Optogenetics is a new field in cell and neurobiology. Optogenetics means the remote control of neural cells via light-gated ion channels as well as via light driven ion pumps. Starting point was the discovery of the light-gated cation channels channelrhodopsin 1 and 2 (ChR1,2) from the unicellular alga Chlamydomonas reinhardtii, which can be expressed in neural cells in culture as well as in the brain of living animals. In the first part of the presentation molecular and functional properties of these unique ion channels are described by electrophysiological and spectroscopic methods. In the second part examples of the application of these microbial rhodopsins are given. It will be shown that neural cells in culture as well as in the brain of living animals can be activated simply by light with up to now unknown temporal and even more important spatial precision. An outlook for biomedical applications such as the recovery of vision and other neurodegenerative diseases is given.