

## Physics 320: Thermal Physics

Excerpts from **Thermodynamics**, by Enrico Fermi (1936):

Introduction:

“*Thermodynamics* is mainly concerned with the transformations of heat into mechanical work and the opposite transformations of mechanical work into heat. Only in comparatively recent times have physicists recognized that heat is a form of energy. Formerly, scientists had thought that heat was some sort of fluid whose total amount was invariable, and had simply interpreted the heating of a body and analogous processes as consisting of the transfer of this fluid from one body to another ...

We know today that the actual basis for the equivalence of heat and dynamical energy is to be sought in the *kinetic* interpretation, which reduces all thermal phenomena to the disordered motions of atoms and molecules. From this point of view, the study of heat must be considered as a special branch of mechanics: the mechanics of an ensemble of such enormous numbers of particles ... that the detailed description of the state and the motion loses importance and only the average properties of large numbers of particles are to be considered. This branch of mechanics, called *statistical mechanics*, which has been developed mainly through the work of Maxwell, Boltzmann, and Gibbs, has led to a very satisfactory understanding of the fundamental thermodynamical laws.”

Chapter II: The First Law of Thermodynamics

“The first law of thermodynamics is essentially the statement of the principle of the conservation of energy for thermodynamical systems. As such, it may be expressed by stating that the variation in [internal] energy of a system during any transformation is equal to the [net] amount of energy that the system receives from the environment [via heat and/or work].”

Chapter III: The Second Law of Thermodynamics

“A transformation whose *only final result* is to transform into work heat extracted from a source which is at the same temperature throughout is impossible. (Postulate of Lord Kelvin.)

A transformation whose *only final result* is to transfer heat from a body at a given temperature to a body at a higher temperature is impossible. (Postulate of Clausius.)”