New Equipment Roundup Dazzles Scientists

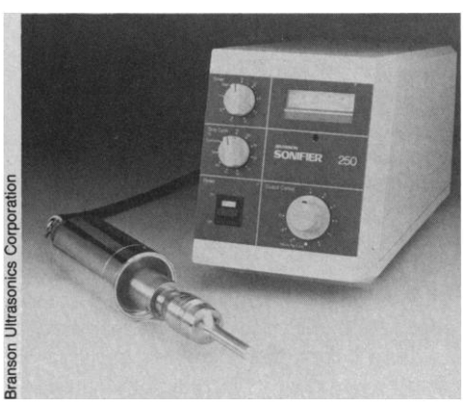
The Pittsburgh Conference & Exposition on Analytical Chemistry and Applied Spectroscopy, affectionately known as Pittcon, met in Atlanta from 6 to 10 March. As veterans of this massive gathering know, a trip to Pittcon means getting a look at the newest equipment in analytical chemistry, hearing about the latest techniques, and going home with very tired feet.

The Pittcon Experience

After walking down miles of aisles, past hundreds of mass spectrometers, liquid chromatographs, electrophoresis units, spectrophotometers, titration systems, computerized balances, and glassware cleaning gizmos, one's eyes tend to glaze over. The feet switch over to automatic pilot and the mind tunes out. The body may look like it belongs to a normally functioning human being, but only a direct stimulus applied to the most primitive parts of the brain can pierce the haze and get a response.

That's why food is big here. One manufacturer's booth operates a theater-style popcorn popper, another has a yogurt machine. A Swiss company offers a plate of Swiss cheese, with each cube flying a tiny Swiss flag on a toothpick. Anything to get a nibble from a customer. There are snack bowls with chocolates, hard candies, and fortune cookies sitting beside shiny, antiseptic lab equipment. A bowl of potato chips rotates slowly in the grip of a fully digital microprocessor-based infrared moisture analyzer.

The Pittsburgh Conference itself provides free apples from bowls scattered around the center. Considering the hue and cry about Alar in apples, this seems rather ironic—after all, it was precisely the type of chemical analysis being promoted here at Pittcon that detected the presence of the cancer-causing chemical in the first place. The scientists who started the whole Alar ruckus may even be walking these aisles, munching popcorn and Swiss cheese and avoiding the apples.



Branson Ultrasonics Corporation

Ultrasonic cell disruptor. *The Sonifier II by Branson Ultrasonics Corporation is used in disintegrating bacteria and yeast, disrupting cells and tissues, degassing liquids, releasing viruses from tissues, and emulsifying immiscible chemicals.*

Pittcon is huge. Two giant exhibition floors are covered with the displays of 850 companies that have rented 2600 10-by-10-foot booths and filled them with information about and samples of their products. A visitor who dawdled for 1 minute at each booth would not have time to visit all of them during the 5 days of the show. Behind the booths are 12,700 exhibitors, who nearly outnumber their potential customers: 8,100 conferees and 4,800 exposition-only registrants.

This is the major trade show in the United States for analytical chemistry equipment and supplies, and it has grown in influence to the point where many manufacturers use Pittcon to introduce new products, timing their development and marketing efforts accordingly. Companies offer seminars and demonstrations of their equipment, and they encourage scientists to bring their own lab samples and try them out on new machines. And although the more staid businesses—such as IBM, with its rows of booths manned (and womanned) by rows of sales representatives in dark gray suits—sit back and wait for customers to come to them, the brash ones reach out and grab.

Alltech Associates Inc. uses a very personable robot, Mr. Sico, to reach out and grab passersby. "Excuse me, sir. You wouldn't happen to be a liquid chromotographer, would you?" The robot rolls up, its vaguely insect-like head nodding and tilting in almost human gestures. "And in your work, do you use filters? Then step right over here and let me show you a major advance in filtration technology." Mr. Sico lets a human assistant do the demonstration—a show reminiscent of a laundry detergent commercial in which a pink liquid filtered through an Anopore Inorganic Membrane becomes clear, while a competitor's filter leaves the liquid pink—but the robot keeps up his joke-filled patter throughout, and even offers to hold the customer's bag.

Two other companies have chosen magicians to draw the rubes; they mix their sleight-of-hand with somewhat corny sales spiels, and leave less of an impression than Mr. Sico. Outside the booth of Kratos Analytical, which is pitching its Profile line of mass spectrometers, a line of people waits for a Kratos artist to do their free caricatures—in profile, of course. Several booths offer drawings for free lab equipment, and one is giving away a trip for two to Stockholm.

