As late as 1945 the Moseley model guided other efforts to build experimental batteries generating electricity from the emissions of radioactive elements.[9] These devices converted the motion energy of the charged particles from a radioisotope directly into electricity, without first converting the motion energies to heat, and thus generated very low powers (thousandths of a watt). At that time neither converters for transforming heat to electricity nor materials exhibiting sufficient efficiency in thermoelectric properties were available. The route that finally led to the RTG—obtaining heat from radioisotopic emissions and converting this heat to electricity—was not followed for some time.[10] Before describing how that route was finally taken, it would be useful to describe the basic nuclear radiation process that is the essence of the quiet atomic tools.

An isotope is "any of two or more varieties of the atoms of a chemical element."[11] Isotopes of the same element have different numbers of neutrons in their nuclei, although they otherwise display the same characteristics of the element. The isotopes of elements that exhibit radioactive decay properties are called radioisotopes. Radioisotopes are unstable elements that produce usable energy in the natural process in which one chemical element is transformed into another. Thus, within a family of radioelements such as uranium, change through decay to another element of the same family is constant and spontaneous.[12]

A radioactive isotope, then, possesses unique and valuable properties that are the basis of the quiet atomic technologies: "It spontaneously emits... nuclear particles.... It decays exponentially in time at a rate which cannot be altered by known physical forces."[13] It is a potential source of usable electricity; its lifetime in generating energy for that purpose can be calculated exactly in terms of the half-life of the particular radioisotope as it decays.

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Before the Manhattan Project developed the atomic bomb, only very small quantities of radioisotopes were available. The AEC-sponsored reactors that continued to turn out large quantities of fission products brought about a great increase between 1940 and 1950 in radioiostopes and in the decay heat available to engineers. Moreover, in 1950 the need for small and reliable electrical power supplies was becoming manifest in the infant space program.[14]