they are involved when chemical reaction takes place. Only the ground state and the excited states which be nearest above them will be important in the phenomena included here.

When an atom or ion appears in a crystal the electronic energy states are affected to a degree which depends on the interaction between the wave functions which describe the state in question with the wave functions of the other electrons in the crystal.

Both the ground state and the excited state may remain closely associated to the original atom. In this case, the energy states may be perturbed by the potential of the surrounding atoms and affected because this potential has less than spherical symmetry. The optical absorption which represents transitions from the ground state to the first excited state still gives discrete peaks, perhaps somewhat broadened by the interaction described above. In some cases, a single peak in a free ion may be split into two or more peaks in the crystal. This sort of effect can be observed in transition metal ions in crystals, or in the spectra of some crystals of fused ring aromatic compounds. An impurity in an insulating crystal may have highly localized states. The