CHEMISTRY

Spots Put To Work

Little spots on a piece of paper help chemists analyze substances. Once separated, the chemicals can be cut apart with a knife or a pair of scissors.

By MARTHA G. MORROW

➤ A LITTLE spot on a piece of paper is one of science's newest methods of chemical analysis.

Such little spots enable chemists to identify small quantities of exceedingly complex materials. They often permit scientists to separate chemicals that have been mixed together, and cut them apart with a knife or pair of scissors.

Let a drop of black ink fall on a piece of white absorbent paper and you have a black stain. But if you moisten the paper beforehand, or stick an end into water so it acts as a wick and draws water up through the spot, you will probably get several colored bands. This simple experiment gives you a pretty good idea of how this popular new method of chemical analysis works.

Color is the key-note to the new laboratory technique that is becoming so popular. Its name, paper chromatography, tells you how it works. "Chromatography" is derived from the Greek "chroma," meaning "color," and "graph," meaning "write."

The compounds identify themselves by colored bands or spots. Since one dye is carried by capillary action across the paper faster than another, the colors are soon separated.

After the materials have been separated on paper, they may be identified directly by their colors. If the solutions are colorless, chemicals may often be added to produce a colored compound to signal their presence. Occasionally the materials must be removed from the paper with solvents and chemically analyzed.

The individual dyes making up a green or brown ink may be seen directly when separated. A solution of milk sugar, dextrose or honey, however, is just as colorless as a solution of cane or beet sugar. But they can be distinguished by streaking their invisible chromatograms with potassium permanganate.

Often water is used to separate the mixtures, but sometimes water will not produce the desired results. Sometimes it is more satisfactory to use pure methyl or ethyl alcohol, isopropyl alcohol (rubbing alcohol), acetone (sometimes sold to remove fingernail enamel) or petroleum ether (fluid from a cigarette lighter).

The yellows and oranges in paprika, for instance, separate out well with petroleum ether, and the yellows and greens in leaves show up with isopropyl alcohol. But this new analytical technique is still in the trial-and-error stage with scientists experimenting to discover the best solvent to use with specific chemicals.

Powdered chalk, magnesia, alumina and diatomaceous earth are also good carriers for the chemicals. But paper is so simple and quick to use, it is usually preferred.

Filter paper is used by scientists because it is chemically quite pure. But many white papers found around your home or office can be used with relatively good success. Dip into water an end of typing paper, writing paper, paper towelling, paper napkin, toilet paper, tissue paper, and whatever other paper you find around to see which picks up water quickly without falling apart.

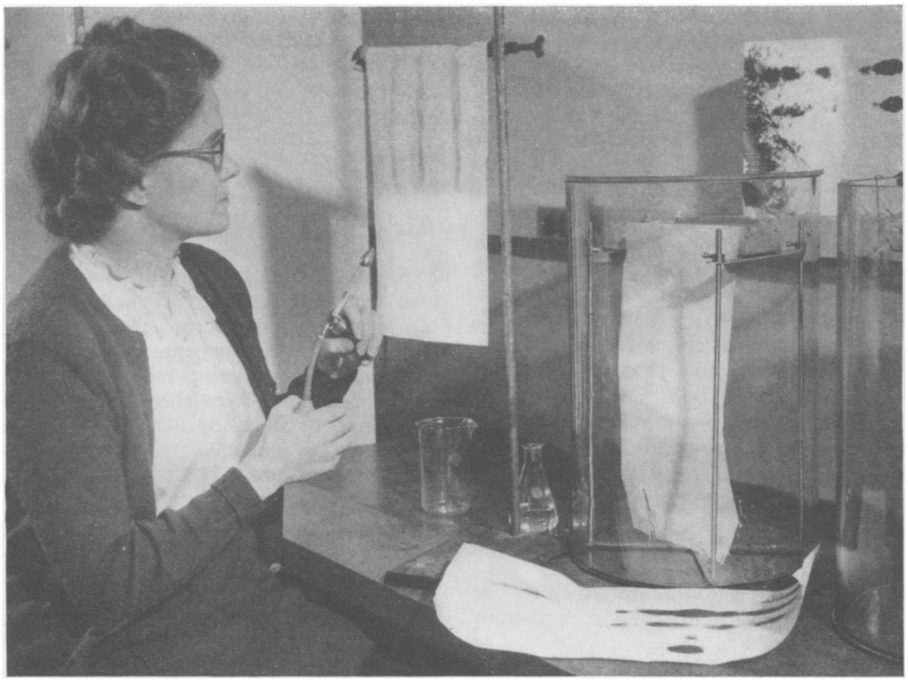
Now round up whatever dark inks you may have handy and try each in turn. First thoroughly moisten with water a piece of the paper that works best, then let a drop of washable black ink fall upon it. Does the ink separate into bands of green and red?

Washable ink is usually made black by combining complementary colors. India ink, on the other hand, is made of black carbon similar to the lead in your pencil, and a type of permanent black ink is made of iron tannate, a black compound.

