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New Police Technology Finds Tales Of Crime In Molecules

By MALCOLM W. BROWNE

CRUSHING caseloads and declining financial support are forcing police laboratories around the country to search for fast and effective new techniques for analyzing clues and solving crimes.

Some of the more sophisticated tools of modern science have been pressed into service, and analytical techniques in today's crime labs are hundreds of times faster and more revealing than those in use a decade ago.

Because the Federal Bureau of Investigation has the most advanced crime laboratory in the country, it is often asked by state and local police departments to assist in difficult cases, and it is in these that the new techniques are proving invaluable.

One local police force was stumped by a murder in which there were only charred remains of the victim. The police believed that the dead man's wife had probably strangled him with a rope and then burned the body, but since she was so much smaller than her robust husband it seemed unlikely she could have overcome him unless he had been incapacitated in some way.

Reasoning that the husband might have been weakened by some poison, the police and the F.B.I. conducted conventional chemical tests on the remains, but the results were inconclusive because the samples of body tissue were small and badly contaminated by the fire. So the F.B.I. sent samples to the National Bureau of Standards at Rockville, Md., to be bombarded by neutrons from a nuclear reactor.

Neutron bombardment causes changes in the nuclei of many different atoms, making them radioactive. Radioactive atoms emit gamma rays, and gamma rays can be split up into a spectrum, in somewhat the way visible light is split up by a prism. Analysis of gamma-ray spectrums can reveal even infinitesimal quantities of the specific atoms emitting them.

Thanks to neutron activation, as the technique is called, the F.B.I. found a sufficient quantity of arsenic in the bones of the dead man to demonstrate that he had been slowly poisoned over a long period of time. His widow was convicted of first-degree murder.

Success depends on detective skill outside the laboratory and luck, as well as painstaking and imaginative analysis. Failure is frequent but police analysts like to remember their successes.

Roger Aaron, special agent in charge of the chemistry unit at the F.B.I.'s 391-member scientific laboratory in Washington, recalled a recent arson case.

"Evidence of arson is often difficult to detect after fires, because it generally burns up," he said. "That seemed to be the case at an office fire where everything was destroyed except a safe and a little patch of carpet on which the safe had rested. The investigators had the good sense to retrieve that patch of fabric and send it to us.

"Using a gas chromatograph coupled with a mass spectrometer and computer, we were able to detect traces of a volatile solvent in the carpet, despite the high temperature to which it had been exposed. That

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demonstrated a high probability that arson had been involved."

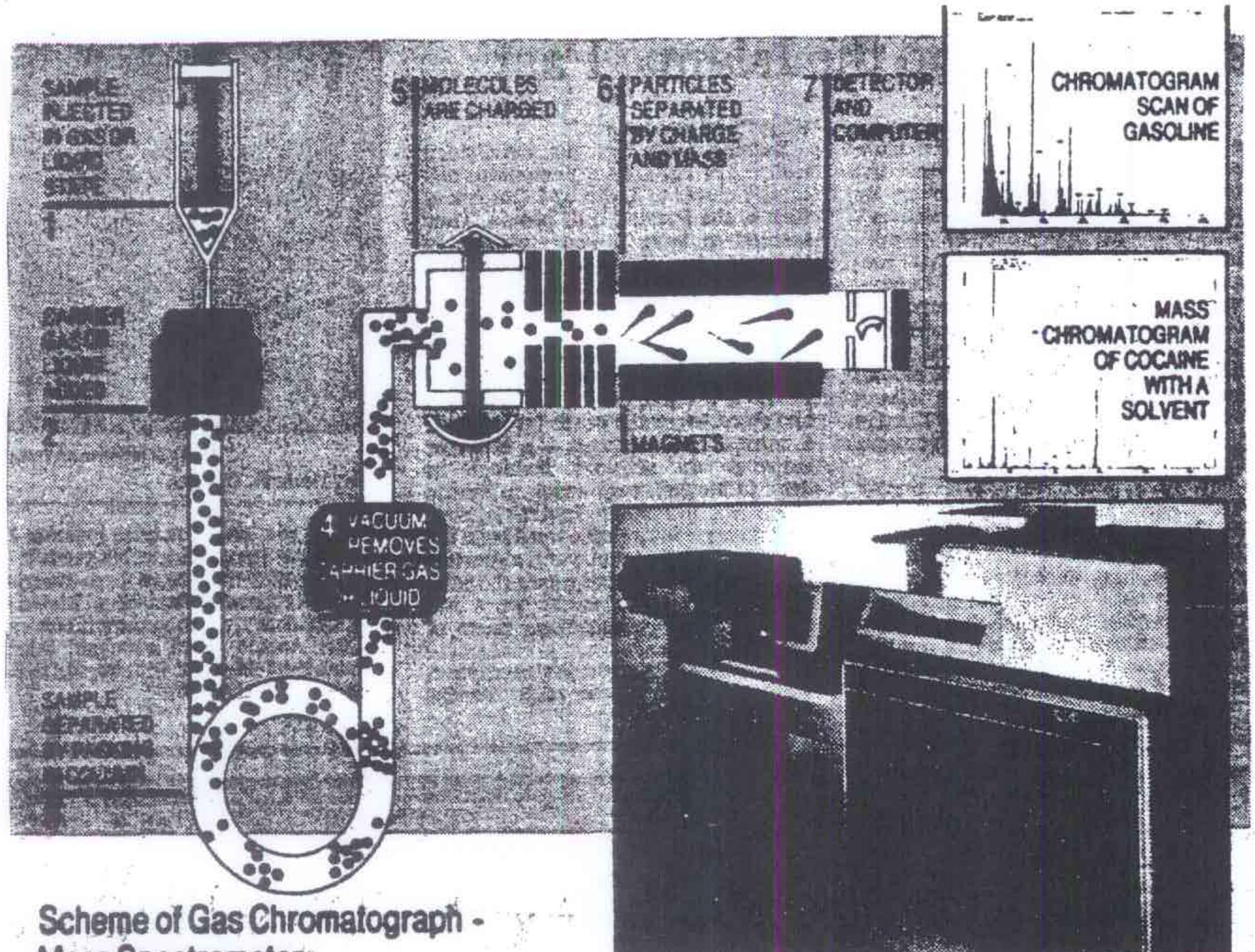
Only in recent years would such a feat of forensic analysis have been possible. The change has been brought about, according to experts at the F.B.I. and the New York City Police Scientific Laboratory, thanks to new instruments and computers capable of interpreting raw data.