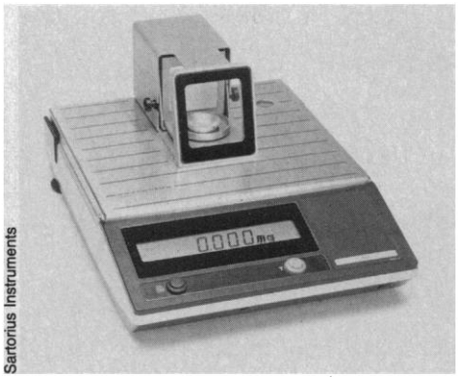
The longest line snakes around the front of the Sartorius Instruments booth, where people wait for up to half an hour to get their "brains balanced." The Sartorians, who dress like aliens out of a 1950s sci-fi film, have set up a brain balancing room where Earthlings sit down, close their eyes, and don stereo headphones and dark glasses. For 10 minutes, soothing music from the headphones combined with light patterns created by the glasses take one's mind off the hectic pace outside the booth. At the end, a voice over the headphones intones, "Go in perfect balance." No doubt, the Earthlings will remember that Sartorius makes laboratory balances.

Crime and Chemical Analysis

It may come as a shock to the reader, but he or she is probably carrying a small amount of cocaine at this moment. According to Lee Hearn, chief toxicologist for the Dade County Medical Examiner Department in Miami, tests suggest that most of the currency in circulation in the United States has at least minute traces of cocaine.

Hearn, speaking at a symposium on analytical chemistry in forensic science, described a series of measurements he made on currency from banks in Miami and around the country. He became interested in the question of how much currency is contaminated by cocaine because of cases where the police confiscated large amounts of cash that showed traces of drugs. The assumption underlying the seizures was that any such money was likely to be "drug money," but Hearn's work calls that assumption into question.

Hearn first checked $20 bills from a number of Miami banks. Arranging the currency into seven packets, he examined them by first washing the bills and then testing the residue with a mass spectrometer, an instru-



Sartorius Instruments

Top-loading microbalance. *The M3P from Sartorius Instruments is the world's first top-loading microbalance. Sensitive to 1 microgram and with a maximum capacity of 3 grams, it has three sensitivity ranges.*

ment that can identify different chemicals in a sample. He detected cocaine in each of the seven packets.

Since Miami is well known as a center of drug smuggling operations, this might not seem too surprising. So Hearn got hold of 135 bills from banks in 12 cities across the country in denominations ranging from $1 to $100, and tested the bills individually. Of the 135, all but 4 had at least a trace of cocaine. The smallest amount measured was a few nanograms, the most was 270 micrograms, and the average for all the bills was 7.3 micrograms. The only uncontaminated bills were crisp and new—right off the printing press.

Hearn hypothesizes that the currency contamination arises from a combination of some bills coming in direct contact with drug users or sellers—the one with 270 micrograms was probably only one or two exchanges removed from a deal, for instance—and other bills coming in contact with them. The original contamination can occur in a number of ways. Some users roll up bills to snort the powder, for instance, and others fold the bills to carry it in their wallets. Some contamination may come from people who have handled cocaine touching the bills. Once a number of contaminated bills are floating around in the currency supply, grains of cocaine will pass from bill to bill in wallets, in cash registers, and in banks.

The bottom line is that any large amount of cash in the United States is likely to show traces of cocaine, Hearn said, which makes drug money confiscation programs problematical. "The police could go into any bank in the country and seize all their money," he said.

As a second example of how things may not be exactly as chemical analysis makes them seem, Hearn described the sad case of an Air Force pilot who was court-martialed because a drug test following a flight accident found traces of amphetamine in his urine. The man insisted he had taken no drugs except over-the-counter diet pills containing phenylpropanolamine (PPA). Upon analysis with a gas chromatograph/mass spectrometer, Hearn found the pills had trace amounts of amphetamine. Looking further, he found that many of the PPA-containing medications in the country had traces of amphetamine, which were allowed to creep into the product by a slight flaw in the manufacturing procedure. After the discovery, the PPA manufacturing process was tightened to exclude amphetamine, and charges against the pilot were dropped. Unfortunately, Hearn said, the stigma against the pilot because of the court-martial kept him from getting another flying position with the Air Force.

