The Pittsburgh Conference: A Special Instrumentation Report

The Pittsburgh Conference on Analytical Chemistry and Applied Spectroscopy, already the largest of its kind in the world, continues to grow. At the 29th annual session, concluded early this month in Cleveland, the number of instrument and equipment companies exhibiting at the show increased 14 percent to 365, the number of technical papers leaped 38 percent to 668, and the total attendance rose by 21 percent to 14,600. For the first time in conference history, a woman—Jane H. Judd of Westinghouse Electric Corporation—was president of the event; also the number of women attending the event seemed larger than in the past. One highlight of the meeting was the greatly increased number of instruments and accessories for HPLC, an acronym that once meant high pressure liquid chromatography, but that now seems to stand for high performance liquid chromatography; meeting veterans suggested that this proliferation was even greater than that which occurred when gas chromatography first became popular more than a decade ago. Perhaps the most interesting sidelight of the meeting was the jockeying between the mayors of Cleveland and Pittsburgh for future meeting dates, which are estimated to bring more than $6 million in business into the host city. The conference will definitely be held in Cleveland next year but Pittsburgh mayor Richard S. Caliguiri flew into town on Monday of meeting week to lobby for the conference's return to Pittsburgh in 1980, when that city's convention center should be completed. Cleveland mayor Dennis J. Kucinich, who, unlike his predecessor Ralph Perk, begged off from attending the traditional opening ceremony because of a crowded schedule, suddenly found some free time to attend the conference and lobby the committee members himself. It seems likely that the conference will remain in Cleveland, despite the fact that the conference strains the city's hotel and motel industry almost to the breaking point, because Pittsburgh's convention center will have less floor space than Cleveland's and because Pittsburgh has fewer hotel rooms. Considering the time of year when the meeting is held, however, many attendees argued that any move should be southward. Some cast an unofficial vote for future conferences to be held in Nassau or Miami Beach.

Microprocessors: More Instruments Are Becoming "Smart"

Again this year, the most striking aspect of the Pittsburgh Conference was the abundance of instruments with integrated microprocessors. These sophisticated silicon chips have found their way into the complete spectrum of instruments ranging from state of the art gas chromatograph–mass spectrometer systems to relatively inexpensive hand pipettes. The incorporation of microprocessors has undoubtedly increased the quality of many instruments and made them easier to use, but there has also been some concern that extensive manipulation of data by the microprocessors can, in some cases, conceal defects of the instruments.

Microprocessors—programmable integrated circuits on one or a few silicon chips—have become a staple ingredient on "Cadillac instruments," the relatively expensive, top-of-the-line equipment for atomic absorption, ultraviolet, and infrared spectroscopy, among others. The need for rapid operation of the instruments and for collection and processing of large amounts of data have made microprocessors all but indispensable. Microprocessors are also appearing more frequently in the "Chevrolet" models, where the same obvious advantages occur. In some of the newer applications, though, the advantages of a microprocessor, while still present, are not as immediately apparent.

Consider, for example, the Microlab P, a microprocessor-controlled hand pipette introduced at the meeting by the Hamilton Company. The $1750 syringe with a motorized plunger is designed to replace a $100 hand pipette, a proposition which at first glance seems ridiculous. But, Hamilton says, a typical hospital laboratory purchases about 20 hand pipettes each year, and these 20 can be replaced by one Microlab P at a net savings and with increased versatility. The Microlab P can be used, for example, as a repeating dispenser for continuous dispensing, as a burette for microtitrations, as a dispenser for serial dilutions, as a transfer pipette for routine work, and as a repeating dilutor—all with an accuracy and reproducibility that cannot be matched by any other type of system.

Another somewhat surprising place where microprocessors have made an appearance is in electronic top-loading balances. Most manufacturers now incorporate some type of chip circuitry to provide such functions as automatic taring and digital readout. Scientech Inc. and the Sartorius division of Brinkmann Instruments Inc., however, now produce microprocessor-equipped balances that offer a much wider range of functions. The chief advantage of these instruments, according to John Holman of Scientech, is that they can incorporate features in the programming or software that could previously be achieved only with specialized circuitry. Instruments from both companies can, for example, average weights over time to give accurate weights in the presence of wind or vibrations or when weighing live animals. They can also be used for parts counting, or for determining the mean weight of, a series of objects, among other things, and can readily convert weights from grams to other units. A typical balance of this type costs about $1600.

Other microprocessor-equipped instruments at the show were more conventional, but some represent advances in instrumentation. Fisher Scientific Company and Leco Corporation, for instance, each introduced microprocessor-controlled sulfur analyzers suitable for use on samples of coal, oil, and metals. Both instruments have ovens that oxidize sulfur in the sample to sulfur dioxide. In the Fisher instrument, the amount of sulfur dioxide is then determined by electrochemical titration in a pyridine-based solvent. In the Leco instrument, a prototype of which was displayed at the conference, detection will be accomplished either by a similar titration or by infrared spectroscopy. In each case, a complete analysis can be carried out in as little as 2 minutes. The new instruments retail for about $8000 each. Less sophisticated sulfur analyzers now on the market sell for as much as $23,000.

Speed of operation is one of the major

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claimed advantages of a new microprocessor-based total organic carbon analyzer introduced at the show by Beckman Instruments Inc. The $8000 instrument can provide analyses of water and waste-water samples in as little as 2 minutes. The microprocessor controls calibration and linearization of the analyzer, zeroes the instrument, and processes the data to put it in a readily usable format.

