If a single particle were constrained as an isolated system, it could only be in a single energy level, $U = \varepsilon_j$. The only spontaneous processes that could occur to the particle would be changes among the g_j states of the jth level. This is not the case in isolated systems of more than one particle. In them we recognize the possibility (indeed probability) that there can be more than one distribution of the N particles among the levels which will satisfy the constraint on total system energy. Each of these distributions describes a net condition of the microscopic particles within the macroscopic system. Each allowed distribution is called a *macrostate* of the system. The macrostates are differentiated from one another by the subscript i. Thus $n_{j,i}$ is that distinct distribution of particles among j levels designated as the ith macrostate. The constraints on allowed $n_{j,i}$ are

$$U = \sum_{j=1}^{J} n_{j,i}\varepsilon_j \qquad N = \sum_{j=1}^{J} n_{j,i} \qquad \text{(IIIA-6a,b)}$$

Hence, a macrostate is defined as a distribution of particles among the levels that satisfies the constraint equations, IIIA-6. It is specified by a set of numbers $(n_{1,i}, n_{2,i}, n_{3,i}, \ldots, n_{j,i}, \ldots, n_{J,i})$. We distinguish macrostates by Roman numerals (I, II, III,...,i, ...I^*). Not only can the system exist in any of I^* allowed macrostate distributions, but it changes from one allowed macrostate to another very frequently as the particles interact (collide) with one another. Collisions between particles permit exchanges of energy and effect alterations in particle distribution.

At any instant properties are determined by the macrostate present. For real systems, the number of particles is very large and macrostates change with such extreme rapidity that during a finite time the system will visit a great many of its macrostates. The observable, time average properties depend upon the sequence and duration of macrostates present during observation. Our approach to the prediction of properties must consider these macrostates and their probabilities. First we must determine the macrostate distributions by solving eqns. IIIA-6. This will depend upon rules governing their solution.

In Section I we solved the Schroedinger equation for a single-point particle in a field-free box. We established the energy states (and levels) available to it. Now we want to treat a system of many particles. How does the solution of the Schroedinger equation change when it is solved for a few and then many particles simultaneously? Are the energy state and level magnitudes altered? The answer to this question depends upon the type of particles present.

Ans. 4. Quantum numbers of ε_7 are (2,2,3), (2,3,2) and (3,2,2); $g_7 = 3$; $\varepsilon_8 = 18\ B_o$, $g_{10} = 6$, $g_{140} = 27$.