interesting and complicated.

The low-energy electronic properties of some materials can be reasonably well understood without explicitly taking electron-electron interactions into account. For good metals, this surprising fact is elucidated by the phenomenological Landau Fermi-liquid theory (Landau, 1957*a*; Landau, 1957*b*) which replaces electrons by noninteracting quasiparticles with a renormalized mass and a finite lifetime. Even when the noninteracting picture fails, phenomena such as long-range order can sometimes be described within a static mean-field theory; here one replaces the effect of the electron-electron interaction on each electron by that of a time averaged (and possibly spin-dependent) electronic charge density. In general however, in particular for transition metal compounds, such effective single-particle pictures fail to satisfactorily reproduce the interesting physical phenomena. These *strongly correlated electron systems*, for which the transition metal compounds are prototype examples due to the strong (and locally essentially unshielded) Coulomb interaction between their well-localized $3d$ and $4f$ valence orbitals, then call for theories which retain the full dynamics of the electronic correlation problem. Theories for such d and f systems typically take only few orbitals per lattice site into account and assume an effectively short-ranged Coulomb interaction. An extreme case is the *Hubbard model* where the Coulomb interaction is reduced to its on-site part (Hubbard, 1963; Gutzwiller, 1963; Kanamori, 1963), i.e., where electrons only interact with each other if they occupy the same lattice site (in the Wannier picture).

The *Dynamical Mean-Field Theory (DMFT)* is a nonperturbative approximation for strongly correlated electron models, namely variants of the Hubbard model, which becomes exact in the limit of infinite dimensionality or, equivalently, infinite lattice coordination number (Metzner and Vollhardt, 1989). It neglects (short-range) spatial correlations between the electrons while it retains their dynamical correlations which are crucial for the description of many interesting phenomena observed in correlated electron systems. The DMFT simplifies the lattice problem by mapping it onto a single-impurity model embedded in a medium that has to be determined self-consistently. Still, explicit solutions can only be obtained by application of either further approximations or of numerical techniques. The *quantum Monte Carlo* (QMC) method is numerically exact, i.e., its error can in principle be made arbitrarily small by increasing the numerical effort; even with today's high-performance computers the method is, however, restricted to not too low temperatures.

The low-temperature electronic properties of materials can be classified as insulating, metallic, or superconducting depending on whether the resistivity increases or decreases upon lowering the temperature or precisely vanishes (below some critical temperature), respectively. Changes in the resistivity and, in particular, phase transitions from a metallic to an insulating state can be induced by, e.g., change of stoichiometric composition, pressure, temperature, or magnetic field or by introducing disorder. In contrast to transitions to (possibly long-range ordered) band insulators or those induced by Anderson localization which can be understood on a noninteracting or static mean-field level, nonperturbative approaches are required for a quantitative theory of the correlation-induced *Mott metal-insulator transition (MIT)* which occurs at a point where potential and kinetic energy are of the same