

way free of arbitrary assumptions with regard to missing information.<sup>5</sup> As time goes on, each state of the maximum-entropy distribution changes due to perturbations that are in general unknown; thus it "spreads out" into several possibilities, and our initial knowledge as to the state of the system is gradually lost. In the "semiclassical" approximation, considered here, the final state of affairs is usually one in which the initial information is completely lost, the density matrix relaxing into a multiple of the unit matrix. The prediction of thermal equilibrium, in which the limiting form of the density matrix is that of the Boltzmann distribution with finite temperature, is found only by using a better approximation which takes into account the quantum nature of the surroundings.

It is of the greatest importance to recognize that in all of this theory it is possible to maintain the view that the system is at all times in some definite but unknown pure state, which changes because of definite but unknown external forces; the probabilities represent only our ignorance as to the true state. With such an interpretation the expression "irreversible process" represents a semantic confusion; it is not the physical process that is irreversible, but rather our ability to follow it. The second law of thermodynamics then becomes merely the statement that although our information as to the state of a system may be lost in a variety of ways, the only way in which it can be gained is by carrying out further measurements. Essential for this is the fact, analogous to Liouville's theorem, that the laws of physics do not provide any tendency for systems initially in different states to "accumulate" in certain final states in preference to others; i. e., the time-development matrix is unitary.

In opposition to the views above, one may assert that irreversibility is not merely a loss of human information; it is an experimental fact, well recognized long before the development of statistical mechanics. Furthermore,