Radioactive Minerals by Larry Littau, from the Goldrush Ledger, reprinted with permission in the April 1992 MMNE newsletter

From THE GOLDRUSH LEDGER, via many bulletins. Submitted by Ralph Carr:

Radioactive Minerals

This article will differ somewhat from our normal format (if you can find anything normal about our other adventures into the realm of the elements). At the request of one of the more prominent people in the club, I'm going to discuss radioactivity and the radioactive minerals. Investigation of the phenomenon of radioactivity started in 1896 when Antoine Becquerel (a French physicist) became interested in Roentgen's newly discovered X-rays. He knew that uranium salts fluoresced when exposed to light and that this was a similar phenomenon to the fluorescent spot that appeared when electrons hit a target in a vacuum tube and produced X-rays. He placed crystals of a uranium salt on a photographic plate that had been wrapped in opaque black paper. When he developed the plate he saw an image of the crystals on the plate. So far, so good. He was going to conduct further experiments with these crystals, but was called away from his laboratory and didn't have a chance to expose the sample to light. Even though the sample didn't fluoresce, he again found that there was an image formed. something similar to X-rays must have been produced by the uranium salt - even without exposure to light.

Uranium salts had been used for many years to color glass so there was a large amount of waste ore available for investigation into the properties of material that produced the mysterious rays. Marie Sklodowska Curie investigated this phenomenon as a doctoral research project. Using equipment developed by her husband Pierre, she tested many different salts and minerals and found that only uranium and thorium containing compounds gave off this radiation. Neither heat nor any other physical affect influenced the radiation, not did the way thorium or uranium was chemically combined. When the mineral pitchblende was tested, she found that it was several times more radioactive than the same weight of pure uranium. She theorized that the high activity was due to an undiscovered element which she and Pierre decided to isolate. By dissolving the pitchblende ore and going through an exhaustive separation process, they were able, in 1898, to announce the discovery of a new element that Madame Curie named Polonium in honor of her homeland, Poland. Another new element was found that had an activity about 1000 times that of uranium. This element was named Radium, as it glowed in the dark. It took almost four years to do it, but by 1902, the Curies had produced about one three-hundredth of an ounce of a radium salt from several tons of pitchblende residues.

It wasn't until 1899 that it was found that there were three different types of radiation that were produced by uranium. These were named alpha, beta, and gamma. Alpha radiation was easily absorbed while beta and gamma radiation was much more penetrating. Over the next few years, it was determined that alpha particles (they were indeed particles) were identical to helium atoms with their electrons removed. Beta particles, or beta rays (yes, these do have the properties of both particles and waves) were identical to high energy electrons. Gamma radiation was the only part of the radiation produced that had the properties of very short wavelength X-rays. When an atom of uranium undergoes radioactive decay (by the way, the term "radioactivity" was coined by Madame Curie), it initiates a series of decay reactions that eventually ends with the formation of an atom of lead. The time that it takes for an atom to go from one step to the next in this series depends on which atom in the series is doing the decaying. For instance, the half life of uranium is about 4.5 BILLION years, (close to one estimate of the age of the earth). Other elements in the same series have half lives that are as low as days or even minutes.

The fourth edition of Dana's Textbook of Mineralogy lists about a dozen thorium containing minerals and almost 50 uranium minerals. Several of the pioneers in the study of radioactivity have been honored by having minerals named after them. Becquerelite ($UO_3 \bullet 2H_20$), Rutherfordine ($UO_2 \bullet CO_3$), and Soddyite (a hydrated uranyl silicate). Two minerals, Sklodowskite and Curite were named for Marie and Pierre Curie.

Most of the radioactive minerals are found as minute crystals in various shades of yellow brown, or green. Several occur as incrustations or earth aggregates. Torbernite and autunite are found as well-formed crystals that reach quite respectable size. When any of the radioactive minerals find their way into a collection by purchase, trade, or the result of a collecting trip, do they pose a health hazard? The answer is an unequivocal maybe. If the sample ONLY emits alpha particles, then just having it in a display box will afford all the protection that is needed. However, if the sample emits beta particles, it could be producing high enough radiation levels to be dangerous. -- by Larry Littau