The book consists of two parts: Part 1 is a standard text of dislocation theory. Mathematics is avoided as much as possible. Part 2 describes application of dislocation theory, which includes mechanical properties (including the inverse temperature dependence of strength) and dislocations in functional materials such as Si, GaN and SiC and dislocations in a thin crystal such as an epitaxial layer. This is what has been long anticipated among researchers in industry.The book contains about 330 illustrations (mostly originals by the author) and the pictures obtained by the author by means of in-situ experiment in a transmission electron microscope over the past 50 years.This book includes many exercises, which the author found useful when he was teaching in Department of Materials Science and Engineering of Nagoya University to stimulate their interests in dislocation theory.