Black Ink from Colors

Red and green probably are not the only colors used to give your washable ink its black color. To discover whether blue and yellow were also used, mark a band of black about an inch from the bottom of a long strip of paper and stand it up in a glass with about a quarter-inch of water in the bottom. A wide chromatogram should result with the colors more distinct and farther apart than when the paper is wet first.

A good way to get a nice play of colors is to use a quart milk bottle. Make a diagonal slash about an inch or so from one end of your absorbent paper to give you a tiny "arm" to hook over the top of the bottle and keep it from slipping inside. Then if you put about a quarter inch of water into the bottom of the bottle, you have a nice long strip for the colored spot or band to move up.



PAPER CHROMATOGRAPHY—Elaborate chromatographic cylinders are used under carefully controlled conditions to separate sugar mixtures on paper at the National Bureau of Standards. To develop colors, Dr. Emma McDonald is here shown spraying with alpha naphthol a paper on which sugar mixtures have been separated into their various parts.

In working with paper chromatography, experts have learned not to let the colored part touch the water. When the band or spot itself is in the water, the color often leaches out and the experiment is spoiled. The color can move down the paper as well as up.

A square or round piece of paper works well when supported by the rim of a glass. If you cut a tab a quarter-inch wide nearly to the center of one of the squares, leaving the tab attached to the square, the tab will act as a wick when stuck in water. In this case the spot of color can be placed high on the tab, about where it joins the paper.

Another good trick is to cut a hole in the center of one of the squares and outline with ink or dye. A wad of cotton placed through the hole will draw the water up onto the filter paper so that the colors spread out.

Cut into one-inch squares a large quantity of the paper you found most satisfactory and pile one on top of the other until you have about 200 of them. Place four or five spots of ink on the 20th piece of paper from the bottom. Pile the squares in a jar, add water up to the 10th sheet and place a weight on top so they will be packed tightly together, each touching its neighbor at almost all points.

Screw on the top of the jar to prevent evaporation, but check from time to time to be sure there is still water on the bottom. When the top square has become moist, take out the paper pack and examine the layers.

This experiment demonstrates another technique used in paper chromatography. When performed under carefully controlled conditions, specific chemicals will often be found on separate sheets of paper.

After you have tried inks, experiment with vegetable dyes and water colors to see which ones are pure and which result from a wide mixture of colors. The fuzzy fibrous end of a paper match makes a good substitute for a paint brush.

The juice from beets or carrots is fun to separate into its various colors, as are bright autumn flowers. But again, water does not always make the best solvent in producing the colored bands.

Chromatography as a method of analysis was developed several decades ago by the Russian botanist, M. Tswett. But he used columns of powdered sugar with petroleum ether (lighter fluid) as a solvent. His experiments are now frequently repeated and the techniques he developed used again and again, but it is the simpler paper chromatography that is serving the chemist so well today.

Papers saturated with brown and green water colors, and a generous supply of filter paper have been secured for you by SCIENCE SERVICE *so you can separate these colors and the inks you may have around the house into the original colors from which they are made. Little packets of blue copper sulfate and yellow potassium ferrocyanide, which form a dark brown compound, are included in this kit along with full directions for experimenting with them. You can secure the experimental kit for the nominal fee of 75 cents. Write* SCIENCE SERVICE, *1719 N St., N. W., Washington 6, D. C., and ask for the Paper Chromatography kit.*

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MEDICINE

ACTH Good for Trichinosis

➤ ACTH, HORMONE CHEMICAL famous for its anti-arthritis action, is good medicine for patients with trichinosis, Drs. Michael A. Luongo, David H. Reid and Woodrow W. Weiss of Boston and nearby Waltham report in the NEW ENGLAND JOURNAL OF MEDICINE (Nov. 15).

Trichinosis is the disease people get from eating wormy pork that is not thoroughly cooked. Symptoms are nausea, vomiting and diarrhea, lasting a few days. This is followed in a few days or a week or so by pain and tenderness of the muscles with fever and change in the blood cell picture. Swollen, painful eyelids also develop.

Three patients seriously sick with this disease showed "striking" improvement when treated with small doses of ACTH. In one patient, the temperature, which had been up to 106 degrees Fahrenheit, dropped to normal within four hours after the first dose of ACTH. The muscle pain and soreness and tired feeling also were promptly relieved.

Dramatic improvement of symptoms came quickly also in the other two patients. One man slept for the first time in 10 days.

ACTH is not labelled a "cure" in the report of these cases. Study of these patients and of guinea pigs given trichinosis in the laboratory did not show any change in the response of the body to infection with the worms. But the hormone chemical does help reduce the severe poisoning, or toxic, symptoms of the disease.

These symptoms, suggesting either the action of a poison or a severe allergic reaction, were what prompted the doctors to try ACTH. Another reason for trying it was the fact that in trichinosis certain white blood cells, called eosinophils, are greatly increased in numbers. Large numbers of these cells in the circulating blood are believed a sign that the adrenal glands are not producing enough hormone to meet conditions of stress. ACTH, from the pituitary gland in the head, stimulates the adrenal glands to produce more hormone. When the glands are able to respond to this stimulus, the number of eosinophils drops. This occurred in all three patients.

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