TECHNOLOGY

Atomic-Age Sherlock Holmes

Neutron activation analysis, the newest method of elemental analysis, is helping to solve crimes, aid industry, find pesticide residues in food and analyze human blood.

By WILLIAM Mc CANN

➤ AN ATOMIC-AGE Sherlock Holmes that can sniff out criminals from the tiniest bits of evidence is becoming an important tool for much more than just crime studies.

Researchers in industry, medicine, agriculture and space studies are also now using the new sensitive technique, called neutron activation analysis, in their investigations. Neutron activation analysis uses penetrating neutron radiation to help find and identify particles invisible to the naked eye. The technique is so sensitive that sub-microscopic traces of elements, often as small as one-billionth of a gram, can be exposed, identified and measured.

Samples Are Made Radioactive

Activation analysis is far more accurate than chemical analysis and more penetrating than a powerful microscope. It works on the principle that elements in a sample are made radioactive by bombardment with neutrons.

In the activation technique, solid, liquid or gas samples are placed in polyetheylene tubes called "rabbits." The tubes are then bombarded by neutrons in a nuclear reactor, where various elements contained in the sample are converted into radioactive isotopes. Each isotope has its own established lifetime and its own "fingerprint," which can be identified in a process called gamma-ray spectrometry.

In gamma-ray spectrometry the activated elements are seen as gamma-ray peaks in a spectrum projected on an oscilloscope screen. Each element has its own identifying peak or peaks. An electronic counter ticks off the element's "name" while the size of the peak on the screen tells the scientist how much of that element is present in the sample.

Neutrons Split Criminal Cases

The same neutrons that split the nuclei of uranium atoms can also split a criminal case wide open, explains Dr. Vincent P. Guinn, technical director of the activation analysis program at the General Atomic Division, General Dynamics Corporation, San Diego, Calif.

When analyzing gunshot residues, criminal investigators look for two principal elements—barium and antimony. A person who has fired a revolver recently has traces of these two elements on the "thumb web" and back-of-hand areas of the gun hand even after firing only one shot. If he has fired a rifle, traces also will be found on his face. Thus, an invisible bit of powder wiped from a suspect's hand or face may help police answer many valuable questions when the activation technique is applied.

It may prove possible one day to tell during analysis not only whether a suspect fired a gun, but how many times he fired it, what type of ammunition was used and whether he was wearing a gold ring at the time, Dr. Guinn reports. If the suspect were wearing a gold ring, analysis might even be able to reveal how many karats it was.

The Los Angeles police, working in conjunction with General Atomic, have used activation analysis experimentally in actual crime investigations. They have found traces as small as ten-billionths of a gram of powder residue on the hand of a person who had recently pulled the trigger of a loaded gun.

A tiny grease smear found on the clothing of a hit-and-run victim may lead a trail straight to a suspect's automobile.

Grease Spots Identified

Recent studies of truck and automobile greases by activation analysis showed that no two of the 13 leading manufactured brands of greases are identical in composition. This means that by using the analysis technique investigators may be able to identify a particular brand of grease involved in hit-and-run cases. It may even be possible to match dirt particles inside a grease smudge on a victim's clothes to dirt particles in the grease found on a suspect's car.

In the same manner, a tiny chip of paint carried away from a robbery scene on the thief's clothes might be matched up to the paint on a jimmied door. Plastics, wood, inks, automobile-tire rubber, soil, dust particles, drugs, metals and human hair can also furnish important clues.

A single strand of hair left at the scene of a crime or found clutched in the hand of a victim can help nab a killer by means of the hair's trace element composition. Human hair, for example, contains traces of elements such as sodium, gold and copper. Activation analysis has shown that the traces of these elements found in each hair is about the same for the individual, but the amount varies from person to person.

A two-inch long hair found under the fingernail of a slain girl brought about a murder conviction in Canada a few years ago. When the neutron "fingerprints" were compared, the hair found under the fingernail matched that of the suspect.

Since activation analysis in many instances does not damage even the tiniest samples, evidence is thereby preserved for admission into court. March 1964 marked the first time that data from neutron activation analysis was introduced and accepted in a United States court. The French also have admitted activation analysis data as evidence in criminal cases.

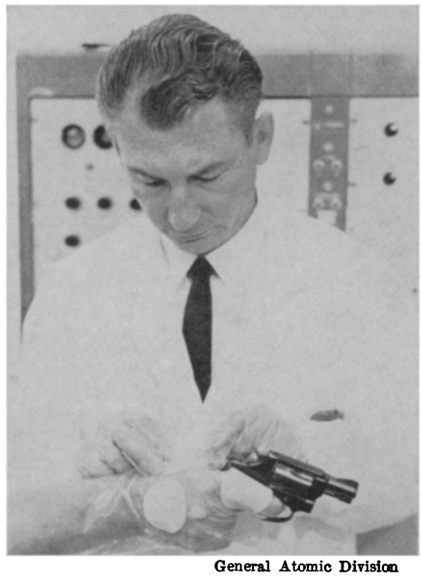
Activation analysis of a dead person's hair can often show if he died from poisoning. Hairs even hundreds of years old can be analyzed for traces of arsenic and other residues.

More than 130 years after the death of Napoleon, Scottish scientists found during tests on a relic of his hair that the hair strands showed a high arsenic level. The belief is now that arsenic contributed to the death of the Little Corporal, although he may have taken it in medicines.

