

SCIENCE - AND - INVENTION

CHEMISTRY AS A CRIME-DETECTOR

THE RÔLE OF CHEMISTRY in connection with criminal investigation is briefly reviewed by Dr. Henry Leffmann, lecturer in the Philadelphia College of Pharmacy and Science, in "Popular Science Talks," a volume issued by that institution. This branch of science, he tells us, early gained recognition as an aid to the detection of many forms of crime, but especially in the identification of poisons. While this is still one of the main objects of the chemist engaged in aiding the police and the courts, other questions of importance have arisen, among which is the detection of blood and the determination of the animal from which it is derived. He continues:

"The modern control of foods and beverages has multiplied greatly the applications of chemistry, and compelled much research and investigation. Crime of all kinds, from murder to petty theft, manifests a good deal of ingenuity and resource, and the work of the public chemist is a sort of a game of hide and seek. A process for detection of a certain poison or adulterant becomes known; those who have criminal intent can frequently find either a substitute which is satisfactory for their purposes, but does not respond to the tests for the original substance, or they can mask the original substance so that the standard test fails. The chemist is constantly discarding processes either because better ones are available or because the ingenuity of law-breakers has changed conditions.

"The microscope has long been used in the detection and distinction of blood-stains. For many years a great reliance was placed on the form of the blood corpuscles, which are materially different in the different classes of animals, but for the higher animals, that is, the common domestic and wild mammals, the shape is about the same, altho some difference in size is noted. The blood of birds, reptiles and fish shows elliptical corpuscles, while those of mammals are round; but since, in cases of blood-stains, it is possible that some common four-footed animal may have been the source of the blood, a specific distinction of human blood is greatly to be desired. For a long while this was impossible, but a test, known as Bordet's test, is now applicable. This usually is carried out as follows: A small amount of human blood deprived of fibrin (the clotting material) is injected into the blood of a rabbit, at intervals of four days, until two fluid ounces have been introduced. After about ten days, the animal is bled, the blood serum introduced into sterile tubes and kept for use. In applying this test some of the solution of the stain is mixed with a minute amount of the prepared serum and the mixture kept at 37 degrees C. If human blood is present, a turbidity will be produced which in a few hours will become a flocculent precipitate. The test liquid prepared as indicated gives no reaction with any of the animals common in temperate climate, but it does react with the blood of some of the manlike apes.

"A general test for blood is with tincture of guaiac resin and hydrogen peroxid, which gives a blue tint. Hawk has found that if the sample to be tested is boiled for 15 to 20 seconds all materials that simulate blood are so altered that they no longer give the color, but blood preserves its property.

"One of the most satisfactory methods of identifying substances is by means of their crystalline form. The appliances for such examination have been brought to a very high pitch, among other methods being modifications of light. The simplest is making a change in the direction of the light as it falls on the object. Another method is by means of colored screens. Polarized light has been of much value. Recently, much valuable information has been obtained by the use of rays of light that are invisible to the human eye, but which have a strong effect on a photographic plate.

"Among the substances which have long been used in criminal poisoning is arsenic. This occurs usually as a white powder, somewhat gritty, and but slightly soluble in water and common liquids. Under the microscope it is seen to consist of brilliant crystals showing more or less triangular faces. Owing to the

slight solubility of arsenic, portions of it may remain for hours in the stomach without losing their distinct crystalline form.

"The manufacture of chemicals on the large scale may not be carried out in the same way in different establishments, and hence, it is sometimes possible to determine the specific source of a substance. In this manner, it was found a number of years ago that two large establishments in Philadelphia produced distinctly different forms of bismuth subnitrate."

Adulteration of food and drugs is extensive and frequent. Naturally, the substitution of cheap materials for dear ones is a common form. The detection of adulterations requires elaborate equipment and thorough training, and the difficulties are still further increased by the new methods of adulteration continually introduced:

"Sometimes an incidental ingredient that happens to be in the adulterating material and not in the genuine substance may serve as means of detection. As an instance of this may be mentioned the use of agar as gelatinizing material in ice-cream. Agar is the tissue of a sea-plant found in the Pacific Ocean. It happens to be usually accompanied by numerous diatoms, which are minute siliceous skeletons, of characteristic form.

"The detection of inferior materials is often very important, and chemical and microscopical methods are employed. The several fibers used in paper-making have distinct characteristics and, in addition, ground wood gives distinct colors with certain solutions. The detection of ground wood might serve to show a fraudulent document, since if a deed or other legal document purported to have been drawn at a date previous to the use of such wood was found to contain such material, the fraud would be evident.