Microprocessors also play a major role in three new instruments introduced by Princeton Applied Research Corporation (PARC). The first of these is a polarographic analyzer that is used in conjunction with a conventional dropping mercury electrode (or with PARC's new static mercury drop electrode) for electrochemical analyses. All setup, scan, data reduction, calculation, and symbolization steps are controlled by the microprocessor. PARC claims that the combination of the analyzer and the new static mercury drop electrode, a system that sells for $14,500, provides the most favorable signal-to-noise ratio available in any commercial polarographic instrument.

The second new PARC instrument is a microprocessor-based variation of the photoacoustic spectrometer introduced by PARC just last year. At $35,000, the new spectrometer costs about $5000 more than last year's model, but the company argues that the increased versatility more than makes up for the price increase. The third new instrument is the company's model 350 corrosion measurement system for electrochemical analysis of intact metal sheets. This is the first commercial instrument to incorporate a battery of techniques to calculate the potential corrosion rate of the metal. It costs $13,750.

Not only the interiors of instruments have been changed by the advent of microprocessors. The Touchtone keyboard that once was the mark of the microprocessor is beginning to be replaced by heat-sensitive electronic switches that nestle snugly behind a flush faceplate. In some cases, the effect is not unlike that of a child's toy with pretend switches lithographed onto a metal surface. The electronic switches are really an improvement, however, because there are no metal contacts to corrode, wear, or be short-circuited by dirt and foreign objects. Typical examples of this new type of instrument design are the R90 thermal analysis programmer and the model 850 high performance liquid chromatography (HPLC) system introduced at the meeting by the DuPont Company. Instruments produced by PARC, Varian, and a few other companies also display this new look.

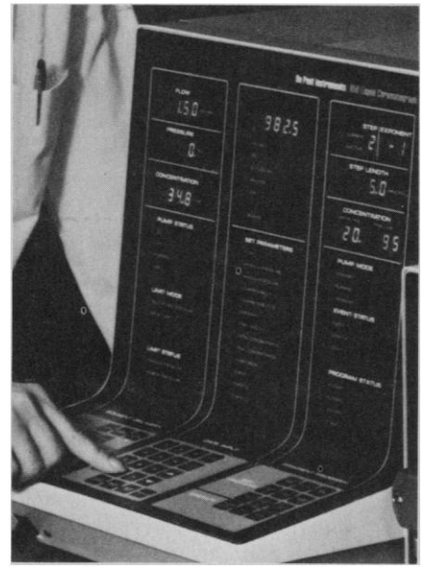

Fig. 1. The DuPont model 850 HPLC features heat-sensitive switches and a flush control panel.

There seems little doubt that the advent of the microprocessor is generally beneficial. In the first place, microprocessor instruments are easier to operate, so that they can be operated by technicians rather than Ph.D.'s once a program is stored inside. Their results are more reproducible, and often better, than those of a conventional instrument. Perhaps most important, they collect and reduce data so that manual manipulation is virtually eliminated.

Some scientists, however, have expressed concern that the microprocessor can act as a buffer between the experiment and the experimenter, allowing faulty data to go undetected. Instruments that manipulate data extensively before printing out results—using curve-smoothing procedures, for example—have the potential to produce results that look acceptable even when the raw data are not. Similarly, a poorly written program for subtraction of backgrounds may produce the same result when subtracting 1 unit from 10 as when subtracting 99,991 from 100,000, even though the result in the second case is meaningless. This problem can be accentuated as the instrument ages and performance deteriorates.

This situation is rare, although one instrument company executive concedes that there are some instruments on the market in which microprocessors have been used to disguise fundamental defects. Many manufacturers, though, go to great lengths to avoid such problems by incorporating circuitry to check for them. Microprocessor-equipped instruments manufactured by Perkin-Elmer Corporation, among others, continually check results and performance of components to ensure that they are within preestablished parameters; when they are not, an error light is flashed.

Nonetheless, with the rapid proliferation of microprocessors, the buyer should be aware of the potential problems, particularly in the bottom-of-the-line models. In many cases, it seems likely that the instrument that has been redesigned completely to incorporate an integral microprocessor may be a safer buy than one to which a microprocessor has been attached as an afterthought or a gimmick.—THOMAS H. MAUGH II

Elemental Analysis: Plasmas Revive Emission Spectroscopy

It may be a mouthful, but inductively coupled plasma-atomic emission spectroscopy, ICP for short, performs more than well enough to make up for its long-winded title. ICP is a 9-year-old technique for elemental analysis that can, in available commercial instruments, quantitatively determine the concentrations of up to 48 elements simultaneously in solids, liquids, and gases with detection limits of 1 part per billion or less for many elements. Computerized ICP spectrometers can deliver a publication quality analysis in 1 minute from the introduction of the sample to printout. And the wide dynamic range of ICP instruments means that concentrations of principal constituents and trace elements can be obtained at the same time without the need for costly and time-consuming dilution or concentration procedures.

Although ICP's have been shown at the Pittsburgh Conference since 1974, the introduction of several new instruments and the prominent display given them this year indicates that manufacturers are girding for a big push. Several observers noted that the technique has been demonstrated to provide reliable analyses of a wide variety of samples and

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