Old Mystery Solved

Activation analysis was also used in an effort to solve a nearly 400-year-old mystery surrounding the death of King Erik XIV of Sweden. When the King's body was exhumed a few years ago, activation analysis revealed that the body contained a large amount of poisonous mercury.

Neutron activation analysis is not a new discovery. The U.S. Atomic Energy Commission reports that the first experiment was undertaken in 1936 by George Hevesy and H. Levi, shortly after the discovery of artificial radioactivity by Nobelists Frederic and Irene Curie-Joliot. Not until after



General Atomic Division

GUNPOWDER CATCHES CRIMINAL—Invisible powder traces taken from the gunhand of the shooting suspect can often turn into valuable evidence during neutron activation analysis. Here, Dr. Vincent P. Guinn is shown removing powder residues from the gunhand during an activation analysis experiment conducted at General Atomic's laboratories for the U.S. Atomic Energy Commission.

World War II, however, when nuclear reactors and more modern electronic equipment became available, did interest in the technique develop rapidly.

Activation analysis has also become useful in many fields other than crime study.

The chemical and petroleum industries are making widespread use of this technique to test for catalyst poisons in feedstocks, detect traces of impurities in plastics and synthetic rubber and measure the efficiency of chemical operations.

Coal Industry Adopts Technique

The coal industry is adopting the technique for the rapid determination of the carbon and ash contents of coal.

Farm products are being analyzed to detect pesticide residues on crops. Using this technique, agricultural scientists can look for traces of bromine and chlorine that are left on foods even after processing.

In medicine, activation analysis is being used to measure concentrations of magnesium, copper, zinc and other elements in human blood. Small amounts of various elements appear to be essential to the human body, but little is known about their actual biological role. Activation analysis is helping biologists solve this problem.

An unmanned device, equipped to perform activation analysis tests, has been developed to travel aboard a future "Surveyor" mission to the moon. The device will automatically perform tests on the minerals on the moon's surface and send the data back to earth.

Neutron activation analysis, a product of the atomic age, is indeed becoming an important tool for modern man.

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GENERAL SCIENCE

Population Growth Seen As Sparking Nuclear War

➤ THE MOST IMPORTANT and challenging problem facing mankind is the "extraordinary, continuing increase in world population," Dr. Albert B. Sabin of the University of Cincinnati said in Turin, Italy. This growth in depressed areas can itself provide the spark for nuclear warfare, he warned.

"It is the competition of the nuclear powers of differing ideologies among the hungry and miserable peoples of the world that carries with it the greatest danger of ultimate catastrophe," he said.

The noted virologist emphasized that he did not regard birth control as the most important or even the most realistic approach to the population problem, however.

If medical science can be held responsible for the tremendous increase in population (by lowering the death rate), "the great achievements of science and technology have also provided the means for conquering hunger and poverty," he said.

Men must learn to stop fighting about the best way to utilize this knowledge for the benefit of all peoples, he advised.

The vicious disease of mutual distrust and suspicion is greater than all the diseases that can be investigated by medical science, he said, adding that the great powers should develop a new philosophy of international relations based on the concept that neither capitalism nor communism will conquer the world.

An all-inclusive reorganized United Nations could help the weak nations become strong and help the great powers to stop their competition, he stated.

Dr. Sabin will give the same address in Milan, Naples and Rome for the Italian Cultural Association. He was one of 32 scientists who participated in the international symposium on specific tumor antigens at Sukhumi on the Black Sea. The symposium was sponsored by the International Union Against Cancer and by the USSR Academy of Medical Sciences. His topic was "Medical Science in the Service of Mankind—the Challenge for Survival in the Remaining Years of the 20th Century."

He himself has contributed to man's good health with his live-virus oral polio vaccine, as well as with vaccines against Japanese B encephalitis, sandfly fever and dengue fever.

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MILITARY SCIENCE

Wide Range of Chemicals Available for Gas War

➤ THE PROBLEM of whether or when to use chemical agents to control human behavior was recently the focus of controversy in Viet Nam and later was a question in the Dominican Republic, where rebels reportedly seized the country's entire stock of tear and vomiting gas.

A wide variety of drugs that influence either the mind or body of man are now known. Many of them are stockpiled by both the large and powerful countries and by smaller ones.

These chemicals range from those that can kill to what has been termed a "two-minute casualty" in riot control, compounds that cause copious tears, vomiting or both. When the short-term "incapacitating" chemicals are used, neither hospitalization nor medical aid is necessary for recovery.

Riot control chemicals that cause tears or nausea have been available and used for a long time, first during World War I. Three typical agents of this kind are bromobenzylcyanide, chloroacetophenone and adamsite.

Bromobenzylcyanide is a tear-producing chemical developed by the French, and one of the most powerful known. Chloroacetophenone, also a lacrimatory chemical, and the vomiting compound, adamsite, were developed in the U.S. although not used during World War I.

Within one minute, adamsite causes the following symptoms in progressive order: irritation of the eyes and mucous membranes, discharge from the nose, sneezing, coughing, severe headache, acute pains and tightness of chest, nausea and vomiting.

Chemically, adamsite is diphenylaminechloroarsine. It is a yellow to green solid, with no odor.

Chloroacetophenone is also a solid. However, it does have the odor of apple blossoms.

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