Probing the Chemistry of the Brain

The activity of the brain consists of a complicated interplay of electrical and chemical signals. Much of the work done on monitoring the activity of the brain has been on the electrical side—recording electroencephalograms as subjects do various tasks, for instance, or measuring the potential across individual neurons. It is the complex chemical behavior of the brain that drives its electrical activity, however, and these chemical dynamics are still largely unmeasured. A symposium on "Electroanalytical Chemistry in the Neurosciences" examined some of the work being done to observe the brain's chemistry.

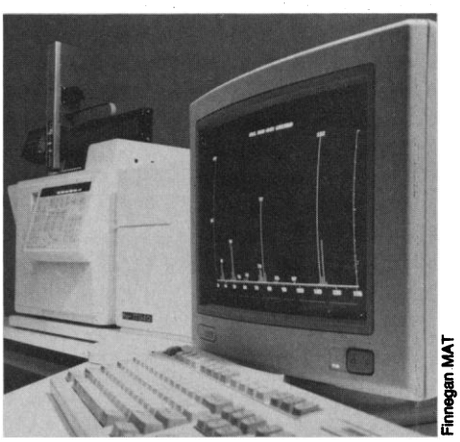
J. B. Justice of Emory University described a technique to sample the extracellular fluid of the brain—the fluid that permeates the spaces between neurons. One application of the method is to see how cocaine affects the level of dopamine in the extracellular fluid. Cocaine is thought to work by building up the level of the neurotransmitter dopamine, which stimulates pleasure receptors.

In Justice's technique, a 300-micrometer-diameter dialysis tube is surgically implanted into whatever region of the brain one wishes to monitor. To examine cocaine dynamics, for instance, the implant would be put in a dopamine-using area. At the end of the tube is a membrane that is permeable to small molecules, such as dopamine, and two individual lines inside the tube keep a slow, constant flow of fluid moving into the tip and back out again. This flow picks up any molecules that cross the membrane and carries them out of the brain for chemical analysis.

One of the advantages of the technique, Justice said, is that it leaves alone larger molecules, such as enzymes, since they cannot cross the membrane, and this helps keep the sample clean. Another plus is that the probe does not stir things up in the extracellular fluid—the movement across the membrane creates no flow turbulence. The disadvantages are that the sampling is rather slow, taking from 5 to 15 minutes; the probe is relatively large, which means that no single cells can be sampled, only large regions; and the dialysis removes a variety of chemicals from the extracellular fluid, which may disturb the functioning of the brain and affect the measurement.

Working with rats, Justice injected cocaine every 15 minutes, every 5 minutes, or every 2 minutes and recorded the concentration of dopamine with this microdialysis technique. With 15-minute intervals between injections, the dopamine level goes up and down in time with the injections. With 5-minute intervals, the dopamine increases at first and then levels off. With 2-minute intervals, it increases and levels off at a higher concentration than with 5-minute injections.

Rats that are allowed to determine how often they get an injection will settle into a pattern of injecting themselves approximately every 5 minutes, Justice noted. That raises the question of why the rats prefer to keep the dopamine at that particular concentration instead of pushing the lever more often and keeping it at an even higher level. There are two possibilities—that the rats have an



Finnegan MAT

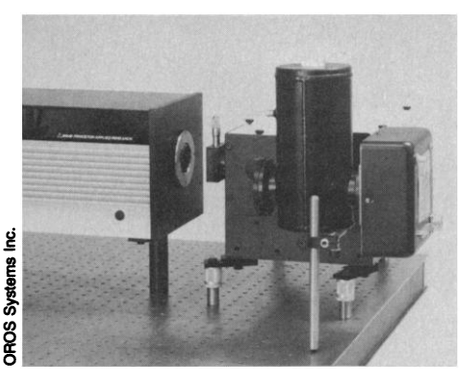
Gas chromatograph/mass spectrometer. *The Ion Trap System 40 from Finnegan MAT is a benchtop GC/MS designed for environmental, forensic, and clinical markets. It performs high-sensitivity analysis (to the picogram level) over a complete spectrum.*

optimum level at which they learn to keep the dopamine, or that there is a minimum level and going above that minimum has no extra benefit. "We can't tell from these data which of these two is right," Justice concluded.

Andrew Ewing of Pennsylvania State University reported on attempts to measure the levels of the neurotransmitters dopamine and serotonin inside a single neuron via voltammetry, a technique that uses two electrodes with a varying potential across them to identify the components in a fluid sample. Working with snails, Ewing placed a 3-micrometer-diameter electrode inside a brain cell, after which the cell wall closed up around the electrode. Surprisingly, the voltammetric measurement showed that there was no measurable dopamine inside the cell, although the cell was known to contain the neurotransmitter. Ewing guessed that the dopamine was bound in vesicles inside the cell rather than circulating freely in the intracellular fluid.

