A Method of Tagging Bats with Radioactive Gold-198 in Homing Experiments[1]

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With the use of radioisotopes, the fields of chemistry and biochemistry have been greatly enhanced. Certain types of experiments can now be performed which were not possible before the use of radioisotopes.

Radioactive isotopes are not solely confined to chemistry. These materials can also be applied advantageously to biological studies involving the movement and tracing of small animals. A number of ways have been devised to apply radioactive materials to small animals without injury to the animal or the experimentor. Stephen V. Kaye (2) describes how he used gold-198 wires inserted under the skin of Eastern harvest mice to trace their movements. We wish to describe one way in which gold-198 was used in homing experiments with bats.

In choosing an isotope, several things must be considered, as described by D. R. Griffin (1) and R. C. Pendleton (3). They say that the type of experiment will determine the kind of radiation needed. Alpha particles can not penetrate the skin and beta particles can only penetrate a few millimeters, therefore an isotope emitting either alpha or beta radiation would only increase the radiation dose to the bats without materially facilitating instrumental detection. Bats have a tendency to crawl into crevices in caves, behind rafters and beams, and brick walls three inches to two feet thick, therefore it is necessary to use an isotope emitting gamma rays with high enough energy to penetrate these objects.

When dealing with living organisms it is usually preferable to use an isotope with a short biological half-life as well as a short physical half-life. An isotope of this type would not give a bat enough radiation dose to alter its natural behavior. It is also a safety factor for the bats and for the experimentor. A short physical half-life is desirable for a number of reasons. Disposing of the waste materials is much more convenient. If expensive laboratory equipment is contaminated, a good physical washing and time will solve the problem rather than disposal. Also, if more than one experiment is to be carried out in the same colony, one would want the activity from the first experiment not to be detectable while doing a second.

Another factor to be considered is the availability of an isotope which would meet the above requirements. Gold-198 was chosen because it has a half-life of 2.7 days, a gamma energy of 0.41 million electron volts, and can be obtained very readily.

The gold came in a liquid called Aurcoloid, which is a colloidal suspension containing particles of radio-gold approximately 0.003 micron in diameter. The specific activity of this gold when prepared is from

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3 to 4 millicuries per milligram or from 20 to 40 millicuries per cubic centimeter. Five lambdas of this liquid were pipetted onto the inner surface of opened U. S. Fish and Wildlife Service bands. The isotope was applied to the inner surface of the band so a bat could not eat the isotope from the band. These bands were then placed under an infra-red light for approximately ten minutes to dry. After drying, the inner surface of the bands were painted with clear finger-nail polish. Finger-nail polish was used to keep the isotope from actually coming in contact with the bats, and because it will not crack or chip when the band is closed on the bat's wing.

As soon as the finger-nail polish had dried, the bands were numerically arranged in groups of ten and put in small pill boxes. These boxes were then put into a lead container about two inches thick in the order in which they would be taken out. The whole process of applying the isotope to the bands and drying them was done behind lead shielding. Thin polystyrene gloves were worn while working with the radioactive material in making up the bands and applying them to the bats. This prevented the gold from coming in contact with the hands.

The bats were not banded until they had been transported the desired distance away from their home colony. It was to our advantage to release the bats as they were banded. By doing this an accumulation of unshielded radiation was avoided. An accumulation of these bands would not have been potentially dangerous, but radiation exposure should be avoided as much as possible no matter how low the activity.

Bands were detected when the bats came back to the home roost with a portable Nuclear Measurements Geiger-Mueller counter with a scale ranging from 0 to .2 milliroentgens per hour. These bands could be detected a little more than a meter away after four to six days. Bats were detected through slate, tin, shingles, rafters, and brick walls with very satisfactory results. Three times during the experiments, we were able to detect radiation behind a brick wall at a distance ranging from 2 to 3 feet. One using the conventional method of banding and recapture could not possibly have seen these bats and would not have been aware of their presence. It was apparent that radiation was not detected by the sense receptors of bats, therefore their natural behavior was probably not altered because of the gold-198 tagging. This method offers another advantage in that the bats can be detected without having to catch them.

An estimation of the percentage of returns was made on the basis of the number of radioactive spots found in a building housing a colony, and the amount of activity found at each spot.

This method of detecting bats in homing experiments has some disadvantages that should not be overlooked. There is a lot of expense involved in equipping a laboratory to handle radioisotopes. The danger of radiation exposure is always present when one works with radioisotopes. Another disadvantage is encountered if the bats are released as they are banded. Sometimes it takes a period of 30 to 40 minutes to band a group of bats. When bats were detected by a Geiger counter, we did not know whether it was the first one released or the last. The greatest disadvantage which we encountered was the fact that gold-198 could be detected for such a long period of time. We had hoped to use one colony for a number

of experiments, but this was impossible because the activity from the first experiment was still detectable after four weeks. Even though 95% of the activity of gold-198 has been emitted after eleven days, the other 5% can be detected for two weeks longer.

This method has a number of disadvantages, but we feel that the advantages by far outweigh the disadvantages. Many of the experiments which we were able to do would not have been possible without the use of radioisotopes.

Literature Cited

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