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Many physical problems are associated with the quantum or statistical mechanics of strings and kinks. They include thermodynamics of adsorbed atoms on a crystal substrate, equilibrium shape of crystals, properties of vortices in a superconducting film with modulated thickness and Josephson vortices in layered superconductors, structure of intercalated compounds and others. Strings or domain wall in 2 dimensions can be treated as fermion world lines in 1+1 dimension. The fermion representation simplifies the problem and allows its exact solution. The fermion approach is especially useful for commensurate-incommensurate phase transition, which is described as the appearance of "living" fermions when the chemical potential exceeds the energy gap. It also allows finding the ground state of a quantum string in a periodic potential. At large enough ratio of quantum fluctuations to the strength of periodic potential its ground state becomes rough, with a multitude of kinks and antikinks. We review theoretical and experimental results in the field and discuss topological aspects of the problem.