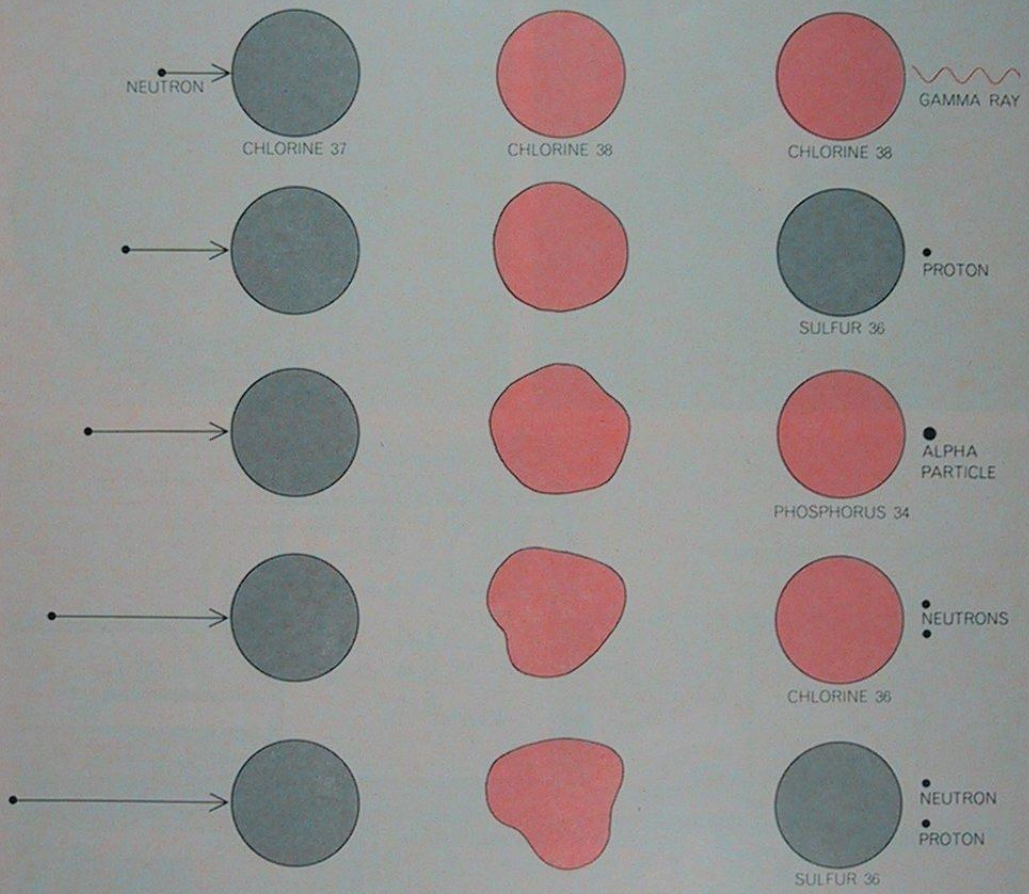
either stable or radioactive. A radioactive nucleus in turn decays and emits radiation. It is this last emission of radiation that is detected and measured in neutron-activation analysis. In addition, the prompt radiation emitted by the compound nucleus is sometimes measured to provide information about the particular reaction that takes place when a compound nucleus disintegrates.

The type of nuclear reaction that will occur in this situation depends largely on the energy of the absorbed neutron. The greater the energy of the neutron, the harder it will hit the nucleus and the greater the probability is that the prompt emission will be in the form of a nuclear particle rather than an electromagnetic wave such as a gamma ray. For example, when a neutron is absorbed by a nucleus of chlorine 37 (a stable isotope of chlorine whose nucleus contains 20 neutrons and 17 protons), a highly unstable form of chlorine 38 is produced. This unstable compound nucleus decays to a more stable state by emitting either a gamma ray or one (or more) of a variety of nuclear particles, such as neutrons, protons or alpha particles [*see illustration below*].

Accordingly the particular radionuclide that is produced when a sample is bombarded by neutrons depends on both the stable nucleus that absorbs the neutron and the energy of the absorbed neutron. Since a sample normally contains many different elements—and hence many more different isotopes—a profusion of radionuclides will be produced by neutron bombardment. The analyst is usually not interested in the total amount of radioactivity that is induced; he is primarily concerned with the activity of a particular radionuclide, since it is the quantitative indicator of the



NEUTRON-ACTIVATION ANALYSIS of chlorine 37 (a stable isotope of chlorine whose nucleus contains 20 neutrons and 17 protons) begins when a chlorine 37 nucleus absorbs an extra neutron (*column 1*), producing a highly unstable "compound nucleus" of chlorine 38 (*column 2*). Almost immediately after a compound nucleus is formed it releases its excess energy by emitting "prompt radiation"; in the process it is transformed into a nucleus that can be either stable or radioactive (*column 3*). Radiation from the radioactive nuclei (*color*) can be measured. The type of nuclear reaction that will take place when a compound nucleus disintegrates depends largely on the energy of the absorbed neutron. The greater the energy of the neutron, the greater the probability that a nuclear particle rather than an electromagnetic wave will be emitted. Energy of the neutrons increases from top to bottom.