To test that hypothesis, he treated the cell with ethanol, which causes vesicles to release their dopamine. Voltammetric measurements then did find dopamine, and Ewing estimated from the two measurements that at least 98% of the cell's dopamine was tied up in the vesicles. He then performed a second set of measurements using capillary electrophoresis, a process by which different molecules are separated according to how quickly they move through a narrow tube under the influence of an electric field. Those experiments verified that dopamine was released when ethanol was applied, Ewing said, although they could not provide the exact quantitative measurement that the voltammetry did.

Ewing added that he could not get good measurements of the serotonin, but French researchers have reported that neurons in another type of snail contain significant amounts of that neurotransmitter. If that is the case, it may imply that serotonin and dopamine have a significant difference in how they are contained in neurons.



OROS Systems Inc.

Automated purification system. *Multilab from OROS Systems Inc. allows users to control all operations from a touch-sensitive screen. Its wide range of purification techniques run unattended, controlled and monitored automatically.*

The Outlook for the Equipment Industry

One thing that sets Pittcon off from other scientific meetings is that this annual assemblage has as much business as science. Yes, there are more than 1600 papers presented, but at its heart Pittcon is a trade show. Of the 26,750 who registered, only 8,100 came to hear the speakers; the rest were exhibitors, visitors to the exhibition, and students who got a good stiff dose of what it is really like to be an analytical chemist. It follows that much of the conversation at the conference centers on the laboratory equipment business—which companies are doing what now, and what they are likely to do in the future.

No sessions were devoted to "The Future of the Laboratory Equipment Industry," but T. Z. Chu, president and chairman of the board of Finnigan MAT, gave a good overview when he spoke at a press luncheon on the challenges of competing in a global marketplace. Although he geared the talk specifically to the market for mass spectrometers, which are Finnigan MAT's specialty, his conclusions applied equally to the entire analytical equipment market.

Chu listed three factors driving the changes that his company must respond to: the move toward a unified European market, the emergence of Asia as an industrial power, and the "individualization" of markets in the United States.

As the 12 countries in the European Community move to get rid of all internal trade barriers by 1992, they are likely to increase trade with one another and thus decrease trade with the outside somewhat, Chu said. To prepare for this possibility, he said, companies that sell in Europe should make sure Europeans think of them as insiders. "Non-European countries who have not invested heavily in Europe will suffer competitively." Finnigan MAT has research and manufacturing facilities in Europe, and its exports from Europe are managed by Europeans, Chu said, so "Finnegan is accepted as a good European citizen." For that reason, "we could cope with a more insular European market, even though Fortress Europe would be a disaster for international trade."

On the other side of the globe, Asia is the fastest growing market for mass spectrometer sales. Japan, Chu said, is the key player in that market for several reasons: The dollar/yen exchange ratio is favorable; the Japanese are trying to import more to soothe criticisms about their trade imbalance; and Western companies are learning to market themselves in Japan, especially since younger Japanese are increasingly more willing to join foreign companies. Other Asian countries such as Korea, Taiwan, and even China will be important markets in years to come, he predicted.

EG&G Princeton Applied Research

Low-level light detector. *The OMA III Model 1433 by EG&G Princeton Applied Research is a cryogenically cooled charge-coupled device array detector to record extremely low light level, two-dimensional spectral images, for use in Raman spectroscopy, fluorescence, and emission spectroscopy.*

The Asian countries fear increasing protectionism in the United States and Europe, Chu said, so they will concentrate on their own Asian market. "We need to become an insider in Asia just as we have done in Europe."

In the United States, customers are asking more and more for individualized service, Chu said. It is no longer enough to manufacture a good, reliable machine and expect people to buy it. A company must design its machines to do what its customers want. "Companies must change their organizational structure," he said. "They cannot separate their customers so much from the part of the company that makes product decisions."

Because customers are using increasingly complicated instruments, they are relying on the manufacturer for more and more assistance. One of the services that Finnegan MAT now offers in response to this need is a direct machine line between the company and the customer. The customer uses a modem to hook his machine to Finnegan MAT, so that company technicians can access the machines directly over a telephone line for diagnosis and service. The relationship between seller and buyer, Chu said, is "now a partnership much like a marriage." With that, Chu finished and left, presumably to court some more partners on the floor of the Pittsburgh Conference.

■ ROBERT POOL