

to neutron bombardment in the reactor. The amount of radioactive material formed from this substance depends, among other things, on the number of neutrons per second bombarding it and the time of bombardment. The higher the neutron flux the shorter is the time that the substance has to be bombarded in order to obtain a given concentration of the desired radioisotope. This is much the same principle as that in the cooking of a roast—the hotter the oven the shorter is the time required to cook the roast. This oven analogy may be used to explain the important advantage that the NRX reactor possesses in the production of radioisotopes. As NRX is the “hottest” reactor (i.e. it has the highest neutron flux) of any known reactor engaged in isotope production, the time required to “cook” a particular sample is much less in NRX than in other reactors, sometimes only one tenth or one twentieth as much. A sample which would require say 6 month’s “cooking” in NRX therefore would require a period of five or ten years in other reactors, and this is usually too long to wait for a particular sample.

Use of radioisotopes as tracers

Probably the best developed use of radioisotopes is their employment as tracers to indicate the course of particular chemical, biological or industrial processes. Most people are familiar with the military use of tracer bullets and they know that the luminous track left by these bullets indicates the course of ordinary bullets of the same calibre. Radioisotope tracer work is based on the same principle but here the bullets are sub-microscopic particles and they do not leave any visible track. They do, however, give off bursts of radiation which can be detected by means of sensitive, very sensitive electronic instruments called counters. So penetrating is this radiation that the presence of isotopes can be detected even through considerable thicknesses of material.

The quantity of these sub-microscopic bullets required for detection purposes is often extremely minute. For example it has been calculated that, if we were to take a teaspoonful of Carbon 14, a radioactive isotope of carbon, and mix this thoroughly with all the water in Lake Ontario, the amount of the isotope then present in one teaspoonful of this water could still be detected. This gives you some idea of the tremendous sensitivity of the tracer method. Sometimes, however, considerable quantities of radioisotopes are required, particularly where the radiation is to be detected through considerable thicknesses of material.

A few examples of tracers in agricultural research

By incorporating a small amount of radioactive phosphorus in a fertilizer and applying this fertilizer at various rates and times and then analyzing individual plants for total phosphorus and for radioactive phosphorus, agricultural scientists are able to determine the amount of phosphorus taken up by the plant from the fertilizer and from the soil. By such experiments they can determine the optimum amount of fertilizer required for a particular crop of a particular soil and the best time of application. By a similar procedure forestry scientists can determine the absorption of chemicals by roots of trees. Again, by placing a drop of a weak solution of Cobalt 60 on the hard shell wing of a pine weevil, entomologists are able to trace this insect and find out where it hibernates.

Tracers in medical research

In medical research by injecting radioactive sodium into the blood, doctors are able to follow the blood circulation in the human body and can locate spots where there is any restriction or impairment of circulation. Then again, since