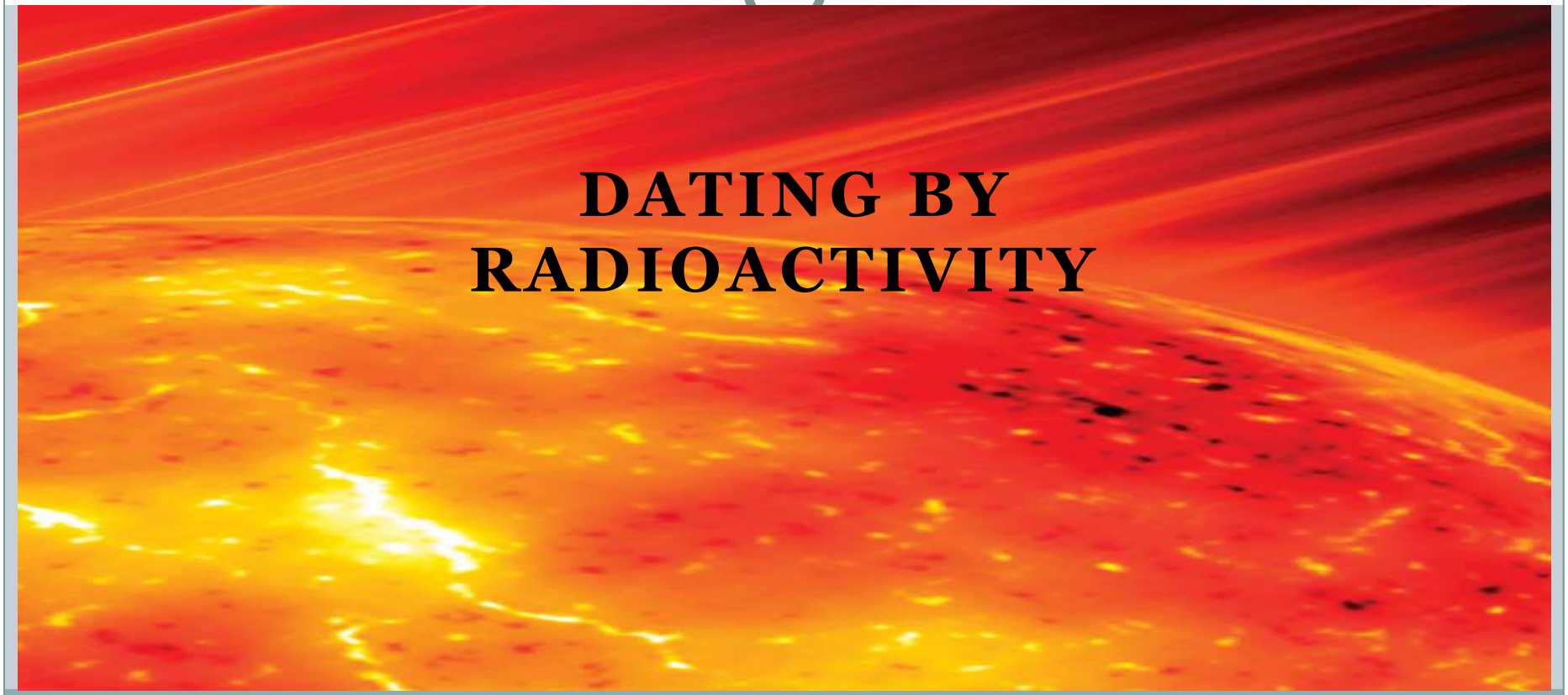
Radioactivity and Nuclear Energy



Dating by Radioactivity

ARCHAEOLOGISTS, GEOLOGISTS, AND OTHERS INVOLVED IN RECONSTRUCTING THE ANCIENT HISTORY OF THE EARTH RELY HEAVILY ON THE HALF-LIVES OF RADIOACTIVE NUCLEI TO PROVIDE ACCURATE DATES FOR ARTIFACTS AND ROCKS.

Dating by Radioactivity

- A method for dating
- ancient articles made from wood or cloth is **radiocarbon dating, or carbon-14 dating,**
- a technique originated in the 1940s by Willard Libby,
- an American chemist who received the Nobel Prize for his efforts.
- Carbon-14 is continuously produced in the atmosphere when high-energy neutrons from space collide with nitrogen-14.

$$^{14}_{6}\mathrm{C} \rightarrow {}^{0}_{-1}\mathrm{e} + {}^{14}_{7}\mathrm{N}$$

Dating by Radioactivity

- Carbon-14 is continuously produced in the atmosphere when high-energy neutrons from space collide with nitrogen-14.
- Just as carbon-14 is continuously produced by this process, it continuously decomposes through - particle production.
- Over the years, these two opposing processes have come into balance, causing the amount of carbon-14 present in the atmosphere to remain approximately constant.

Dating by Radioactivity

- Carbon-14 can be used to date wood and cloth artifacts because the Carbon-14 along with the other carbon isotopes in the atmosphere, reacts with oxygen to form carbon dioxide.
- A living plant consumes this carbon dioxide in the photosynthesis process and incorporates the carbon, including Carbon-14, into its molecules.
- As long as the plant lives, the Carbon-14 content in its molecules remains the same as in the atmosphere because of the plant's continuous uptake of carbon.
- However, as soon as a tree is cut to make a wooden bowl or a flax plant is harvested to make linen, it stops taking in carbon.
- There is no longer a source of Carbon-14 to replace that lost to radioactive decay, so the material's Carbon-14 content begins to decrease.
- Because the half-life of Carbon-14 is known to be 5730 years, a wooden bowl found in an archaeological dig that shows a Carbon-14 content of half that found in currently living trees is approximately 5730 years old. That is, because half of the Carbon-14 present when the tree was cut has disappeared, the tree must have been cut one half-life of Carbon-14 ago.

Dating by Radioactivity

Click this link to see:

- How Stuff Works Video- Carbon-14 dating

Dating by Radioactivity

- **Dating Diamonds**
- Diamonds are formed in the earth's crust at depths of about 200 kilometers, where the high pressures and temperatures favor the most dense form of carbon.
- As the diamond is formed, impurities are sometimes trapped and these can be used to determine the diamond's date of "birth."
- One valuable dating impurity is radioactive uranium which decays in a series of steps to become lead which is stable (nonradioactive).
- Because the rate at which radioactive uranium decays is known, the amount of lead tells scientists the amount of time that has elapsed since the radioactive uranium trapped in the diamond as it was formed.

- The End