"The alteration of checks is one of the most serious troubles that business men have. In former days merchants were content to write their checks on plain white paper, but roguery is now too common, and checks are printed on safety papers. Photography has been successfully applied to the detection of alterations and forgeries. By the use of color screens and special forms of light, the texture of the paper and the detail of the writing and erasures can be brought out often quite vividly.

"The substitution of artificial colors for natural colors, especially in the preparation of fruit juices, syrups, jams, jellies and soft drinks, is a very frequent form of adulteration. The methods of detection in these cases are purely chemical, principally by the use of dyeing of woolen or silk fabrics. Natural colors, at least, of the common fruits and flowers, do not dye very firmly, while artificial colors do.

"It must be borne in mind that the work of the chemist is not always in the direction of positive results, or of securing conviction for crime. In many cases the laboratory fails to solve the problem submitted, and in others finds results contradictory to those that have been assumed. The world hears less of such cases than of the affirmative ones, but failures are often very instructive. Very often, popular clamor and mistaken inferences lead to investigations which ultimately show that the charges are without foundation, but sometimes the contradiction does not get the currency that the original assertion did. During the late war, statements were made that powdered glass was found in certain food articles supplied to the camps. In at least one case it was found that the material supposed to be powdered glass was really crystals of ammonium magnesium phosphate, formed through some chemical change that had occurred in the materials. In another case a sample of grape-jelly was submitted to Dr. LaWall, on account of brilliant particles scattered through it, the person who brought the sample being convinced that these were powdered glass. Analysis showed them to be crystals of cream of tartar, a constant ingredient of grape-juice, which had crystallized out. The client, however, was not satisfied with the analyst's statement until a few of the crystals were dissolved in boiling water.

"Chemists who do work for physicians meet with many instances of false claims. Red stains are alleged to be blood; fragments of common stones are submitted as calculi and lots of

other fakes are practised. Those who are engaged in industrial work, such as the analysis of ores and minerals, are constantly meeting with faked minerals, which have been submitted to boost some mining or manufacturing scheme. 'Fool's gold' is an old name for an iron-containing mineral which has a bright gold luster and has deceived many a searcher for mining investments."

INSECT SKYSCRAPERS

LOFTY TOWERS BUILT BY TERMITES, or so-called "white ants," in California are described in *Natural History* (New York) by R. W. Doane, associate professor of entomology in Leland Stanford University. At any rate these towers are lofty relatively to their builders, one reaching a height of nearly 15 inches, while its diameter nowhere exceeded half an inch. In April, 1919, Professor Doane's attention was called to some unusual structures made by termites in the basement of a house in Palo Alto. The first one of these was found rising from a concrete wall that surrounded the lower part of the basement. It was nearly fifteen inches high, the first three inches lying against the beveled base of a concrete pillar, the rest standing entirely free from the pillar or any other support. Around the base of this turret were other smaller ones rising to a height of from two to five inches. He goes on:

"Later additional groups of these turrets were noticed in other parts of the basement. In one of these groups there were several turrets varying in height from three or four inches to seventeen inches. These rose directly from the ground about two feet away from the concrete foundation of the house.

"All of the turrets were very brittle, a slight touch being enough to send them crumbling to the ground. In order that they might be taken to the laboratory for further study, some of them were sprayed with very thin shellac. Only a few could be saved even in this way, however, as the light blast of air from the atomizer that was used for spraying caused most of them to topple over and break into small fragments.

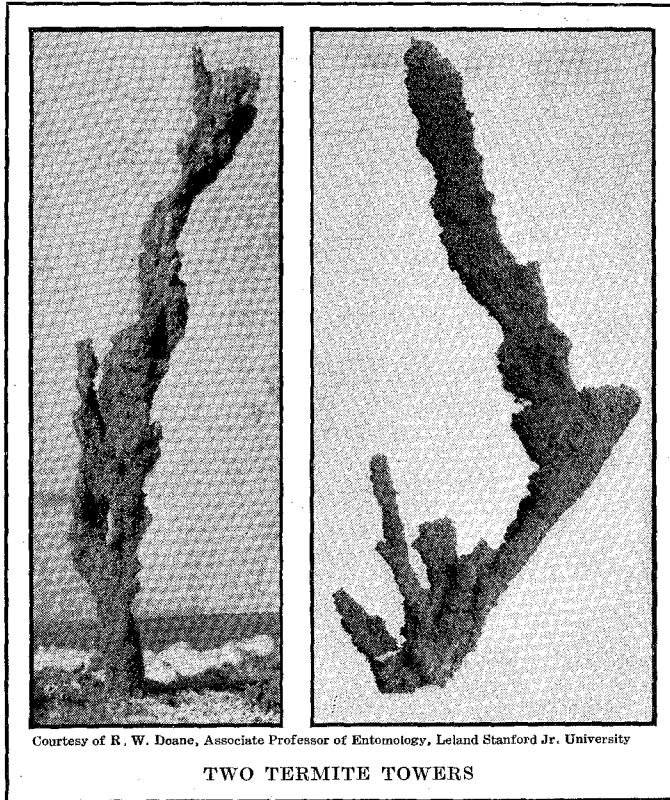
"As soon as any part of a turret was broken, a few termites would crawl out and wander about until they could find some crack or crevice in which to hide. Nearly all of these turrets were populated by workers, soldiers, and winged individuals.

