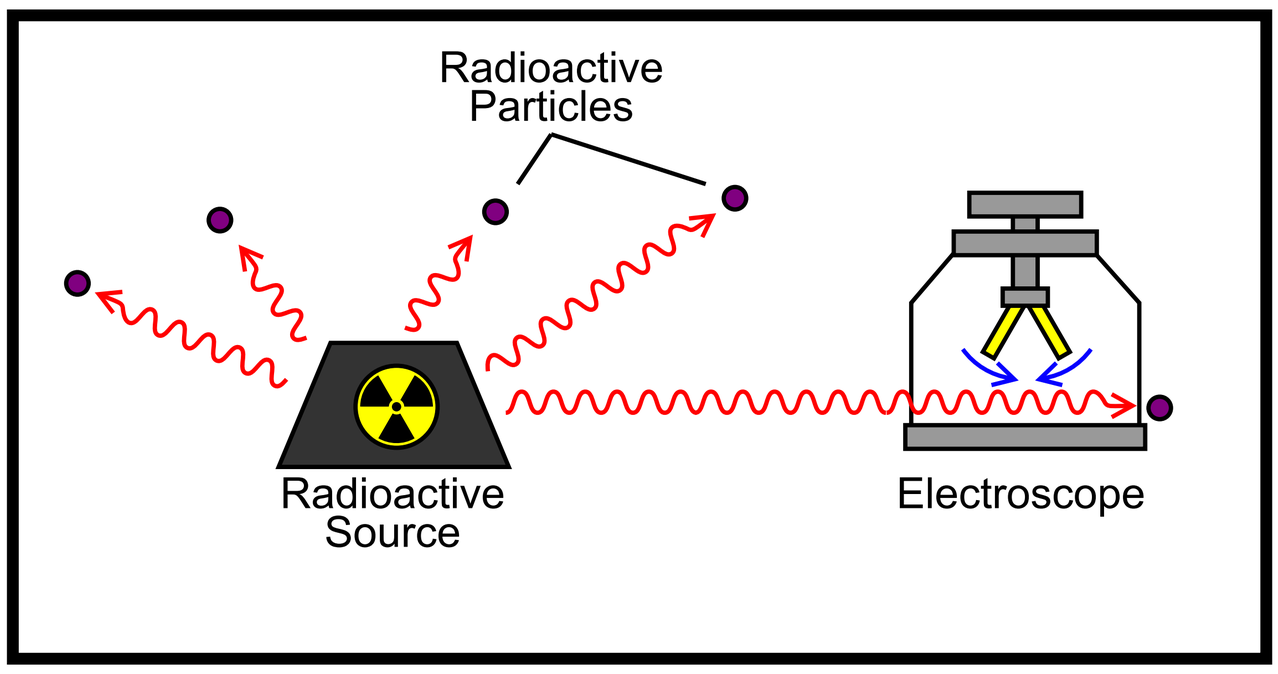
History of Cosmic Ray Research

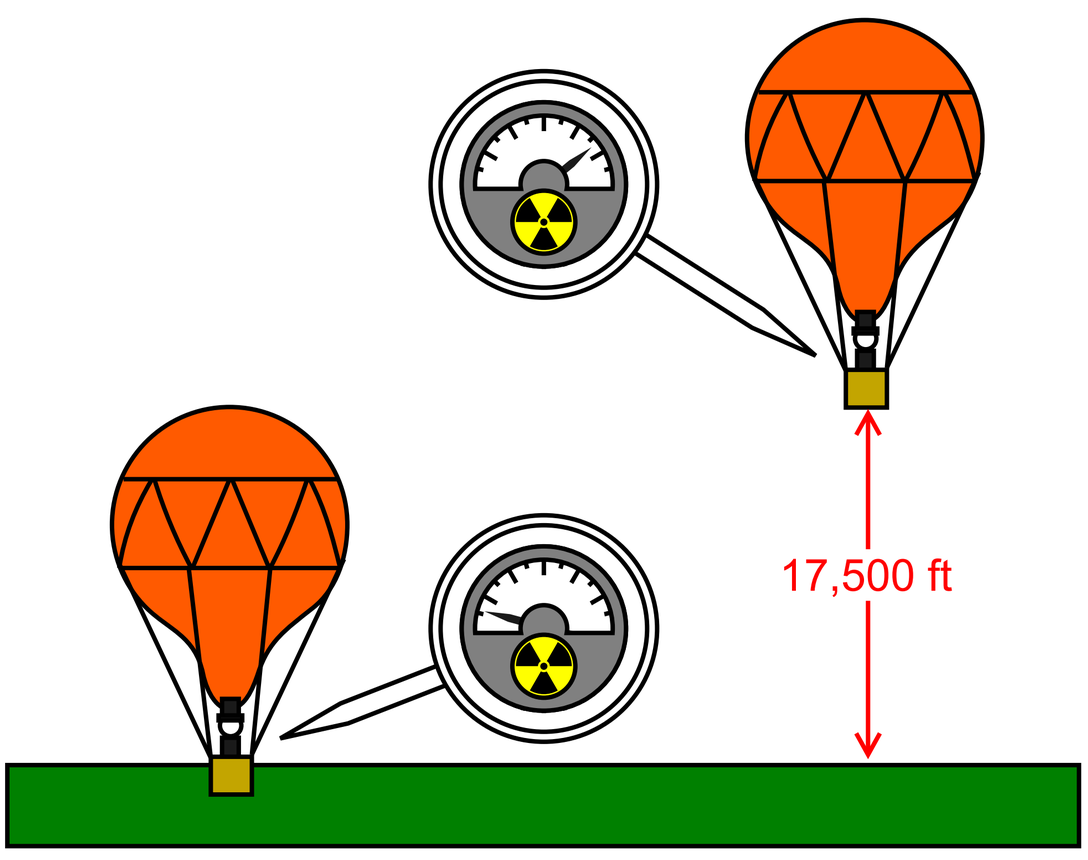
Radiation and Subatomic Particles

Ionizing radiation is a major component of cosmic rays. These can be: alpha particles (helium nuclei,) beta particles (electrons,) x-rays (high energy photons), gamma rays (very high energy photons.) X-rays come from excitation-deexcitation of inner core electrons in a heavy atom. Gamma-rays are produced in nuclear level transitions. Cosmic rays can also be particles such as a proton or the nucleus of an atom which has been stripped of its electrons.

An electroscope is an early scientific instrument used to detect the presence and quantity of electric charge. It consists of two thin metal (gold) leaves suspended in a vacuum jar. An electrical charge is initially applied to to the electroscope causing the leaves to repel each other. When ionizing radiation, such as cosmic ray particles, pass through the jar, they cause the leaves to discharge and so they get closer together.



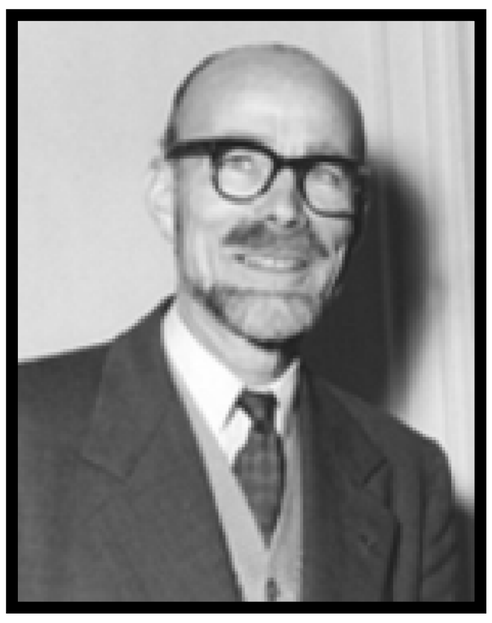
The Discovery of Cosmic Rays



The discovery of radiation in 1896 spurred a flurry of experiments to discover its origin. Scientists observed that some radiation originated from elements in the Earth. One way they studied the radiation of different materials was using an apparatus called an "electroscope." In 1912, Victor Hess wanted to make studies away from terrestrial background radiation. He took three electroscopes up in his balloon and measured the amount of radiation as he got further from the Earth. Over a series of flights, he went up as high as 17,500 ft. His data showed that rate of radiation initially decreased as the balloon rose from the ground, however, it increased again as he continued to higher altitudes. From this, Hess deduced that there was a source of radiation outside of our atmosphere: "cosmic radiation." This phrase was later shortened to "cosmic rays." Victor Hess was awarded the Nobel Prize for this discovery in 1936.

In the 1930's, Pierre Auger found that he could observe cosmic radiation events in spatially seperated detectors which were correlated in time. He deduced that they were associated with a single event, an extensive air shower.

Victor Hess



Pierre Auger

One of the first attempts to observe extensive air showers by the fluorescent emissions were made by a group led by Professor Ken Greisen at Cornell University in the mid-1960's *(picture right.)* This detector operated for several years but was not sensitive enough to make unambiguous detection of Ultra High Energy cosmic rays. The lenses used were too small and the atmospheric clarity was poor.

Scientists needed to look for a high desert atmosphere in order to test the fluorescence technique. Utah is an ideal location for this type of experiment.