THE KINETIC THEORY OF GASES

In its simplest form, kinetic gas theory considers gases to be composed of discrete particles (molecules) whose total effective molecular volume is many times smaller than the volume which the gases themselves are considered to occupy. Most of a gas, therefore, is postulated to consist only of empty space—empty of ordinary matter, that is. That space still contains photons and neutrinos.

The molecules of a gas (or a mixture of gases, such as makes up the gaseous atmosphere) are further assumed to be in a continual state of movement. These movements result in the collision of the molecules with one another and with any exposed surface. In these collisions, kinetic energy is exchanged between the molecules themselves and between the molecules and any exposed surface.

The chief characteristic of a gas—the one that sets gases apart from both the solid and the liquid phases of matter—is its ability to expand so as to enter into (but **not** fill) any part of any space into which it is released. If that space in unaffected by any outside force, then the probability that any given portion of that space contains ***n*** molecules (where ***n*** is any real number) is the same for that portion or any portion of that space of identical volume. That probability is also consistent over time.

Notice that we are speaking of probability here, not actuality. That distinction is the essence of statistical mechanics. The most probable number of molecules in a small volume of gaseous air at any instant is virtually certain not to be the actual number present at that time. If the temperature and pressure do not change, then the most probable number will be identical over time. The actual number, however, will change from one instant to another, but that actual number will always be very close to the most probable number.

The molecules of even a small portion of a gas are too numerous and their collisions too frequent to allow us to use the formulae of conventional mechanics to predict their behavior. Instead, we use statistical mechanics. Statistical mechanics allows us to predict the behavior of a gas or a mixture of gases with a very high level of accuracy indeed.

The kinetic theory of gases is currently the accepted model of the nature of gases. Engineers may treat gases as if they were continuous fluids, but they do so for the sake of convenience. The formulae of continuous fluids are generally simpler and easier to apply to engineering requirements than the probabilistic formulae of statistical mechanics. Nevertheless, engineers understand that gases are not continuous fluids, but are composed of discrete particles in continuous motions—motions that are not the same as the gross motion of fluid flow.