"Soon after the turrets referred to were observed, some smaller ones were discovered in a greenhouse. When they were first seen, the owner of the greenhouse thought that the children had been driving sticks in one of the walks between the benches. When he attempted to pull up these 'sticks,' he was surprised to find them crumbling to pieces and to see the white 'ants' crawling out. Some of these structures were about three inches high. Most of them consisted of a slender, upright shaft; others were broader and branched like coral.

"A little later three additional colonies were found building low turrets from one-half to one inch high in cracks of the sidewalk in the business district of Palo Alto, where the streets have all been paved for many years. These turrets were destroyed every day by people walking over them but they would be rebuilt during the night.

"Still another colony was located on the University campus. These turrets were in exposed places and were only one or two inches high. The winged termites were issuing from them.

"The termites that built these turrets belong to the species *Reticulitermes hesperus*."



Courtesy of R. W. Doane, Associate Professor of Entomology, Leland Stanford Jr. University

TWO TERMITE TOWERS

THE MONKEY AND THE WEIGHT

SOME APPARENTLY SIMPLE PROBLEMS turn out to be particularly puzzling, as shown by the facts that different answers are given by those whose opinions are to be respected and who ought to agree. One of these is that of the monkey and the weight, regarding which Carl Hering writes as follows to *Science* (New York):

"A supposedly weightless rope passing over a frictionless pulley has a 10-pound weight hanging on one end and a 10-pound monkey on the other. What will happen when the monkey climbs up the rope? We are told that the correct answer is that the weight will move up as fast as the monkey and that they will ultimately meet at the top.

The monkey, therefore, does twice the work of lifting himself to that height. This is said to have been crudely confirmed by a boy who found it far more difficult to pull himself up in such a case than when the top of the rope was immovably secured. It seems necessary to distinguish between a jerky and a uniform movement of the monkey; the former involves acceleration, deceleration and inertia. It is claimed that with a uniform motion the weight would not move, as the monkey can not pull with a greater force than his weight. And that with a jerky upward motion of the monkey, involving acceleration and deceleration, the weight would move up and down for each jerk, but its average and ultimate position would remain the same. Others claim that the weight would move up with every jerk, but would not descend again during the deceleration, hence its ultimate upward motion would be equal to that of the monkey. A spring or elastic rope introduces another complication. For a uniform motion the problem may be put in a simpler form. Suppose

a motor suspended on a rope moves itself up or down fast but at a uniform velocity, by winding or unwinding the rope around its shaft. Will the tension on the rope then be greater or less respectively than that when the motor is at rest?"

RADIO-NAPOLEONS—Napoleon, it is said, could carry on several trains of thought at once. Apparently radio is developing the same faculty. We read in *The Radio World* (New York):

"Several of our old friends defend the belief that experienced operators can copy or memorize more than one English message at a time, citing one expert in San Francisco credited with having taken three dispatches at once—all proving to be correct when written out. There is a former Naval operator, now in a high governmental radio position, who claims that while copying one message, he has often been able to note mentally other messages, interfering with the reception of the first, and later write them out. When copying some dull and uninteresting report, he says, he always was able to note with accuracy messages pertaining to shore-leave, pay or other such features.

"Another government official says he once got the same message from two shore stations, transmitting simultaneously while he was aboard ship off California. An important message for his ship was routed via San Francisco and also via Los Angeles. Both KPH and KPJ called him at the same time, and when he told San Francisco to go ahead, both began to send simultaneously. He tried to take them both, which proved very easy when he discovered they were identical. His O. K., intended for KPH was considered by both stations as acknowledgment. The only trouble arose later, when both shore stations billed his ship for the message, each claiming credit for transmission."