Chemical analysis depends on the separation and identification of molecules in an unknown mixture. Traditional methods involve treating the mixture with chemicals known as reagents that force specific types of molecules or parts of molecules to separate from solutions as crystals or in other forms. Each step in such an analysis may involve operations so time-consuming as to be impractical for hard-pressed police laboratories. But new electronic techniques can separate the components of chemical substances simultaneously.

The gas chromatograph coupled with a mass spectrometer is one of the new instruments used by advanced police laboratories, and it works in two stages. First, the vaporized sample is injected into a tube packed with tiny spheres of inert material that impede passage of the gas. Light molecules pass through the tube relatively rapidly, while heavy molecules or molecules with a special affinity for the packing are slowed down.

The vaporized gas therefore leaves the tube one component at a time, in pulses. The pulses are measured for intensity and duration, and the graph produced from such information is often sufficient to identify a substance as surely as a fingerprint.

Separating a complex mixture of molecules is often enough to solve a case, but sometimes, especially when substances are present only in tiny quantities, the molecules themselves



Scheme of Gas Chromatograph - Mass Spectrometer

The New York Times / Feb. 3, 1981; source Finnigan Corporation

Finnigan 1020, inset, is widely used in crime labs. It matches information from unknown and known substances.

must be analyzed and precisely measured. For this, the pulsating stream of molecules coming from the gas chromatograph is ducted into a mass spectrometer. In the spectrometer, the molecules are charged with electrons and shot into a magnetic field, where different molecules are separated into a spectrum that is examined by a detector. The detector feeds data into a computer, which produces a graph, indicating the type and relative amounts of each molecule.

A New York City police expert typed some commands on the keyboard of his computer and a graph appeared on the screen in front of him. "This," he said, "is the complete result of an analysis of heroin we just received. But it represents the sum of everything in the sample, not just heroin but other narcotics, as well as four different sugars that were used by various dealers to cut it."

He pressed some keys. "Now, you see, we subtract all the data in this graph except that coming from the sugars to get a closer look. Now we can see the types and quantities of each sugar, telling us the unique history of this sample. By knowing what dealers use which sugars, we have a fair idea of where this heroin has been."

Getting such detailed information from a sample now may require only 15 minutes or so. A few years ago, using traditional chemical methods, it would have taken weeks.

An analogous technique used to identify blood is being perfected at several police establishments, including the New York City police laboratory.

The technique, known as electrophoresis, depends upon the fact that blood contains many different proteins, and that the relative proportions of these proteins vary from one person to another. It yields far more information from a much smaller sample than was possible with traditional blood group tests made by measuring the clumping of red cells.

The proteins in blood can be electrically charged and then driven across a flat plate by pushing them with an electric field. As they creep across the flat plate, they are impeded by a starch gel or similar substance, so that some move faster than others. After covering a certain distance — several inches in 17 hours — the race between the component proteins has separated them into patterns of bands which are characteristic of specific protein mixtures.

Despite the huge investment some police laboratories have made in new instruments (a gas chromatograph-mass spectrometer combination with associated equipment costs a quarter